Description of STM32L4/L4+ HAL and low-layer drivers

Introduction

STM32Cube is an STMicroelectronics original initiative to significantly improve developer productivity by reducing development effort, time and cost. STM32Cube covers the STM32 portfolio.

STM32Cube includes:

- STM32CubeMX, a graphical software configuration tool that allows the generation of C initialization code using graphical wizards.
- A comprehensive embedded software platform, delivered per Series (such as STM32CubeL4 for STM32L4 and STM32L4+)
  - The STM32Cube HAL, STM32 abstraction layer embedded software ensuring maximized portability across the STM32 portfolio. HAL APIs are available for all peripherals.
  - Low-layer APIs (LL) offering a fast light-weight expert-oriented layer which is closer to the hardware than the HAL. LL APIs are available only for a set of peripherals.
  - A consistent set of middleware components such as RTOS, USB and Graphics.
  - All embedded software utilities, delivered with a full set of examples.

The HAL driver layer provides a simple, generic multi-instance set of APIs (application programming interfaces) to interact with the upper layer (application, libraries and stacks).

The HAL driver APIs are split into two categories: generic APIs, which provide common and generic functions for all the STM32 series and extension APIs, which include specific and customized functions for a given line or part number. The HAL drivers include a complete set of ready-to-use APIs that simplify the user application implementation. For example, the communication peripherals contain APIs to initialize and configure the peripheral, manage data transfers in polling mode, handle interrupts or DMA, and manage communication errors.

The HAL drivers are feature-oriented instead of IP-oriented. For example, the timer APIs are split into several categories following the IP functions, such as basic timer, capture and pulse width modulation (PWM). The HAL driver layer implements run-time failure detection by checking the input values of all functions. Such dynamic checking enhances the firmware robustness. Run-time detection is also suitable for user application development and debugging.

The LL drivers offer hardware services based on the available features of the STM32 peripherals. These services reflect exactly the hardware capabilities, and provide atomic operations that must be called by following the programming model described in the product line reference manual. As a result, the LL services are not based on standalone processes and do not require any additional memory resources to save their states, counter or data pointers. All operations are performed by changing the content of the associated peripheral registers. Unlike the HAL, LL APIs are not provided for peripherals for which optimized access is not a key feature, or for those requiring heavy software configuration and/or a complex upper-level stack (such as USB).

The HAL and LL are complementary and cover a wide range of application requirements:

- The HAL offers high-level and feature-oriented APIs with a high-portability level. These hide the MCU and peripheral complexity from the end-user.
- The LL offers low-level APIs at register level, with better optimization but less portability. These require deep knowledge of the MCU and peripheral specifications.

The HAL- and LL-driver source code is developed in Strict ANSI-C, which makes it independent of the development tools. It is checked with the CodeSonar® static analysis tool. It is fully documented.

It is compliant with MISRA C®:2004 standard.

This user manual is structured as follows:

- Overview of HAL drivers
- Overview of low-layer drivers
- Cohabiting of HAL and LL drivers
- Detailed description of each peripheral driver: configuration structures, functions, and how to use the given API to build your application

1 General information

The STM32CubeL4 MCU Package runs on STM32L4 and STM32L4+ 32-bit microcontrollers based on the Arm® Cortex®-M processor.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 Acronyms and definitions

Table 1. Acronyms and definitions

Acronym	Definition
ADC	Analog-to-digital converter
AES	Advanced encryption standard
ANSI	American national standards institute
API	Application programming interface
BSP	Board support package
CAN	Controller area network
CEC	Consumer electronic controller
CMSIS	Cortex microcontroller software interface standard
COMP	Comparator
CORDIC	Trigonometric calculation unit
CPU	Central processing unit
CRC	CRC calculation unit
CRYP	Cryptographic processor
CSS	Clock security system
DAC	Digital to analog converter
DLYB	Delay block
DCMI	Digital camera interface
DFSDM	Digital filter sigma delta modulator
DMA	Direct memory access
DMAMUX	Direct memory access request multiplexer
DSI	Display serial interface
DTS	Digital temperature sensor
ETH	Ethernet controller
EXTI	External interrupt/event controller
FDCAN	Flexible data-rate controller area network unit
FLASH	Flash memory
FMAC	Filtering mathematical calculation unit
FMC	Flexible memory controller
FW	Firewall
GFXMMU	Chrom-GRC™
GPIO	General purpose I/Os
GTZC	Global TrustZone controller
GTZC-MPCBB	GTZC block-based memory protection controller
GTZC-MPCWM	GTZC watermark memory protection controller
GTZC-TZIC	GTZC TrustZone illegal access controller
GTZC-TZSC	GTZC TrustZone security controller

Acronym	Definition
HAL	Hardware abstraction layer
HASH	Hash processor
HCD	USB host controller driver
HRTIM	High-resolution timer
I2C	Inter-integrated circuit
I2S	Inter-integrated sound
ICACHE	Instruction cache
IRDA	Infrared data association
IWDG	Independent watchdog
JPEG	Joint photographic experts group
LCD	Liquid crystal display controler
LTDC	LCD TFT Display Controller
LPTIM	Low-power timer
LPUART	Low-power universal asynchronous receiver/transmitter
MCO	Microcontroller clock output
MDIOS	Management data input/output (MDIO) slave
MDMA	Master direct memory access
MMC	MultiMediaCard
MPU	Memory protection unit
MSP	MCU specific package
NAND	NAND Flash memory
NOR	NOR Flash memory
NVIC	Nested vectored interrupt controller
OCTOSPI	Octo-SPI interface
OPAMP	Operational amplifier
OTFDEC	On-the-fly decryption engine
OTG-FS	USB on-the-go full-speed
PKA	Public key accelerator
PCD	USB peripheral controller driver
PPP	STM32 peripheral or block
PSSI	Parallel synchronous slave interface
PWR	Power controller
QSPI	QuadSPI Flash memory
RAMECC	RAM ECC monitoring
RCC	Reset and clock controller
RNG	Random number generator
RTC	Real-time clock
SAI	Serial audio interface
SD	Secure digital
SDMMC	SD/SDIO/MultiMediaCard card host interface

Acronym	Definition
SMARTCARD	Smartcard IC
SMBUS	System management bus
SPI	Serial peripheral interface
SPDIFRX	SPDIF-RX Receiver interface
SRAM	SRAM external memory
SWPMI	Serial wire protocol master interface
SysTick	System tick timer
TIM	Advanced-control, general-purpose or basic timer
TSC	Touch sensing controller
TZ	Arm TrustZone-M
TZEN	TrustZone® enable Flash user option bit
UART	Universal asynchronous receiver/transmitter
UCPD	USB Type-C and power delivery interface
USART	Universal synchronous receiver/transmitter
VREFBUF	Voltage reference buffer
WWDG	Window watchdog
USB	Universal serial bus

3 Overview of HAL drivers

The HAL drivers are designed to offer a rich set of APIs and to interact easily with the application upper layers.

Each driver consists of a set of functions covering the most common peripheral features. The development of each driver is driven by a common API which standardizes the driver structure, the functions and the parameter names.

The HAL drivers include a set of driver modules, each module being linked to a standalone peripheral. However, in some cases, the module is linked to a peripheral functional mode. As an example, several modules exist for the USART peripheral: UART driver module, USART driver module, SMARTCARD driver module and IRDA driver module.

The HAL main features are the following:

- Cross-family portable set of APIs covering the common peripheral features as well as extension APIs in case of specific peripheral features.
- Three API programming models: polling, interrupt and DMA.
- APIs are RTOS compliant:
  - Fully reentrant APIs
  - Systematic usage of timeouts in polling mode.
- Support of peripheral multi-instance allowing concurrent API calls for multiple instances of a given peripheral (USART1, USART2...)
- All HAL APIs implement user-callback functions mechanism:
  - Peripheral Init/DeInit HAL APIs can call user-callback functions to perform peripheral system level Initialization/De-Initialization (clock, GPIOs, interrupt, DMA)
  - Peripherals interrupt events
  - Error events.
- Object locking mechanism: safe hardware access to prevent multiple spurious accesses to shared resources.
- Timeout used for all blocking processes: the timeout can be a simple counter or a timebase.

3.1 HAL and user-application files

3.1.1 HAL driver files

A HAL drivers are composed of the following set of files:

Table 2. HAL driver files

File	Description
stm32l4xx_hal_ppp.c	Main peripheral/module driver file. It includes the APIs that are common to all STM32 devices. *Example: stm32l4xx_hal_adc.c, stm32l4xx_hal_irda.c, …*
stm32l4xx_hal_ppp.h	Header file of the main driver C file It includes common data, handle and enumeration structures, define statements and macros, as well as the exported generic APIs. *Example:stm32l4xx_hal_adc.h,stm32l4xx_hal_irda.h, …*
stm32l4xx_hal_ppp_ex.c	Extension file of a peripheral/module driver. It includes the specific APIs for a given part number or family, as well as the newly defined APIs that overwrite the default generic APIs if the internal process is implemented in different way. *Example:stm32l4xx_hal_adc_ex.c,stm32l4xx_hal_flash_ex.c, …*
stm32l4xx_hal_ppp_ex.h	Header file of the extension C file. It includes the specific data and enumeration structures, define statements and macros, as well as the exported device part number specific APIs

File	Description
	Example: stm32l4xx_hal_adc_ex.h,stm32l4xx_hal_flash_ex.h, …
stm32l4xx_hal.c	This file is used for HAL initialization and contains DBGMCU, Remap and Time Delay based on SysTick APIs.
stm32l4xx_hal.h	stm32l4xx_hal.c header file
stm32l4xx_hal_msp_template.c	Template file to be copied to the user application folder. It contains the MSP initialization and de-initialization (main routine and callbacks) of the peripheral used in the user application.
stm32l4xx_hal_conf_template.h	Template file allowing to customize the drivers for a given application.
stm32l4xx_hal_def.h	Common HAL resources such as common define statements, enumerations, structures and macros.

3.1.2 User-application files

The minimum files required to build an application using the HAL are listed in the table below:

Table 3. User-application files

File	Description
system_stm32l4xx.c	This file contains SystemInit() that is called at startup just after reset and before branching to the main program. It does not configure the system clock at startup (contrary to the standard library). This is to be done using the HAL APIs in the user files. It allows relocating the vector table in internal SRAM.
startup_stm32l4xx.s	Toolchain specific file that contains reset handler and exception vectors. For some toolchains, it allows adapting the stack/heap size to fit the application requirements.
stm32l4xx_flash.icf (optional)	Linker file for EWARM toolchain allowing mainly adapting the stack/heap size to fit the application requirements.
stm32l4xx_hal_msp.c	This file contains the MSP initialization and de-initialization (main routine and callbacks) of the peripheral used in the user application.
stm32l4xx_hal_conf.h	This file allows the user to customize the HAL drivers for a specific application. It is not mandatory to modify this configuration. The application can use the default configuration without any modification.
stm32l4xx_it.c/.h	This file contains the exceptions handler and peripherals interrupt service routine, and calls HAL_IncTick() at regular time intervals to increment a local variable (declared in *stm32l4xx*_hal.c) used as HAL timebase. By default, this function is called each 1ms in Systick ISR. . The PPP_IRQHandler() routine must call HAL_PPP_IRQHandler() if an interrupt based process is used within the application.
main.c/.h	This file contains the main program routine, mainly: • Call to HAL_Init() • assert_failed() implementation • system clock configuration • peripheral HAL initialization and user application code.

The STM32Cube package comes with ready-to-use project templates, one for each supported board. Each project contains the files listed above and a preconfigured project for the supported toolchains.

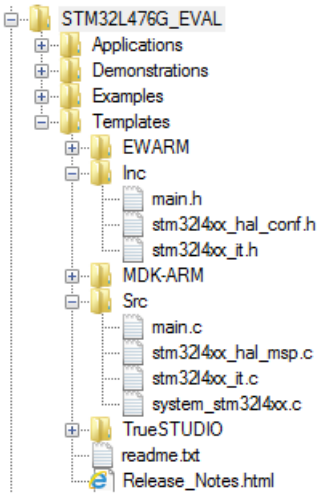
Each project template provides empty main loop function and can be used as a starting point to get familiar with project settings for STM32Cube. Its features are the following:

- It contains the sources of HAL, CMSIS and BSP drivers which are the minimal components to develop a code on a given board.
- It contains the include paths for all the firmware components.
- It defines the STM32 device supported, and allows configuring the CMSIS and HAL drivers accordingly.

- It provides ready to use user files preconfigured as defined below:
  - HAL is initialized
  - SysTick ISR implemented for HAL_GetTick()
  - System clock configured with the selected device frequency.

Note: If an existing project is copied to another location, then include paths must be updated.

Figure 1. Example of project template



3.2 HAL data structures

Each HAL driver can contain the following data structures:

- Peripheral handle structures
- Initialization and configuration structures
- Specific process structures.

3.2.1 Peripheral handle structures

The APIs have a modular generic multi-instance architecture that allows working with several IP instances simultaneously.

PPP_HandleTypeDef *handle is the main structure that is implemented in the HAL drivers. It handles the peripheral/module configuration and registers and embeds all the structures and variables needed to follow the peripheral device flow.

The peripheral handle is used for the following purposes:

- Multi-instance support: each peripheral/module instance has its own handle. As a result instance resources are independent.
- Peripheral process intercommunication: the handle is used to manage shared data resources between the process routines.

  Example: global pointers, DMA handles, state machine.
- Storage : this handle is used also to manage global variables within a given HAL driver.

An example of peripheral structure is shown below:

```
typedef struct
{
USART_TypeDef *Instance; /* USART registers base address */
USART_InitTypeDef Init; /* Usart communication parameters */
uint8_t *pTxBuffPtr;/* Pointer to Usart Tx transfer Buffer */
uint16_t TxXferSize; /* Usart Tx Transfer size */
__IO uint16_t TxXferCount;/* Usart Tx Transfer Counter */
uint8_t *pRxBuffPtr;/* Pointer to Usart Rx transfer Buffer */
uint16_t RxXferSize; /* Usart Rx Transfer size */
__IO uint16_t RxXferCount; /* Usart Rx Transfer Counter */
DMA_HandleTypeDef *hdmatx; /* Usart Tx DMA Handle parameters */
DMA_HandleTypeDef *hdmarx; /* Usart Rx DMA Handle parameters */
HAL_LockTypeDef Lock; /* Locking object */
__IO HAL_USART_StateTypeDef State; /* Usart communication state */
__IO HAL_USART_ErrorTypeDef ErrorCode;/* USART Error code */
}USART_HandleTypeDef;
```

Note:

1. *The multi-instance feature implies that all the APIs used in the application are reentrant and avoid using global variables because subroutines can fail to be reentrant if they rely on a global variable to remain unchanged but that variable is modified when the subroutine is recursively invoked. For this reason, the following rules are respected:*
   - *Reentrant code does not hold any static (or global) non-constant data: reentrant functions can work with global data. For example, a reentrant interrupt service routine can grab a piece of hardware status to work with (e.g. serial port read buffer) which is not only global, but volatile. Still, typical use of static variables and global data is not advised, in the sense that only atomic read-modify-write instructions should be used in these variables. It should not be possible for an interrupt or signal to occur during the execution of such an instruction.*
   - *Reentrant code does not modify its own code.*
2. *When a peripheral can manage several processes simultaneously using the DMA (full duplex case), the DMA interface handle for each process is added in the PPP_HandleTypeDef.*
3. *For the shared and system peripherals, no handle or instance object is used. The peripherals concerned by this exception are the following:*
   - *GPIO*
   - *SYSTICK*
   - *NVIC*
   - *PWR*
   - *RCC*
   - *FLASH*

3.2.2 Initialization and configuration structure

These structures are defined in the generic driver header file when it is common to all part numbers. When they can change from one part number to another, the structures are defined in the extension header file for each part number.

```
typedef struct
{
uint32_t BaudRate; /*!< This member configures the UART communication baudrate.*/
uint32_t WordLength; /*!< Specifies the number of data bits transmitted or received in a fram
e.*/
uint32_t StopBits; /*!< Specifies the number of stop bits transmitted.*/
uint32_t Parity; /*!< Specifies the parity mode. */
uint32_t Mode; /*!< Specifies wether the Receive or Transmit mode is enabled or disabled.*/
uint32_t HwFlowCtl; /*!< Specifies wether the hardware flow control mode is enabled or disabl
ed.*/
uint32_t OverSampling; /*!< Specifies wether the Over sampling 8 is enabled or disabled,
to achieve higher speed (up to fPCLK/8).*/
}UART_InitTypeDef;
```

Note: The config structure is used to initialize the sub-modules or sub-instances. See below example:

```
HAL_ADC_ConfigChannel (ADC_HandleTypeDef* hadc, ADC_ChannelConfTypeDef* sConfig)
```

3.2.3 Specific process structures

The specific process structures are used for specific process (common APIs). They are defined in the generic driver header file.

Example:

```
HAL_PPP_Process (PPP_HandleTypeDef* hadc,PPP_ProcessConfig* sConfig)
```

3.3 API classification

The HAL APIs are classified into three categories:

- **Generic APIs:** common generic APIs applying to all STM32 devices. These APIs are consequently present in the generic HAL driver files of all STM32 microcontrollers.

```
HAL_StatusTypeDef HAL_ADC_Init(ADC_HandleTypeDef* hadc);
HAL_StatusTypeDef HAL_ADC_DeInit(ADC_HandleTypeDef *hadc);
HAL_StatusTypeDef HAL_ADC_Start(ADC_HandleTypeDef* hadc);
HAL_StatusTypeDef HAL_ADC_Stop(ADC_HandleTypeDef* hadc);
HAL_StatusTypeDef HAL_ADC_Start_IT(ADC_HandleTypeDef* hadc);
HAL_StatusTypeDef HAL_ADC_Stop_IT(ADC_HandleTypeDef* hadc);
void HAL_ADC_IRQHandler(ADC_HandleTypeDef* hadc);
```

- **Extension APIs:**

  This set of API is divided into two sub-categories :

  – **Family specific APIs**: APIs applying to a given family. They are located in the extension HAL driver file (see example below related to the ADC).

```
HAL_StatusTypeDef HAL_ADCEx_Calibration_Start(ADC_HandleTypeDef* hadc, uint32_t Sing
leDiff);
uint32_t HAL_ADCEx_Calibration_GetValue(ADC_HandleTypeDef* hadc, uint32_t SingleDiff
);
```

  – **Device part number specific APIs:**These APIs are implemented in the extension file and delimited by specific define statements relative to a given part number.

```
#if defined(STM32L475xx) || defined(STM32L476xx)|| defined(STM32L486xx)
void HAL_PWR
Ex_EnableVddUSB(void); void HAL_PWREx_DisableVddUSB(void);
#endif /* STM32L475xx ||
STM32L476xx || STM32L486xx */
```

Note: The data structure related to the specific APIs is delimited by the device part number define statement. It is located in the corresponding extension header C file.

The following table summarizes the location of the different categories of HAL APIs in the driver files.

Table 4. API classification

	Generic file	Extension file
Common APIs	X	X
Family specific APIs		X
Device specific APIs		X

Note: Family specific APIs are only related to a given family. This means that if a specific API is implemented in another family, and the arguments of this latter family are different, additional structures and arguments might need to be added.

Note: The IRQ handlers are used for common and family specific processes.

3.4 Devices supported by HAL drivers

Table 5. List of STM32L4 Series devices supported by HAL drivers

IP/Module	STM32L431xx	STM32L432xx	STM32L442xx	STM32L433xx	STM32L443xx	STM32L451xx	STM32L452xx	STM32L462xx	STM32L471xx	STM32L475xx	STM32L476xx	STM32L485xx	STM32L486xx	STM32L496xx	STM32L4A6xx
stm32l4xx_hal.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_adc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_adc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_can.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_comp.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_cortex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_crc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_crc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_cryp.c	No	No	Yes	No	Yes	No	No	Yes	No	No	No	Yes	Yes	No	Yes
stm32l4xx_hal_cryp_ex.c	No	No	Yes	No	Yes	No	No	Yes	No	No	No	Yes	Yes	No	Yes
stm32l4xx_hal_dac.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dac_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dcmi.c	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes
stm32l4xx_hal_dfsdm.c	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dfsdm_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_dma.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dma_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_dma2d.c	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes
stm32l4xx_hal_dsi.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_firewall.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_flash.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_flash_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_flash_ramfunc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_gfxmmu.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_gpio.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_hash.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
stm32l4xx_hal_hash_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
stm32l4xx_hal_hcd.c	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_i2c.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_i2c_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_irda.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_iwdg.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_lcd.c	No	No	No	Yes	Yes	No	No	No	No	No	Yes	No	Yes	Yes	Yes
stm32l4xx_hal_lptim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

IP/Module	STM32L431xx	STM32L432xx	STM32L442xx	STM32L433xx	STM32L443xx	STM32L451xx	STM32L452xx	STM32L462xx	STM32L471xx	STM32L475xx	STM32L476xx	STM32L485xx	STM32L486xx	STM32L496xx	STM32L4A6xx
stm32l4xx_hal_ltdc.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_ltdc_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_msp_template.c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
stm32l4xx_hal_nand.c	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_nor.c	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_opamp.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_opamp_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_ospi.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_pcd.c	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pcd_ex.c	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pwr.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pwr_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_qspi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rcc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rcc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rng.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rtc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rtc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sai.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sai_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_sd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sd_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_smartcard.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_smartcard_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_smbus.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_spi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_spi_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sram.c	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_swpmi.c	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_tim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_tim_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_tsc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_uart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_uart_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_usart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_usart_ex.c	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
stm32l4xx_hal_wwdg.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6. List of STM32L4+ Series devices supported by HAL drivers

IP/module	STM32L4P5xx	STM32L4Q5xx	STM32L4R5xx	STM32L4R7xx	STM32L4R9xx	STM32L4S5xx	STM32L4S7xx	STM32L4S9xx
stm32l4xx_hal.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_adc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_adc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_can.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_comp.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_cortex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_crc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_crc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_cryp.c	No	Yes	No	No	No	Yes	Yes	Yes
stm32l4xx_hal_cryp_ex.c	No	Yes	No	No	No	Yes	Yes	Yes
stm32l4xx_hal_dac.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dac_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dcmi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dfsdm.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dfsdm_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dma.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dma_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dma2d.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_dsi.c	No	No	No	No	Yes	No	No	Yes
stm32l4xx_hal_firewall.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_flash.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_flash_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_flash_ramfunc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_gfxmmu.c	No	No	No	Yes	Yes	No	Yes	Yes
stm32l4xx_hal_gpio.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_hash.c	Yes	Yes	No	No	No	Yes	Yes	Yes
stm32l4xx_hal_hash_ex.c	Yes	Yes	No	No	No	Yes	Yes	Yes
stm32l4xx_hal_hcd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_i2c.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_i2c_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_irda.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_iwdg.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_lcd.c	No	No	No	No	No	No	No	No
stm32l4xx_hal_lptim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_ltdc.c	Yes	Yes	No	Yes	Yes	No	Yes	Yes
stm32l4xx_hal_ltdc_ex.c	Yes	Yes	No	Yes	Yes	No	Yes	Yes

IP/module	STM32L4P5xx	STM32L4Q5xx	STM32L4R5xx	STM32L4R7xx	STM32L4R9xx	STM32L4S5xx	STM32L4S7xx	STM32L4S9xx
stm32l4xx_hal_msp_template.c	NA	NA	NA	NA	NA	NA	NA	NA
stm32l4xx_hal_nand.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_nor.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_opamp.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_opamp_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_ospi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pcd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pcd_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pka.c	No	Yes	No	No	No	No	No	No
stm32l4xx_hal_pssi.c	Yes	Yes	No	No	No	No	No	No
stm32l4xx_hal_pwr.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_pwr_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_qspi.c	No	No	No	No	No	No	No	No
stm32l4xx_hal_rcc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rcc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rng.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rng_ex.c	Yes	Yes	No	No	No	No	No	No
stm32l4xx_hal_rtc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_rtc_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sai.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sai_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sd.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sd_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_smartcard.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_smartcard_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_smbus.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_spi.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_spi_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_sram.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_swpmi.c	No	No	No	No	No	No	No	No
stm32l4xx_hal_tim.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_tim_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_tsc.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_uart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_uart_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_usart.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l4xx_hal_usart_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

IP/module	STM32L4P5xx	STM32L4Q5xx	STM32L4R5xx	STM32L4R7xx	STM32L4R9xx	STM32L4S5xx	STM32L4S7xx	STM32L4S9xx
stm32l4xx_hal_wwdg.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

3.5 HAL driver rules

3.5.1 HAL API naming rules

The following naming rules are used in HAL drivers:

Table 7. HAL API naming rules

	Generic	Family specific	Device specific
File names	*stm32l4xx_hal_ppp (c/h)*	*stm32l4xx_hal_ppp_ex (c/h)*	*stm32l4xx_ hal_ppp_ex (c/h)*
Module name	*HAL_PPP_ MODULE*		
Function name	*HAL_PPP_Function* *HAL_PPP_FeatureFunction_MODE*	*HAL_PPPEx_Function* *HAL_PPPEx_FeatureFunction_MODE*	*HAL_PPPEx_Function* *HAL_PPPEx_FeatureFunction_MODE*
Handle name	*PPP_HandleTypedef*	*NA*	*NA*
Init structure name	*PPP_InitTypeDef*	*NA*	*PPP_InitTypeDef*
Enum name	*HAL_PPP_StructnameTypeDef*	*NA*	*NA*

- The **PPP** prefix refers to the peripheral functional mode and not to the peripheral itself. For example, if the USART, PPP can be USART, IRDA, UART or SMARTCARD depending on the peripheral mode.
- The constants used in one file are defined within this file. A constant used in several files is defined in a header file. All constants are written in uppercase, except for peripheral driver function parameters.
- typedef variable names should be suffixed with _TypeDef.
- Registers are considered as constants. In most cases, their name is in uppercase and uses the same acronyms as in the STM32L4 and STM32L4+ reference manuals.
- Peripheral registers are declared in the PPP_TypeDef structure (e.g. ADC_TypeDef) in the stm32l4xxx.h header file:

  stm32l4xxx.h corresponds to stm32l412xx.h, stm32l422xx.h, stm32l431xx.h, stm32l432xx.h, stm32l433xx.h, stm32l442xx.h, stm32l443xx.h, stm32l4521xx.h, stm32l452xx.h, stm32l462xx.h, stm32l471xx.h, stm32l475xx.h, stm32l476xx.h, stm32l485xx.h, stm32l486xx.h, stm32l496xx.h, stm32l4a6xx.h, stm32l4p5xx.h, stm32l4q5xx.h, stm32l4r5xx.h, stm32l4r7xx.h, stm32l4r9xx.h, stm32l4s5xx.h, stm32l4s7xx.h, stm32l4s9xx.h.
- Peripheral function names are prefixed by HAL_, then the corresponding peripheral acronym in uppercase followed by an underscore. The first letter of each word is in uppercase (e.g. HAL_UART_Transmit()). Only one underscore is allowed in a function name to separate the peripheral acronym from the rest of the function name.
- The structure containing the PPP peripheral initialization parameters are named PPP_InitTypeDef (e.g. ADC_InitTypeDef).
- The structure containing the Specific configuration parameters for the PPP peripheral are named PPP_xxxxConfTypeDef (e.g. ADC_ChannelConfTypeDef).
- Peripheral handle structures are named PPP_HandleTypedef (e.g DMA_HandleTypeDef)
- The functions used to initialize the PPP peripheral according to parameters specified in PPP_InitTypeDef are named HAL_PPP_Init (e.g. HAL_TIM_Init()).
- The functions used to reset the PPP peripheral registers to their default values are named HAL_PPP_DeInit (e.g. HAL_TIM_DeInit()).
- The **MODE** suffix refers to the process mode, which can be polling, interrupt or DMA. As an example, when the DMA is used in addition to the native resources, the function should be called: *HAL_PPP_Function_DMA ()*.

- The **Feature** prefix should refer to the new feature.
  Example: *HAL_ADCEx_InjectedStart()*() refers to the injection mode

3.5.2 HAL general naming rules

- For the shared and system peripherals, no handle or instance object is used. This rule applies to the following peripherals:
  – GPIO
  – SYSTICK
  – NVIC
  – RCC
  – FLASH.

Example: The *HAL_GPIO_Init()* requires only the GPIO address and its configuration parameters.

```
HAL_StatusTypeDef HAL_GPIO_Init (GPIO_TypeDef* GPIOx, GPIO_InitTypeDef *Init)
{
/*GPIO Initialization body */
}
```

- The macros that handle interrupts and specific clock configurations are defined in each peripheral/module driver. These macros are exported in the peripheral driver header files so that they can be used by the extension file. The list of these macros is defined below:

Note: This list is not exhaustive and other macros related to peripheral features can be added, so that they can be used in the user application.

Table 8. Macros handling interrupts and specific clock configurations

Macros	Description
__HAL_PPP_ENABLE_IT(__HANDLE__, __INTERRUPT__)	Enables a specific peripheral interrupt
__HAL_PPP_DISABLE_IT(__HANDLE__, __INTERRUPT__)	Disables a specific peripheral interrupt
__HAL_PPP_GET_IT (__HANDLE__, __ INTERRUPT __)	Gets a specific peripheral interrupt status
__HAL_PPP_CLEAR_IT (__HANDLE__, __ INTERRUPT __)	Clears a specific peripheral interrupt status
__HAL_PPP_GET_FLAG (__HANDLE__, __FLAG__)	Gets a specific peripheral flag status
__HAL_PPP_CLEAR_FLAG (__HANDLE__, __FLAG__)	Clears a specific peripheral flag status
__HAL_PPP_ENABLE(__HANDLE__)	Enables a peripheral
__HAL_PPP_DISABLE(__HANDLE__)	Disables a peripheral
__HAL_PPP_XXXX (__HANDLE__, __PARAM__)	Specific PPP HAL driver macro
__HAL_PPP_GET_ IT_SOURCE (__HANDLE__, __ INTERRUPT __)	Checks the source of specified interrupt

- NVIC and SYSTICK are two Arm® Cortex® core features. The APIs related to these features are located in the stm32l4xx_hal_cortex.c file.
- When a status bit or a flag is read from registers, it is composed of shifted values depending on the number of read values and of their size. In this case, the returned status width is 32 bits. Example : STATUS = XX | (YY << 16) or STATUS = XX | (YY << 8) | (YY << 16) | (YY << 24)".
- The PPP handles are valid before using the HAL_PPP_Init() API. The init function performs a check before modifying the handle fields.

```
 HAL_PPP_Init(PPP_HandleTypeDef)
if(hppp == NULL)
 {
 return HAL_ERROR;
 }
```

- The macros defined below are used:
  - Conditional macro:

```
#define ABS(x) (((x) > 0) ? (x) : -(x))
```

  - Pseudo-code macro (multiple instructions macro):

```
#define __HAL_LINKDMA(__HANDLE__, __PPP_DMA_FIELD_, __DMA_HANDLE_) \
do{ \
(__HANDLE__)->__PPP_DMA_FIELD_ = &(__DMA_HANDLE_); \
(__DMA_HANDLE_).Parent = (__HANDLE__); \
} while(0)
```

3.5.3 HAL interrupt handler and callback functions

Besides the APIs, HAL peripheral drivers include:

- HAL_PPP_IRQHandler() peripheral interrupt handler that should be called from stm32l4xx_it.c
- User callback functions.

The user callback functions are defined as empty functions with “weak” attribute. They have to be defined in the user code.

There are three types of user callbacks functions:

- Peripheral system level initialization/ de-Initialization callbacks: HAL_PPP_MspInit() and HAL_PPP_MspDeInit
- Process complete callbacks : HAL_PPP_ProcessCpltCallback
- Error callback: HAL_PPP_ErrorCallback.

Table 9. Callback functions

Callback functions	Example
HAL_PPP_MspInit() / _DeInit()	Example: HAL_USART_MspInit() Called from HAL_PPP_Init() API function to perform peripheral system level initialization (GPIOs, clock, DMA, interrupt)
HAL_PPP_ProcessCpltCallback	Example: HAL_USART_TxCpltCallback Called by peripheral or DMA interrupt handler when the process completes
HAL_PPP_ErrorCallback	Example: HAL_USART_ErrorCallback Called by peripheral or DMA interrupt handler when an error occurs

3.6 HAL generic APIs

The generic APIs provide common generic functions applying to all STM32 devices. They are composed of four APIs groups:

- **Initialization and de-initialization functions:**HAL_PPP_Init(), HAL_PPP_DeInit()
- **IO operation functions**: HAL_PPP_Read(), HAL_PPP_Write(),HAL_PPP_Transmit(), HAL_PPP_Receive()
- **Control functions**: HAL_PPP_Set (), HAL_PPP_Get ().
- **State and Errors functions**: HAL_PPP_GetState (), HAL_PPP_GetError ().

For some peripheral/module drivers, these groups are modified depending on the peripheral/module implementation.

Example: in the timer driver, the API grouping is based on timer features (PWM, OC, IC...).

The initialization and de-initialization functions allow initializing a peripheral and configuring the low-level resources, mainly clocks, GPIO, alternate functions (AF) and possibly DMA and interrupts. The *HAL_DeInit()*function restores the peripheral default state, frees the low-level resources and removes any direct dependency with the hardware.

The IO operation functions perform a row access to the peripheral payload data in write and read modes.

The control functions are used to change dynamically the peripheral configuration and set another operating mode.

The peripheral state and errors functions allow retrieving in run time the peripheral and data flow states, and identifying the type of errors that occurred. The example below is based on the ADC peripheral. The list of generic APIs is not exhaustive. It is only given as an example.

Table 10. HAL generic APIs

Function group	Common API name	Description
Initialization group	*HAL_ADC_Init()*	This function initializes the peripheral and configures the low -level resources (clocks, GPIO, AF..)
	HAL_ADC_DeInit()	This function restores the peripheral default state, frees the low-level resources and removes any direct dependency with the hardware.
IO operation group	*HAL_ADC_Start ()*	This function starts ADC conversions when the polling method is used

Function group	Common API name	Description
IO operation group	*HAL_ADC_Stop ()*	This function stops ADC conversions when the polling method is used
	HAL_ADC_PollForConversion()	This function allows waiting for the end of conversions when the polling method is used. In this case, a timout value is specified by the user according to the application.
	HAL_ADC_Start_IT()	This function starts ADC conversions when the interrupt method is used
	HAL_ADC_Stop_IT()	This function stops ADC conversions when the interrupt method is used
	HAL_ADC_IRQHandler()	This function handles ADC interrupt requests
	HAL_ADC_ConvCpltCallback()	Callback function called in the IT subroutine to indicate the end of the current process or when a DMA transfer has completed
	HAL_ADC_ErrorCallback()	Callback function called in the IT subroutine if a peripheral error or a DMA transfer error occurred
Control group	*HAL_ADC_ConfigChannel()*	This function configures the selected ADC regular channel, the corresponding rank in the sequencer and the sample time
	HAL_ADC_AnalogWDGConfig	This function configures the analog watchdog for the selected ADC
State and Errors group	*HAL_ADC_GetState()*	This function allows getting in run time the peripheral and the data flow states.
	HAL_ADC_GetError()	This fuction allows getting in run time the error that occurred during IT routine

3.7 HAL extension APIs

3.7.1 HAL extension model overview

The extension APIs provide specific functions or overwrite modified APIs for a specific family (series) or specific part number within the same family.

The extension model consists of an additional file, stm32l4xx_hal_ppp_ex.c, that includes all the specific functions and define statements (stm32l4xx_hal_ppp_ex.h) for a given part number.

Below an example based on the ADC peripheral:

Table 11. HAL extension APIs

Function group	Common API name
HAL_ADCEx_CalibrationStart()	This function is used to start the automatic ADC calibration

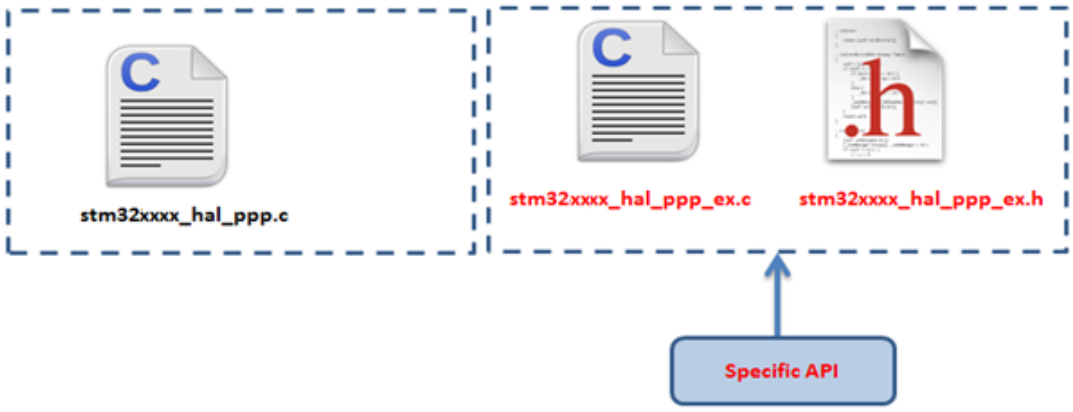
3.7.2 HAL extension model cases

The specific IP features can be handled by the HAL drivers in five different ways. They are described below.

Adding a part number-specific function

When a new feature specific to a given device is required, the new APIs are added in the stm32l4xx_hal_ppp_ex.c extension file. They are named HAL_PPPEx_Function().

Figure 2. **Adding device-specific functions**



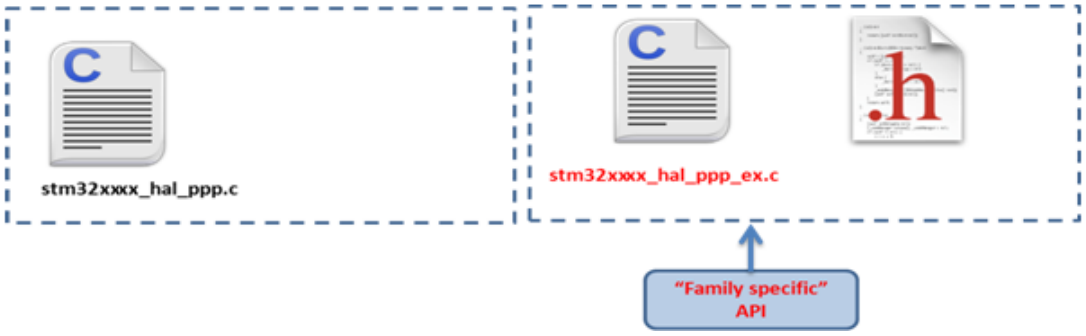
Example: stm32l4xx_hal_adc_ex.c/h

```
#if defined(STM32L475xx) || defined(STM32L476xx) || defined(STM32L486xx)
void HAL_PWREx_EnableVddUSB(void);
void HAL_PWREx_DisableVddUSB(void);
#endif /* STM32L475xx || STM32L476xx || STM32L486xx */
```

Adding a family-specific function

In this case, the API is added in the extension driver C file and named HAL_PPPEx_Function ().

Figure 3. **Adding family-specific functions**

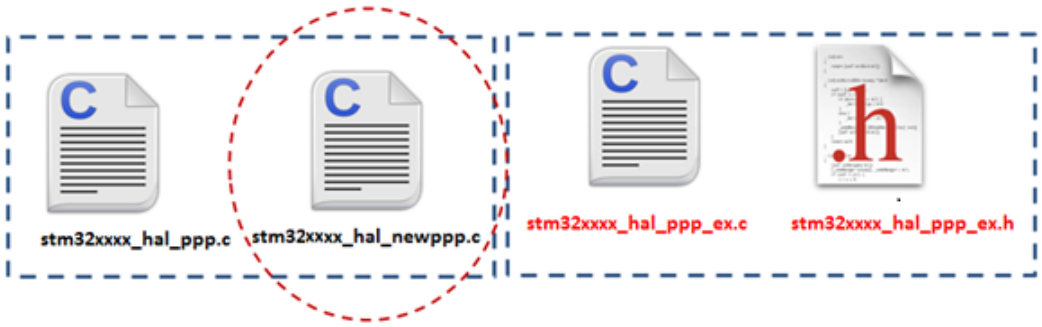


Adding a new peripheral (specific to a device belonging to a given family)

When a peripheral which is available only in a specific device is required, the APIs corresponding to this new peripheral/module (newPPP) are added in a new stm32l4xx_hal_newppp.c. However the inclusion of this file is selected in the stm32l4xx_hal_conf.h using the macro:

```
#define HAL_NEWPPP_MODULE_ENABLED
```

Figure 4. **Adding new peripherals**

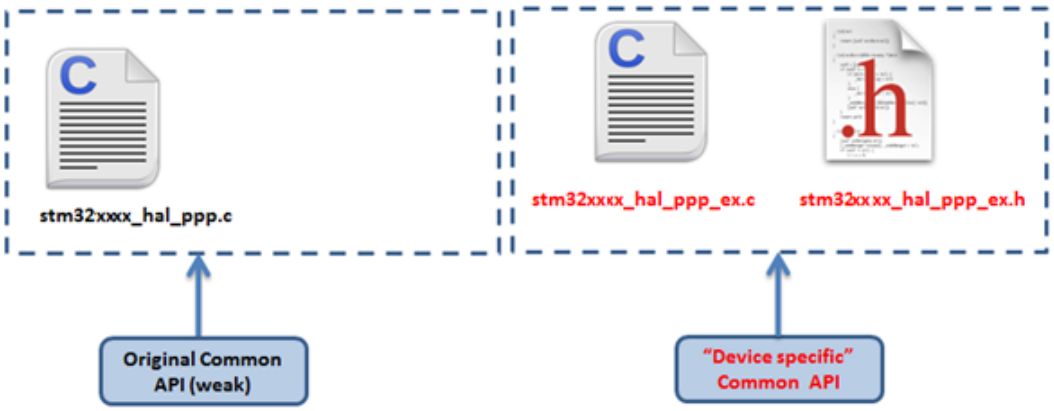


Example: stm32l4xx_hal_adc.c/h

Updating existing common APIs

In this case, the routines are defined with the same names in the stm32l4xx_hal_ppp_ex.c extension file, while the generic API is defined as *weak*, so that the compiler will overwrite the original routine by the new defined function.

Figure 5. **Updating existing APIs**



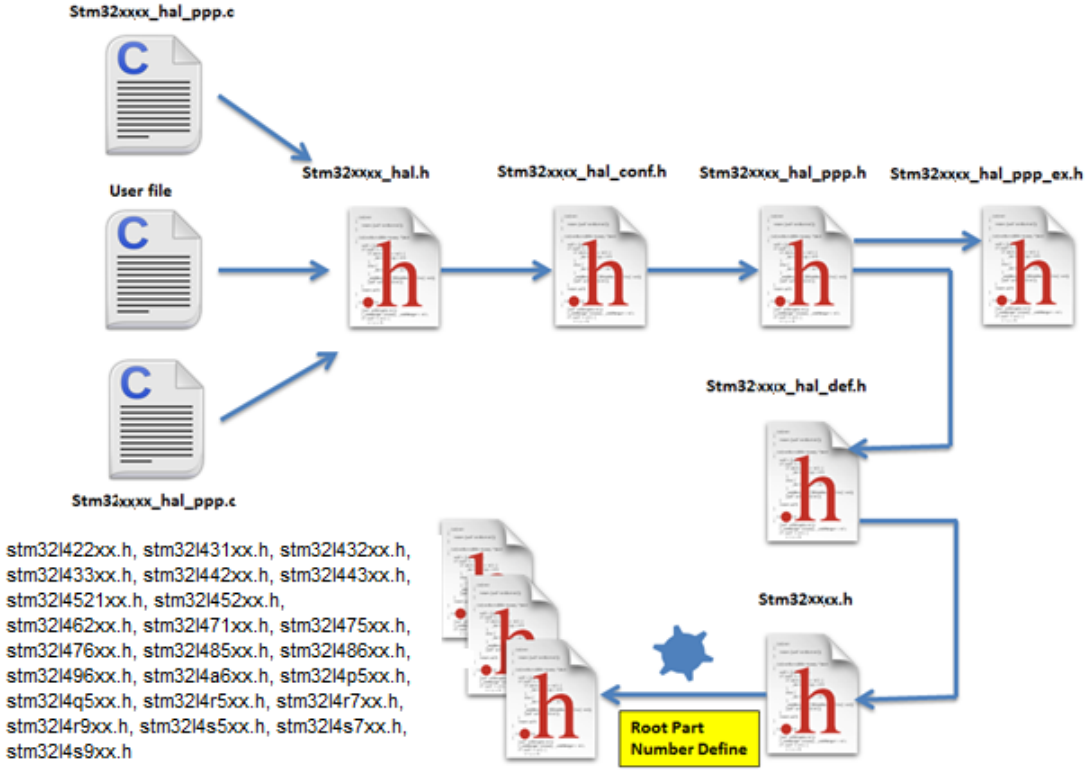
Updating existing data structures

The data structure for a specific device part number (e.g. PPP_InitTypeDef) can have different fields. In this case, the data structure is defined in the extension header file and delimited by the specific part number define statement.

3.8 File inclusion model

The header of the common HAL driver file (stm32l4xx_hal.h) includes the common configurations for the whole HAL library. It is the only header file that is included in the user sources and the HAL C sources files to be able to use the HAL resources.

Figure 6. File inclusion model



A PPP driver is a standalone module which is used in a project. The user must enable the corresponding USE_HAL_PPP_MODULE define statement in the configuration file.

```
/**********************************************************************
* @file stm32l4xx_hal_conf.h
* @author MCD Application Team
* @version VX.Y.Z * @date dd-mm-yyyy
* @brief This file contains the modules to be used
**********************************************************************
(…)
#define HAL_USART_MODULE_ENABLED
#define HAL_IRDA_MODULE_ENABLED
#define HAL_DMA_MODULE_ENABLED
#define HAL_RCC_MODULE_ENABLED
(…)
```

3.9 HAL common resources

The common HAL resources, such as common define enumerations, structures and macros, are defined in *stm32l4xx_hal_def.h.*The main common define enumeration is *HAL_StatusTypeDef*.

- **HAL Status**

  The HAL status is used by almost all HAL APIs, except for boolean functions and IRQ handler. It returns the status of the current API operations. It has four possible values as described below:

```
Typedef enum
{
HAL_OK = 0x00,
HAL_ERROR = 0x01,
HAL_BUSY = 0x02,
HAL_TIMEOUT = 0x03
} HAL_StatusTypeDef;
```

- **HAL Locked**

  The HAL lock is used by all HAL APIs to prevent accessing by accident shared resources.

```
typedef enum
{
HAL_UNLOCKED = 0x00, /*!<Resources unlocked */
HAL_LOCKED = 0x01 /*!< Resources locked */
} HAL_LockTypeDef;
```

  In addition to common resources, the stm32l4xx_hal_def.h file calls the stm32l4xx.h file in CMSIS library to get the data structures and the address mapping for all peripherals:

  – Declarations of peripheral registers and bits definition.
  – Macros to access peripheral registers hardware (Write register, Read register…etc.).

- **Common macros**

  – Macro defining HAL_MAX_DELAY

```
#define HAL_MAX_DELAY 0xFFFFFFFF
```

  – Macro linking a PPP peripheral to a DMA structure pointer:

```
#define __HAL_LINKDMA(__HANDLE__, __PPP_DMA_FIELD_, __DMA_HANDLE_) \
do{ \
  (__HANDLE__)->__PPP_DMA_FIELD_ = &(__DMA_HANDLE_); \
  (__DMA_HANDLE_).Parent = (__HANDLE__); \
} while(0)
```

3.10 HAL configuration

The configuration file, stm32l4xx_hal_conf.h, allows customizing the drivers for the user application. Modifying this configuration is not mandatory: the application can use the default configuration without any modification.

To configure these parameters, the user should enable, disable or modify some options by uncommenting, commenting or modifying the values of the related define statements as described in the table below:

Table 12. Define statements used for HAL configuration

Configuration item	Description	Default Value
HSE_VALUE	Defines the value of the external oscillator (HSE) expressed in Hz. The user must adjust this define statement when using a different crystal value.	8 000 000 Hz
HSE_STARTUP_TIMEOUT	Timeout for HSE start-up, expressed in ms	100
HSI_VALUE	Defines the value of the internal oscillator (HSI) expressed in Hz.	16 000 000 Hz
MSI_VALUE	Defines the default value of the Multiplespeed internal oscillator (MSI) expressed in Hz.	4 000 000 Hz
LSI_VALUE	Defines the default value of the Low-speed internal oscillator (LSI) expressed in Hz.	32000 Hz

Configuration item	Description	Default Value
LSE_VALUE	Defines the value of the external oscillator (LSE) expressed in Hz. The user must adjust this define statement when using a different crystal value.	32768 Hz
LSE_STARTUP_TIMEOUT	Timeout for LSE start-up, expressed in ms	5000
VDD_VALUE	VDD value	3300 (mV)
USE_RTOS	Enables the use of RTOS	FALSE (for future use)
PREFETCH_ENABLE	Enables prefetch feature	FALSE
INSTRUCTION_CACHE_ENABLE	Enables I-cache feature	TRUE
DATA_CACHE_ENABLE	Enables D-cache feature	TRUE

Note: The stm32l4xx_hal_conf_template.h file is located in the HAL drivers Inc folder. It should be copied to the user folder, renamed and modified as described above.

Note: By default, the values defined in the stm32l4xx_hal_conf_template.h file are the same as the ones used for the examples and demonstrations. All HAL include files are enabled so that they can be used in the user code without modifications.

3.11 HAL system peripheral handling

This chapter gives an overview of how the system peripherals are handled by the HAL drivers. The full API list is provided within each peripheral driver description section.

3.11.1 Clock

Two main functions can be used to configure the system clock:

- HAL_RCC_OscConfig (RCC_OscInitTypeDef *RCC_OscInitStruct). This function configures/enables multiple clock sources (HSE, HSI, MSI, LSE, LSI, PLL).
- HAL_RCC_ClockConfig (RCC_ClkInitTypeDef *RCC_ClkInitStruct, uint32_t FLatency). This function
  - selects the system clock source
  - configures AHB, APB1 and APB2 clock dividers
  - configures the number of Flash memory wait states
  - updates the SysTick configuration when HCLK clock changes.

Some peripheral clocks are not derived from the system clock (such as RTC, USB). In this case, the clock configuration is performed by an extended API defined in stm32l4xx_hal_rcc_ex.c: *HAL_RCCEx_PeriphCLKConfig(RCC_PeriphCLKInitTypeDef *PeriphClkInit)*.

Additional RCC HAL driver functions are available:

- HAL_RCC_DeInit() Clock de-initialization function that returns clock configuration to reset state
- Get clock functions that allow retreiving various clock configurations (system clock, HCLK, PCLK1, PCLK2, …)
- MCO and CSS configuration functions

A set of macros are defined in stm32l4xx_hal_rcc.h and stm32l4xx_hal_rcc_ex.h. They allow executing elementary operations on RCC block registers, such as peripherals clock gating/reset control:

- __HAL_PPP_CLK_ENABLE/__HAL_PPP_CLK_DISABLE to enable/disable the peripheral clock
- __HAL_PPP_FORCE_RESET/__HAL_PPP_RELEASE_RESET to force/release peripheral reset
- __HAL_PPP_CLK_SLEEP_ENABLE/__HAL_PPP_CLK_SLEEP_DISABLE to enable/disable the peripheral clock during Sleep mode.
- __HAL_PPP_IS_CLK_ENABLED/__HAL_PPP_IS_CLK_DISABLED to query about the enabled/disabled status of the peripheral clock.
- __HAL_PPP_IS_CLK_SLEEP_ENABLED/__HAL_PPP_IS_CLK_SLEEP_DISABLED to query about the enabled/disabled status of the peripheral clock during Sleep mode.

3.11.2 GPIOs

GPIO HAL APIs are the following:

- HAL_GPIO_Init() / HAL_GPIO_DeInit()
- HAL_GPIO_ReadPin() / HAL_GPIO_WritePin()
- HAL_GPIO_TogglePin ().

In addition to standard GPIO modes (input, output, analog), the pin mode can be configured as EXTI with interrupt or event generation.

When selecting EXTI mode with interrupt generation, the user must call HAL_GPIO_EXTI_IRQHandler() from stm32l4xx_it.c and implement HAL_GPIO_EXTI_Callback()

The table below describes the GPIO_InitTypeDef structure field.

Table 13. Description of GPIO_InitTypeDef structure

Structure field	Description
Pin	Specifies the GPIO pins to be configured. Possible values: GPIO_PIN_x or GPIO_PIN_All, where x[0..15]
Mode	Specifies the operating mode for the selected pins: GPIO mode or EXTI mode. Possible values are: • GPIO mode – GPIO_MODE_INPUT : Input floating – GPIO_MODE_OUTPUT_PP : Output push-pull – GPIO_MODE_OUTPUT_OD : Output open drain – GPIO_MODE_AF_PP : Alternate function push-pull – GPIO_MODE_AF_OD : Alternate function open drain – GPIO_MODE_ANALOG : Analog mode – GPIO_MODE_ANALOG_ADC_CONTROL: ADC analog mode • External Interrupt mode – GPIO_MODE_IT_RISING : Rising edge trigger detection – GPIO_MODE_IT_FALLING : Falling edge trigger detection – GPIO_MODE_IT_RISING_FALLING : Rising/Falling edge trigger detection • External Event mode – GPIO_MODE_EVT_RISING : Rising edge trigger detection – GPIO_MODE_EVT_FALLING : Falling edge trigger detection – GPIO_MODE_EVT_RISING_FALLING: Rising/Falling edge trigger detection
Pull	Specifies the Pull-up or Pull-down activation for the selected pins. Possible values are: GPIO_NOPULL GPIO_PULLUP GPIO_PULLDOWN
Speed	Specifies the speed for the selected pins Possible values are: GPIO_SPEED_FREQ_LOW GPIO_SPEED_FREQ_MEDIUM GPIO_SPEED_FREQ_HIGH GPIO_SPEED_FREQ_VERY_HIGH

Please find below typical GPIO configuration examples:

- Configuring GPIOs as output push-pull to drive external LEDs:

```
GPIO_InitStruct.Pin = GPIO_PIN_12 | GPIO_PIN_13 | GPIO_PIN_14 | GPIO_PIN_15;
GPIO_InitStruct.Mode = GPIO_MODE_OUTPUT_PP;
GPIO_InitStruct.Pull = GPIO_PULLUP;
GPIO_InitStruct.Speed = GPIO_SPEED_FREQ_MEDIUM;
HAL_GPIO_Init(GPIOD, &GPIO_InitStruct);
```

- Configuring PA0 as external interrupt with falling edge sensitivity:

```
GPIO_InitStructure.Mode = GPIO_MODE_IT_FALLING;
GPIO_InitStructure.Pull = GPIO_NOPULL;
GPIO_InitStructure.Pin = GPIO_PIN_0;
HAL_GPIO_Init(GPIOA, &GPIO_InitStructure);
```

3.11.3 Cortex® NVIC and SysTick timer

The Cortex® HAL driver, stm32l4xx_hal_cortex.c, provides APIs to handle NVIC and SysTick. The supported APIs include:

- HAL_NVIC_SetPriority()/ HAL_NVIC_SetPriorityGrouping()
- HAL_NVIC_GetPriority() / HAL_NVIC_GetPriorityGrouping()
- HAL_NVIC_EnableIRQ()/HAL_NVIC_DisableIRQ()
- HAL_NVIC_SystemReset()
- HAL_SYSTICK_IRQHandler()
- HAL_NVIC_GetPendingIRQ() / HAL_NVIC_SetPendingIRQ () / HAL_NVIC_ClearPendingIRQ()
- HAL_NVIC_GetActive(IRQn)
- HAL_SYSTICK_Config()
- HAL_SYSTICK_CLKSourceConfig()
- HAL_SYSTICK_Callback()

3.11.4 PWR

The PWR HAL driver handles power management. The features shared between all STM32 Series are listed below:

- PVD configuration, enabling/disabling and interrupt handling
  - HAL_PWR_ConfigPVD()
  - HAL_PWR_EnablePVD() / HAL_PWR_DisablePVD()
  - HAL_PWR_PVD_IRQHandler()
  - HAL_PWR_PVDCallback()
- Wakeup pin configuration
  - HAL_PWR_EnableWakeUpPin() / HAL_PWR_DisableWakeUpPin()
- Low-power mode entry
  - HAL_PWR_EnterSLEEPMode()
  - HAL_PWR_EnterSTOPMode() (kept for compatibility with other family but identical to HAL_PWREx_EnterSTOP0Mode() or HAL_PWREx_EnterSTOP1Mode() (see hereafter))
  - HAL_PWR_EnterSTANDBYMode()
- STM32L4 and STM32L4+ new low-power management features:
  - HAL_PWREx_EnterSTOP0Mode()
  - HAL_PWREx_EnterSTOP1Mode()
  - HAL_PWREx_EnterSTOP2Mode()
  - HAL_PWREx_EnterSHUTDOWNMode()

3.11.5 EXTI

The EXTI is not considered as a standalone peripheral but rather as a service used by other peripheral, that are handled through EXTI HAL APIs. In addition, each peripheral HAL driver implements the associated EXTI configuration and function as macros in its header file.

The first 16 EXTI lines connected to the GPIOs are managed within the GPIO driver. The GPIO_InitTypeDef structure allows configuring an I/O as external interrupt or external event.

The EXTI lines connected internally to the PVD, RTC, USB, and Ethernet are configured within the HAL drivers of these peripheral through the macros given in the table below.

The EXTI internal connections depend on the targeted STM32 microcontroller (refer to the product datasheet for more details):

Table 14. Description of EXTI configuration macros

Macros	Description
__HAL_PPP_{SUBLOCK}__EXTI_ENABLE_IT()	Enables a given EXTI line interrupt Example: __HAL_PWR_PVD_EXTI_ENABLE_IT()
__HAL_PPP_{SUBLOCK}__EXTI_DISABLE_IT()	Disables a given EXTI line. Example: __HAL_PWR_PVD_EXTI_DISABLE_IT()
__HAL_ PPP_{SUBLOCK}__EXTI_GET_FLAG()	Gets a given EXTI line interrupt flag pending bit status. Example: __HAL_PWR_PVD_EXTI_GET_FLAG()
__HAL_ PPP_{SUBLOCK}_EXTI_CLEAR_FLAG()	Clears a given EXTI line interrupt flag pending bit. Example; __HAL_PWR_PVD_EXTI_CLEAR_FLAG()
__HAL_ PPP_{SUBLOCK}_EXTI_GENERATE_SWIT()	Generates a software interrupt for a given EXTI line. Example: __HAL_PWR_PVD_EXTI_ GENERATE_SWIT ()
__HAL_PPP_SUBBLOCK_EXTI_ENABLE_EVENT()	Enable a given EXTI line event Example: __HAL_RTC_WAKEUP_EXTI_ENABLE_EVENT()
__HAL_PPP_SUBBLOCK_EXTI_DISABLE_EVENT()	Disable a given EXTI line event Example: __HAL_RTC_WAKEUP_EXTI_DISABLE_EVENT()
__HAL_ PPP_SUBBLOCK_EXTI_ENABLE_RISING_EDGE()	Configure an EXTI Interrupt or Event on rising edge
__HAL_ PPP_SUBBLOCK_EXTI_DISABLE_FALLING_EDGE()	Enable an EXTI Interrupt or Event on Falling edge
__HAL_ PPP_SUBBLOCK_EXTI_DISABLE_RISING_EDGE()	Disable an EXTI Interrupt or Event on rising edge
__HAL_ PPP_SUBBLOCK_EXTI_DISABLE_FALLING_EDGE()	Disable an EXTI Interrupt or Event on Falling edge
__HAL_ PPP_SUBBLOCK_EXTI_ENABLE_RISING_FALLING_EDGE()	Enable an EXTI Interrupt or Event on Rising/Falling edge
__HAL_ PPP_SUBBLOCK_EXTI_DISABLE_RISING_FALLING_EDGE()	Disable an EXTI Interrupt or Event on Rising/Falling edge

If the EXTI interrupt mode is selected, the user application must call HAL_PPP_FUNCTION_IRQHandler() (for example HAL_PWR_PVD_IRQHandler()), from stm32l4xx_it.c file, and implement HAL_PPP_FUNCTIONCallback() callback function (for example HAL_PWR_PVDCallback().

3.11.6 DMA

The DMA HAL driver allows enabling and configuring the peripheral to be connected to the DMA Channels (except for internal SRAM/FLASH memory which do not require any initialization). Refer to the product reference manual for details on the DMA request corresponding to each peripheral.

For a given channel, HAL_DMA_Init() API allows programming the required configuration through the following parameters:

- Transfer direction
- Source and destination data formats
- Circular, Normal control mode
- Channel priority level
- Source and destination Increment mode

Two operating modes are available:

- Polling mode I/O operation
  1. Use HAL_DMA_Start() to start DMA transfer when the source and destination addresses and the Length of data to be transferred have been configured.
  2. Use HAL_DMA_PollForTransfer() to poll for the end of current transfer. In this case a fixed timeout can be configured depending on the user application.
- Interrupt mode I/O operation
  1. Configure the DMA interrupt priority using HAL_NVIC_SetPriority()
  2. Enable the DMA IRQ handler using HAL_NVIC_EnableIRQ()
  3. Use HAL_DMA_Start_IT() to start DMA transfer when the source and destination addresses and the length of data to be transferred have been confgured. In this case the DMA interrupt is configured.
  4. Use HAL_DMA_IRQHandler() called under DMA_IRQHandler() Interrupt subroutine
  5. When data transfer is complete, HAL_DMA_IRQHandler() function is executed and a user function can be called by customizing XferCpltCallback and XferErrorCallback function pointer (i.e. a member of DMA handle structure).

Additional functions and macros are available to ensure efficient DMA management:

- Use HAL_DMA_GetState() function to return the DMA state and HAL_DMA_GetError() in case of error detection.
- Use HAL_DMA_Abort() function to abort the current transfer

The most used DMA HAL driver macros are the following:

- __HAL_DMA_ENABLE: enables the specified DMA channel.
- __HAL_DMA_DISABLE: disables the specified DMA channel.
- __HAL_DMA_GET_FLAG: gets the DMA channel pending flags.
- __HAL_DMA_CLEAR_FLAG: clears the DMA channel pending flags.
- __HAL_DMA_ENABLE_IT: enables the specified DMA channel interrupts.
- __HAL_DMA_DISABLE_IT: disables the specified DMA channel interrupts.
- __HAL_DMA_GET_IT_SOURCE: checks whether the specified DMA channel interrupt has been enabled or not.

Note: When a peripheral is used in DMA mode, the DMA initialization should be done in the HAL_PPP_MspInit() callback. In addition, the user application should associate the DMA handle to the PPP handle (refer to section "HAL IO operation functions").

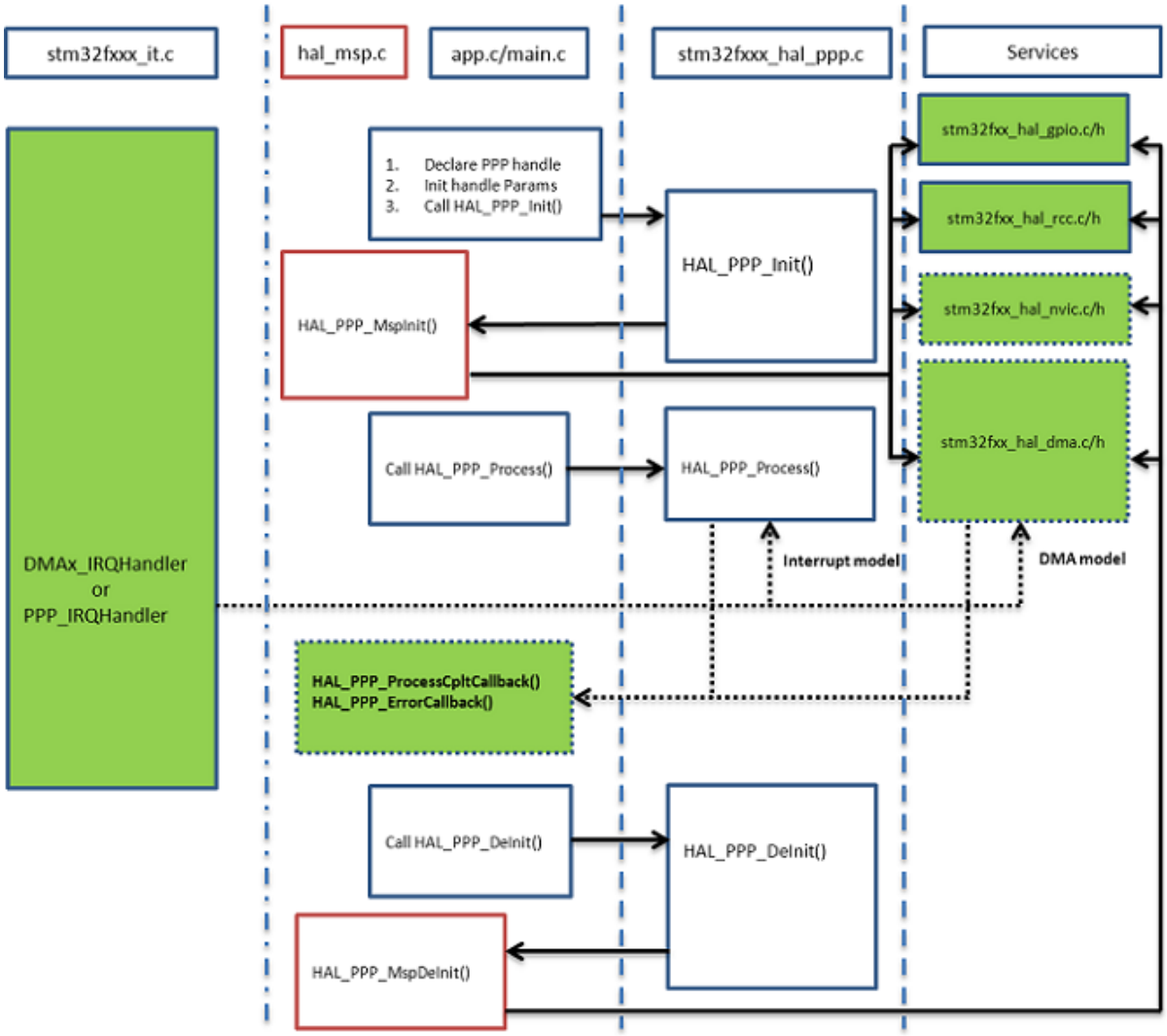
Note: DMA channel callbacks need to be initialized by the user application only in case of memory-to-memory transfer. However when peripheral-to-memory transfers are used, these callbacks are automatically initialized by calling a process API function that uses the DMA.

3.12 How to use HAL drivers

3.12.1 HAL usage models

The following figure shows the typical use of the HAL driver and the interaction between the application user, the HAL driver and the interrupts.

Figure 7. **HAL driver model**



Note: The functions implemented in the HAL driver are shown in green, the functions called from interrupt handlers in dotted lines, and the msp functions implemented in the user application in red. Non-dotted lines represent the interactions between the user application functions.

Basically, the HAL driver APIs are called from user files and optionally from interrupt handlers file when the APIs based on the DMA or the PPP peripheral dedicated interrupts are used.

When DMA or PPP peripheral interrupts are used, the PPP process complete callbacks are called to inform the user about the process completion in real-time event mode (interrupts). Note that the same process completion callbacks are used for DMA in interrupt mode.

3.12.2 HAL initialization

3.12.2.1 HAL global initialization

In addition to the peripheral initialization and de-initialization functions, a set of APIs are provided to initialize the HAL core implemented in file stm32l4xx_hal.c.

- HAL_Init(): this function must be called at application startup to
  - initialize data/instruction cache and pre-fetch queue
  - set SysTick timer to generate an interrupt each 1ms (based on HSI clock) with the lowest priority
  - call HAL_MspInit() user callback function to perform system level initializations (Clock, GPIOs, DMA, interrupts). HAL_MspInit() is defined as “weak” empty function in the HAL drivers.

- HAL_DeInit()
  - resets all peripherals
  - calls function HAL_MspDeInit() which a is user callback function to do system level De-Initalizations.
- HAL_GetTick(): this function gets current SysTick counter value (incremented in SysTick interrupt) used by peripherals drivers to handle timeouts.
- HAL_Delay(). this function implements a delay (expressed in milliseconds) using the SysTick timer.

  Care must be taken when using HAL_Delay() since this function provides an accurate delay (expressed in milliseconds) based on a variable incremented in SysTick ISR. This means that if HAL_Delay() is called from a peripheral ISR, then the SysTick interrupt must have highest priority (numerically lower) than the peripheral interrupt, otherwise the caller ISR will be blocked.

3.12.2.2 *System clock initialization*

The clock configuration is done at the beginning of the user code. However the user can change the configuration of the clock in his own code.

Please find below the typical Clock configuration sequence to reach the maximum 80 MHz clock frequency based on the HSE clock:

```
 void SystemClock_Config(void)
{
   RCC_ClkInitTypeDef clkinitstruct = {0};
   RCC_OscInitTypeDef oscinitstruct = {0};
/* Configure PLLs------------------------------------------------------*/
/* PLL configuration: PLLCLK =  (HSE/PLLM * PLLN) / PLLR = (16/1 * 20) / 2 = 80 MHz*/
/* Enable HSE Oscillator and activate PLL with HSE as source */
   oscinitstruct.OscillatorType =  RCC_OSCILLATORTYPE_HSE;
   oscinitstruct.HSEState =   RCC_HSE_ON;
   oscinitstruct.PLL.PLLState = RCC_PLL_ON;
   oscinitstruct.PLL.PLLSource =   RCC_PLLSOURCE_HSE;
   oscinitstruct.PLL.PLLM = 1;
   oscinitstruct.PLL.PLLN = 20;
   oscinitstruct.PLL.PLLR = 2;
   oscinitstruct.PLL.PLLL = 7;
   oscinitstruct.PLL.PLLQ = 4;
   if   (HAL_RCC_OscConfig(&oscinitstruct)!= HAL_OK)
   {
    /* Initialization Error */
       while(1);
   }
   /* Select PLL as system clock source and configure the HCLK, PCLK1 and PCLK2   clocks divi
ders    */
   clkinitstruct.ClockType = (RCC_CLOCKTYPE_SYSCLK I   RCC_CLOCKTYPE_HCLK I RCC_CLOCKTYPE_PCL
K1 I RCC_CLOCKTYPE_PCLK2);
   clkinitstruct.SYSCLKSource = RCC_SYSCLKSOURCE_PLLCLK;
   clkinitstruct.AHBCLKDivider = RCC_SYSCLK_DIV1;
   clkinitstruct.APB2CLKDivider =   RCC_HCLK_DIV1;
   clkinitstruct.APB1CLKDivider = RCC_HCLK_DIV1;
   if
      (HAL_RCC_ClockConfig(&clkinitstruct,FLASH_LATENCY_4)!= HAL_OK)
    {
      /*   Initialization Error */
     while(1);
    }
 }
```

3.12.2.3 *HAL MSP initialization process*

The peripheral initialization is done through *HAL_PPP_Init()* while the hardware resources initialization used by a peripheral (PPP) is performed during this initialization by calling MSP callback function *HAL_PPP_MspInit()*.

The MspInit callback performs the low level initialization related to the different additional hardware resources: RCC, GPIO, NVIC and DMA.

All the HAL drivers with handles include two MSP callbacks for initialization and de-initialization:

```
/**
* @brief Initializes the PPP MSP.
* @param hppp: PPP handle
* @retval None */
void __weak HAL_PPP_MspInit(PPP_HandleTypeDef *hppp) {
/* NOTE : This function Should not be modified, when the callback is needed,
the HAL_PPP_MspInit could be implemented in the user file */
}
/**
* @brief DeInitializes PPP MSP.
* @param hppp: PPP handle
* @retval None */
void __weak HAL_PPP_MspDeInit(PPP_HandleTypeDef *hppp) {
/* NOTE : This function Should not be modified, when the callback is needed,
the HAL_PPP_MspDeInit could be implemented in the user file */
}
```

The MSP callbacks are declared empty as weak functions in each peripheral driver. The user can use them to set the low level initialization code or omit them and use his own initialization routine.

The HAL MSP callback is implemented inside the *stm32l4xx_hal_msp.c* file in the user folders. An *stm32l4xx_hal_msp.c* file template is located in the HAL folder and should be copied to the user folder. It can be generated automatically by STM32CubeMX tool and further modified. Note that all the routines are declared as weak functions and could be overwritten or removed to use user low level initialization code.

stm32l4xx_hal_msp.c file contains the following functions:

Table 15. MSP functions

Routine	Description
void HAL_MspInit()	Global MSP initialization routine
void HAL_MspDeInit()	Global MSP de-initialization routine
void HAL_PPP_MspInit()	PPP MSP initialization routine
void HAL_PPP_MspDeInit()	PPP MSP de-initialization routine

By default, if no peripheral needs to be de-initialized during the program execution, the whole MSP initialization is done in *Hal_MspInit()* and MSP De-Initialization in the *Hal_MspDeInit()*. In this case the *HAL_PPP_MspInit()* and *HAL_PPP_MspDeInit()* are not implemented.

When one or more peripherals needs to be de-initialized in run time and the low level resources of a given peripheral need to be released and used by another peripheral, HAL_PPP_MspDeInit() and *HAL_PPP_MspInit()* are implemented for the concerned peripheral and other peripherals initialization and de-Initialization are kept in the global *HAL_MspInit()* and the *HAL_MspDeInit()*.

If there is nothing to be initialized by the global *HAL_MspInit()* and *HAL_MspDeInit()*, the two routines can simply be omitted.

3.12.3 HAL I/O operation process

The HAL functions with internal data processing like transmit, receive, write and read are generally provided with three data processing modes as follows:

- Polling mode
- Interrupt mode
- DMA mode

3.12.3.1 Polling mode

In Polling mode, the HAL functions return the process status when the data processing in blocking mode is complete. The operation is considered complete when the function returns the HAL_OK status, otherwise an error status is returned. The user can get more information through the *HAL_PPP_GetState()* function. The data processing is handled internally in a loop. A timeout (expressed in ms) is used to prevent process hanging.

The example below shows the typical Polling mode processing sequence :

```
HAL_StatusTypeDef HAL_PPP_Transmit ( PPP_HandleTypeDef * phandle, uint8_t pData,
int16_tSize,uint32_tTimeout)
{
if((pData == NULL ) || (Size == 0))
{
return HAL_ERROR;
}
(…) while (data processing is running)
{
if( timeout reached )
{
return HAL_TIMEOUT;
}
}
(…)
return HAL_OK; }
```

3.12.3.2 *Interrupt mode*

In Interrupt mode, the HAL function returns the process status after starting the data processing and enabling the appropriate interruption. The end of the operation is indicated by a callback declared as a weak function. It can be customized by the user to be informed in real-time about the process completion. The user can also get the process status through the *HAL_PPP_GetState()* function.

In Interrupt mode, four functions are declared in the driver:

- *HAL_PPP_Process_IT()*: launch the process
- *HAL_PPP_IRQHandler()*: the global PPP peripheral interruption
- *__weak HAL_PPP_ProcessCpltCallback ()*: the callback relative to the process completion.
- *__weak HAL_PPP_ProcessErrorCallback()*: the callback relative to the process Error.

To use a process in Interrupt mode, *HAL_PPP_Process_IT()* is called in the user file and HAL_PPP_IRQHandler in *stm32l4xx_it.c.*

The *HAL_PPP_ProcessCpltCallback()* function is declared as weak function in the driver. This means that the user can declare it again in the application. The function in the driver is not modified.

An example of use is illustrated below:

main.c file:

```
UART_HandleTypeDef UartHandle;
int main(void)
{
/* Set User Parameters */
UartHandle.Init.BaudRate = 9600;
UartHandle.Init.WordLength = UART_DATABITS_8;
UartHandle.Init.StopBits = UART_STOPBITS_1;
UartHandle.Init.Parity = UART_PARITY_NONE;
UartHandle.Init.HwFlowCtl = UART_HWCONTROL_NONE;
UartHandle.Init.Mode = UART_MODE_TX_RX;
UartHandle.Init.Instance = USART1;
HAL_UART_Init(&UartHandle);
HAL_UART_SendIT(&UartHandle, TxBuffer, sizeof(TxBuffer));
while (1);
}
void HAL_UART_TxCpltCallback(UART_HandleTypeDef *huart)
{
}
void HAL_UART_ErrorCallback(UART_HandleTypeDef *huart)
{
}
```

*stm32l4xx_it.c*file:

```
extern UART_HandleTypeDef UartHandle;
void USART1_IRQHandler(void)
{
HAL_UART_IRQHandler(&UartHandle);
}
```

3.12.3.3 DMA mode

In DMA mode, the HAL function returns the process status after starting the data processing through the DMA and after enabling the appropriate DMA interruption. The end of the operation is indicated by a callback declared as a weak function and can be customized by the user to be informed in real-time about the process completion. The user can also get the process status through the *HAL_PPP_GetState()* function. For the DMA mode, three functions are declared in the driver:

- *HAL_PPP_Process_DMA()*: launch the process
- *HAL_PPP_DMA_IRQHandler()*: the DMA interruption used by the PPP peripheral
- *__weak HAL_PPP_ProcessCpltCallback()*: the callback relative to the process completion.
- *__weak HAL_PPP_ErrorCpltCallback()*: the callback relative to the process Error.

To use a process in DMA mode, *HAL_PPP_Process_DMA()* is called in the user file and the *HAL_PPP_DMA_IRQHandler()* is placed in the *stm32l4xx_it.c*. When DMA mode is used, the DMA initialization is done in the *HAL_PPP_MspInit()* callback. The user should also associate the DMA handle to the PPP handle. For this purpose, the handles of all the peripheral drivers that use the DMA must be declared as follows:

```
typedef struct
{
PPP_TypeDef *Instance; /* Register base address */
PPP_InitTypeDef Init; /* PPP communication parameters */
HAL_StateTypeDef State; /* PPP communication state */
(…)
DMA_HandleTypeDef *hdma; /* associated DMA handle */
} PPP_HandleTypeDef;
```

The initialization is done as follows (UART example):

```
int main(void)
{
/* Set User Parameters */
UartHandle.Init.BaudRate = 9600;
UartHandle.Init.WordLength = UART_DATABITS_8;
UartHandle.Init.StopBits = UART_STOPBITS_1;
UartHandle.Init.Parity = UART_PARITY_NONE;
UartHandle.Init.HwFlowCtl = UART_HWCONTROL_NONE;
UartHandle.Init.Mode = UART_MODE_TX_RX;
UartHandle.Init.Instance = UART1;
HAL_UART_Init(&UartHandle);
(..)
}
void HAL_USART_MspInit (UART_HandleTypeDef * huart)
{
static DMA_HandleTypeDef hdma_tx;
static DMA_HandleTypeDef hdma_rx;
(…)
__HAL_LINKDMA(UartHandle, DMA_Handle_tx, hdma_tx);
__HAL_LINKDMA(UartHandle, DMA_Handle_rx, hdma_rx);
(…)
}
```

The *HAL_PPP_ProcessCpltCallback()* function is declared as weak function in the driver that means, the user can declare it again in the application code. The function in the driver should not be modified.

An example of use is illustrated below:

main.c file:

```
UART_HandleTypeDef UartHandle;
int main(void)
{
/* Set User Paramaters */
UartHandle.Init.BaudRate = 9600;
UartHandle.Init.WordLength = UART_DATABITS_8;
UartHandle.Init.StopBits = UART_STOPBITS_1;
UartHandle.Init.Parity = UART_PARITY_NONE;
UartHandle.Init.HwFlowCtl = UART_HWCONTROL_NONE;
UartHandle.Init.Mode = UART_MODE_TX_RX; UartHandle.Init.Instance = USART1;
HAL_UART_Init(&UartHandle);
HAL_UART_Send_DMA(&UartHandle, TxBuffer, sizeof(TxBuffer));
while (1);
}
void HAL_UART_TxCpltCallback(UART_HandleTypeDef *phuart)
{
}
void HAL_UART_TxErrorCallback(UART_HandleTypeDef *phuart)
{
}
```

stm32l4xx_it.c file:

```
extern UART_HandleTypeDef UartHandle;
void DMAx_IRQHandler(void)
{
HAL_DMA_IRQHandler(&UartHandle.DMA_Handle_tx);
}
```

HAL_USART_TxCpltCallback() and *HAL_USART_ErrorCallback()* should be linked in the *HAL_PPP_Process_DMA()* function to the DMA transfer complete callback and the DMA transfer Error callback by using the following statement:

```
HAL_PPP_Process_DMA (PPP_HandleTypeDef *hppp, Params….)
{
(…)
hppp->DMA_Handle->XferCpltCallback = HAL_UART_TxCpltCallback ;
hppp->DMA_Handle->XferErrorCallback = HAL_UART_ErrorCallback ;
(…)
}
```

3.12.4 Timeout and error management

3.12.4.1 *Timeout management*

The timeout is often used for the APIs that operate in Polling mode. It defines the delay during which a blocking process should wait till an error is returned. An example is provided below:

```
HAL_StatusTypeDef HAL_DMA_PollForTransfer(DMA_HandleTypeDef *hdma, uint32_t CompleteLevel, ui
nt32_t Timeout)
```

The timeout possible value are the following:

Table 16. Timeout values

Timeout value	Description
0	No poll : Immediate process check and exit
1 ... (HAL_MAX_DELAY -1) (1)	Timeout in ms
HAL_MAX_DELAY	Infinite poll till process is successful

1. *HAL_MAX_DELAY is defined in the stm32l4xx_hal_def.h as 0xFFFFFFFF*

However, in some cases, a fixed timeout is used for system peripherals or internal HAL driver processes. In these cases, the timeout has the same meaning and is used in the same way, except when it is defined locally in the drivers and cannot be modified or introduced as an argument in the user application.

Example of fixed timeout:

```
#define LOCAL_PROCESS_TIMEOUT 100
HAL_StatusTypeDef HAL_PPP_Process(PPP_HandleTypeDef)
{
(…)
timeout = HAL_GetTick() + LOCAL_PROCESS_TIMEOUT;
(…)
while(ProcessOngoing)
{
(…)
if(HAL_GetTick() ≥ timeout)
{
/* Process unlocked */
__HAL_UNLOCK(hppp);
hppp->State= HAL_PPP_STATE_TIMEOUT;
return HAL_PPP_STATE_TIMEOUT;
}
}
(…)
}
```

The following example shows how to use the timeout inside the polling functions:

```
HAL_PPP_StateTypeDef HAL_PPP_Poll (PPP_HandleTypeDef *hppp, uint32_t Timeout)
{
(…)
timeout = HAL_GetTick() + Timeout;
(…)
while(ProcessOngoing)
{
(…)
if(Timeout != HAL_MAX_DELAY)
{
if(HAL_GetTick() ≥ timeout)
{
/* Process unlocked */
__HAL_UNLOCK(hppp);
hppp->State= HAL_PPP_STATE_TIMEOUT;
return hppp->State;
}
}
(…)
}
```

3.12.4.2 *Error management*

The HAL drivers implement a check on the following items:

- Valid parameters: for some process the used parameters should be valid and already defined, otherwise the system may crash or go into an undefined state. These critical parameters are checked before being used (see example below).

```
HAL_StatusTypeDef HAL_PPP_Process(PPP_HandleTypeDef* hppp, uint32_t *pdata, uint32 Size)

{
if ((pData == NULL ) || (Size == 0))
{
return HAL_ERROR;
}
}
```

- Valid handle: the PPP peripheral handle is the most important argument since it keeps the PPP driver vital parameters. It is always checked in the beginning of the *HAL_PPP_Init()* function.

```
HAL_StatusTypeDef HAL_PPP_Init(PPP_HandleTypeDef* hppp)
{
if (hppp == NULL) //the handle should be already allocated
{
return HAL_ERROR;
}
}
```

- Timeout error: the following statement is used when a timeout error occurs:

```
while (Process ongoing)
{
timeout = HAL_GetTick() + Timeout; while (data processing is running)
{
if(timeout) { return HAL_TIMEOUT;
}
}
```

When an error occurs during a peripheral process, *HAL_PPP_Process ()* returns with a *HAL_ERROR* status. The HAL PPP driver implements the *HAL_PPP_GetError ()* to allow retrieving the origin of the error.

```
HAL_PPP_ErrorTypeDef HAL_PPP_GetError (PPP_HandleTypeDef *hppp);
```

In all peripheral handles, a *HAL_PPP_ErrorTypeDef* is defined and used to store the last error code.

```
typedef struct
{
PPP_TypeDef * Instance; /* PPP registers base address */
PPP_InitTypeDef Init; /* PPP initialization parameters */
HAL_LockTypeDef Lock; /* PPP locking object */
__IO HAL_PPP_StateTypeDef State; /* PPP state */
__IO HAL_PPP_ErrorTypeDef ErrorCode; /* PPP Error code */
(…)
/* PPP specific parameters */
}
PPP_HandleTypeDef;
```

The error state and the peripheral global state are always updated before returning an error:

```
PPP->State = HAL_PPP_READY;  /* Set the peripheral ready */
PP->ErrorCode = HAL_ERRORCODE ; /* Set the error code */
_HAL_UNLOCK(PPP) ; /* Unlock the PPP resources */
return HAL_ERROR;  /*return with HAL error */
```

HAL_PPP_GetError () must be used in interrupt mode in the error callback:

```
void HAL_PPP_ProcessCpltCallback(PPP_HandleTypeDef *hspi)
{
ErrorCode = HAL_PPP_GetError (hppp); /* retreive error code */
}
```

3.12.4.3 *Run-time checking*

The HAL implements run-time failure detection by checking the input values of all HAL driver functions. The run-time checking is achieved by using an *assert_param* macro. This macro is used in all the HAL driver functions which have an input parameter. It allows verifying that the input value lies within the parameter allowed values.

To enable the run-time checking, use the *assert_param* macro, and leave the define ***USE_FULL_ASSERT*** uncommented in *stm32l4xx_hal_conf.h* file.

```
void HAL_UART_Init(UART_HandleTypeDef *huart)
{
(..) /* Check the parameters */
assert_param(IS_UART_INSTANCE(huart->Instance));
assert_param(IS_UART_BAUDRATE(huart->Init.BaudRate));
assert_param(IS_UART_WORD_LENGTH(huart->Init.WordLength));
assert_param(IS_UART_STOPBITS(huart->Init.StopBits));
assert_param(IS_UART_PARITY(huart->Init.Parity));
assert_param(IS_UART_MODE(huart->Init.Mode));
assert_param(IS_UART_HARDWARE_FLOW_CONTROL(huart->Init.HwFlowCtl));
(..)
```

```
/** @defgroup UART_Word_Length *
@{
*/
#define UART_WORDLENGTH_8B ((uint32_t)0x00000000)
#define UART_WORDLENGTH_9B ((uint32_t)USART_CR1_M)
#define IS_UART_WORD_LENGTH(LENGTH) (((LENGTH) == UART_WORDLENGTH_8B) ||
\ ((LENGTH) == UART_WORDLENGTH_9B))
```

If the expression passed to the assert_param macro is false, the*assert_failed* function is called and returns the name of the source file and the source line number of the call that failed. If the expression is true, no value is returned.

The *assert_param* macro is implemented in stm32l4xx_hal_conf.h:

```
/* Exported macro ------------------------------------------------------------*/
#ifdef USE_FULL_ASSERT
/**
* @brief The assert_param macro is used for function's parameters check.
* @param expr: If expr is false, it calls assert_failed function
* which reports the name of the source file and the source
* line number of the call that failed.
* If expr is true, it returns no value.
* @retval None */
#define assert_param(expr) ((expr)?(void)0:assert_failed((uint8_t *)__FILE__, __LINE__))
/* Exported functions --------------------------------------*/
void assert_failed(uint8_t* file, uint32_t line);
#else
#define assert_param(expr)((void)0)
#endif /* USE_FULL_ASSERT */
```

The *assert_failed* function is implemented in the main.c file or in any other user C file:

```
#ifdef USE_FULL_ASSERT /**
* @brief Reports the name of the source file and the source line number
* where the assert_param error has occurred.
* @param file: pointer to the source file name
* @param line: assert_param error line source number
* @retval None */
void assert_failed(uint8_t* file, uint32_t line)
{
/* User can add his own implementation to report the file name and line number,
ex: printf("Wrong parameters value: file %s on line %d\r\n", file, line) */
/* Infinite loop */
while (1)
{
}
}
```

Note: ***Because of the overhead run-time checking introduces, it is recommended to use it during application code development and debugging, and to remove it from the final application to improve code size and speed.***

4 Overview of low-layer drivers

The low-layer (LL) drivers are designed to offer a fast light-weight expert-oriented layer which is closer to the hardware than the HAL. Contrary to the HAL, LL APIs are not provided for peripherals where optimized access is not a key feature, or those requiring heavy software configuration and/or complex upper-level stack (such as USB).

The LL drivers feature:

- A set of functions to initialize peripheral main features according to the parameters specified in data structures
- A set of functions used to fill initialization data structures with the reset values of each field
- Functions to perform peripheral de-initialization (peripheral registers restored to their default values)
- A set of inline functions for direct and atomic register access
- Full independence from HAL since LL drivers can be used either in standalone mode (without HAL drivers) or in mixed mode (with HAL drivers)
- Full coverage of the supported peripheral features.

The low-layer drivers provide hardware services based on the available features of the STM32 peripherals. These services reflect exactly the hardware capabilities and provide one-shot operations that must be called following the programming model described in the microcontroller line reference manual. As a result, the LL services do not implement any processing and do not require any additional memory resources to save their states, counter or data pointers: all the operations are performed by changing the associated peripheral registers content.

4.1 Low-layer files

The low-layer drivers are built around header/C files (one per each supported peripheral) plus five header files for some System and Cortex related features.

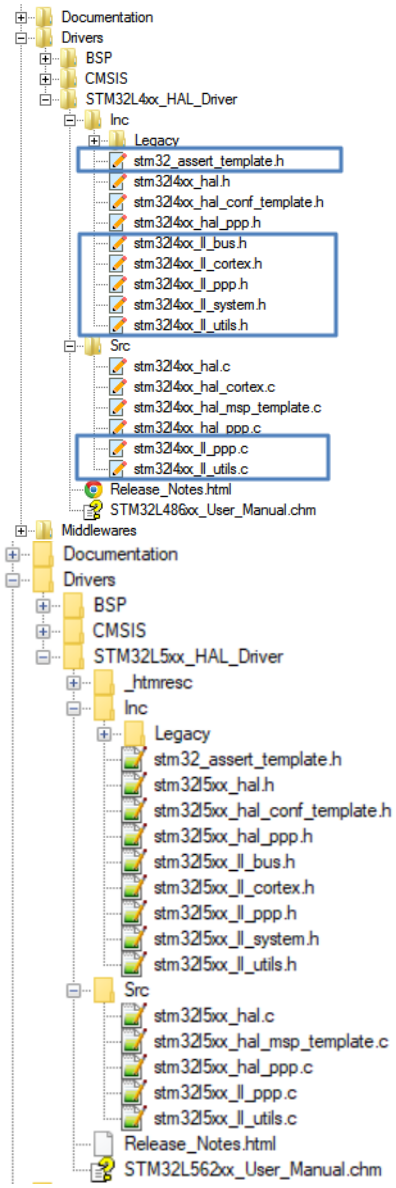
Table 17. LL driver files

File	Description
stm32l4xx_ll_bus.h	This is the h-source file for core bus control and peripheral clock activation and deactivation *Example: LL_AHB2_GRP1_EnableClock*
stm32l4xx_ll_ppp.h/.c	stm32l4xx_ll_ppp.c provides peripheral initialization functions such as LL_PPP_Init(), LL_PPP_StructInit(), LL_PPP_DeInit(). All the other APIs are definined within stm32l4xx_ll_ppp.h file. The low-layer PPP driver is a standalone module. To use it, the application must include it in the stm32l4xx_ll_ppp.h file.
stm32l4xx_ll_cortex.h	Cortex-M related register operation APIs including the Systick, Low power (LL_SYSTICK_xxxxx, LL_LPM_xxxxx "Low Power Mode" ...)
stm32l4xx_ll_utils.h/.c	This file covers the generic APIs: • Read of device unique ID and electronic signature • Timebase and delay management • System clock configuration.
stm32l4xx_ll_system.h	System related operations. Example: LL_SYSCFG_xxx, LL_DBGMCU_xxx and LL_FLASH_xxx and LL_VREFBUF_xxx
stm32_assert_template.h	Template file allowing to define the assert_param macro, that is used when run-time checking is enabled. This file is required only when the LL drivers are used in standalone mode (without calling the HAL APIs). It should be copied to the application folder and renamed to stm32_assert.h.

Note: There is no configuration file for the LL drivers.

The low-layer files are located in the same HAL driver folder.

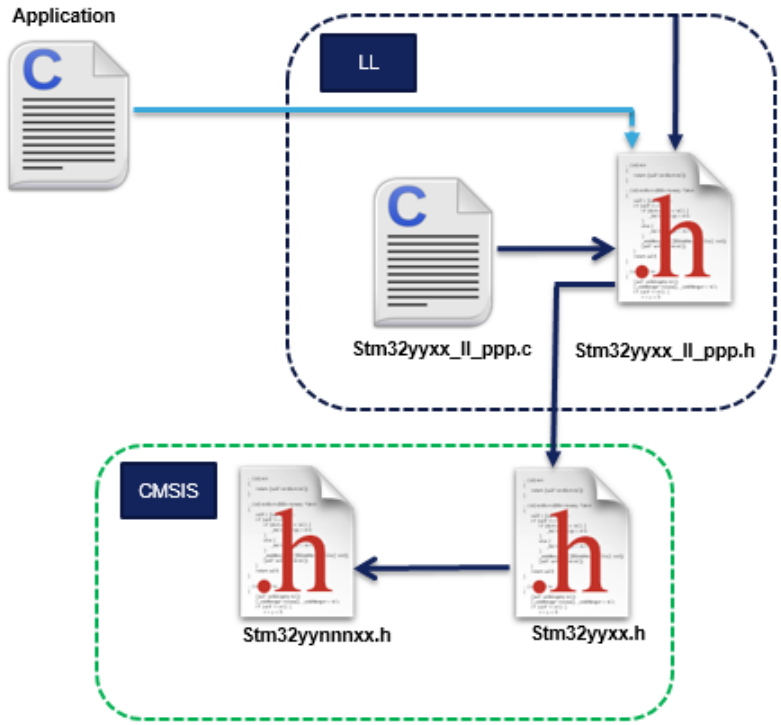
Figure 8. Low-layer driver folders



In general, low-layer drivers include only the STM32 CMSIS device file.

```
#include "stm32yyxx.h"
```

Figure 9. **Low-layer driver CMSIS files**



Application files have to include only the used low-layer driver header files.

4.2 Overview of low-layer APIs and naming rules

4.2.1 Peripheral initialization functions

The LL drivers offer three sets of initialization functions. They are defined in stm32l4xx_ll_ppp.c file:

- Functions to initialize peripheral main features according to the parameters specified in data structures
- A set of functions used to fill initialization data structures with the reset values of each field
- Function for peripheral de-initialization (peripheral registers restored to their default values)

The definition of these LL initialization functions and associated resources (structure, literals and prototypes) is conditioned by a compilation switch: *USE_FULL_LL_DRIVER*. To use these functions, this switch must be added in the toolchain compiler preprocessor or to any generic header file which is processed before the LL drivers.

The below table shows the list of the common functions provided for all the supported peripherals:

Table 18. **Common peripheral initialization functions**

Functions	Return Type	Parameters	Description
LL_PPP_Init	*ErrorStatus*	• *PPP_TypeDef* PPPx* • *LL_PPP_InitTypeDef* PPP_InitStruct*	Initializes the peripheral main features according to the parameters specified in PPP_InitStruct. Example: LL_USART_Init(USART_TypeDef *USARTx, LL_USART_InitTypeDef *USART_InitStruct)
LL_PPP_StructInit	*void*	• *LL_PPP_InitTypeDef* PPP_InitStruct*	Fills each PPP_InitStruct member with its default value. Example. LL_USART_StructInit(LL_USART_InitTypeDef *USART_InitStruct)

Functions	Return Type	Parameters	Description
LL_PPP_DeInit	*ErrorStatus*	• *PPP_TypeDef* PPPx*	De-initializes the peripheral registers, that is restore them to their default reset values. Example. LL_USART_DeInit(USART_TypeDef *USARTx)

Additional functions are available for some peripherals (refer to Table 19. Optional peripheral initialization functions).

Table 19. Optional peripheral initialization functions

Functions	Return Type	Parameters	Examples
LL_PPP{_CATEGORY}_Init	*ErrorStatus*	• *PPP_TypeDef* PPPx* • *LL_PPP{_CATEGORY}_InitTypeDef* PPP{_CATEGORY}_InitStruct*	Initializes peripheral features according to the parameters specified in PPP_InitStruct. Example: LL_ADC_INJ_Init(ADC_TypeDef *ADCx, LL_ADC_INJ_InitTypeDef *ADC_INJ_InitStruct) LL_RTC_TIME_Init(RTC_TypeDef *RTCx, uint32_t RTC_Format, LL_RTC_TimeTypeDef *RTC_TimeStruct) LL_RTC_DATE_Init(RTC_TypeDef *RTCx, uint32_t RTC_Format, LL_RTC_DateTypeDef *RTC_DateStruct) LL_TIM_IC_Init(TIM_TypeDef* TIMx, uint32_t Channel, LL_TIM_IC_InitTypeDef* TIM_IC_InitStruct) LL_TIM_ENCODER_Init(TIM_TypeDef* TIMx, LL_TIM_ENCODER_InitTypeDef* TIM_EncoderInitStruct)
LL_PPP{_CATEGORY}_StructInit	*void*	*LL_PPP{_CATEGORY}_InitTypeDef* PPP{_CATEGORY}_InitStruct*	Fills each *PPP{_CATEGORY}_InitStruct* member with its default value. Example: LL_ADC_INJ_StructInit(LL_ADC_INJ_InitTypeDef *ADC_INJ_InitStruct)
LL_PPP_CommonInit	*ErrorStatus*	• *PPP_TypeDef* PPPx* • *LL_PPP_CommonInitTypeDef* PPP_CommonInitStruct*	Initializes the common features shared between different instances of the same peripheral. Example: LL_ADC_CommonInit(ADC_Common_TypeDef *ADCxy_COMMON, LL_ADC_CommonInitTypeDef *ADC_CommonInitStruct)
LL_PPP_CommonStructInit	*void*	*LL_PPP_CommonInitTypeDef* PPP_CommonInitStruct*	Fills each *PPP_CommonInitStruct* member with its default value Example: LL_ADC_CommonStructInit(LL_ADC_CommonInitTypeDef *ADC_CommonInitStruct)
LL_PPP_ClockInit	*ErrorStatus*	• *PPP_TypeDef* PPPx* • *LL_PPP_ClockInitTypeDef* PPP_ClockInitStruct*	Initializes the peripheral clock configuration in synchronous mode. Example: LL_USART_ClockInit(USART_TypeDef *USARTx, LL_USART_ClockInitTypeDef *USART_ClockInitStruct)
LL_PPP_ClockStructInit	*void*	*LL_PPP_ClockInitTypeDef* PPP_ClockInitStruct*	Fills each *PPP_ClockInitStruct* member with its default value Example: LL_USART_ClockStructInit(LL_USART_ClockInitTypeDef *USART_ClockInitStruct)

4.2.1.1 *Run-time checking*

Like HAL drivers, LL initialization functions implement run-time failure detection by checking the input values of all LL driver functions. For more details please refer to Section 3.12.4.3 Run-time checking.

When using the LL drivers in standalone mode (without calling HAL functions), the following actions are required to use run-time checking:

1. Copy stm32_assert_template.h to the application folder and rename it to stm32_assert.h. This file defines the assert_param macro which is used when run-time checking is enabled.
2. Include stm32_assert.h file within the application main header file.
3. Add the USE_FULL_ASSERT compilation switch in the toolchain compiler preprocessor or in any generic header file which is processed before the stm32_assert.h driver.

Note: Run-time checking is not available for LL inline functions.

4.2.2 Peripheral register-level configuration functions

On top of the peripheral initialization functions, the LL drivers offer a set of inline functions for direct atomic register access. Their format is as follows:

```
__STATIC_INLINE return_type LL_PPP_Function (PPPx_TypeDef *PPPx, args)
```

The “Function” naming is defined depending to the action category:

- **Specific Interrupt, DMA request and status flags management**: Set/Get/Clear/Enable/Disable flags on interrupt and status registers

Table 20. Specific Interrupt, DMA request and status flags management

Name	Examples
LL_PPP_{_CATEGORY}_ActionItem_BITNAME *LL_PPP{_CATEGORY}_IsItem_BITNAME_Action*	• LL_RCC_IsActiveFlag_LSIRDY • LL_RCC_IsActiveFlag_FWRST() • LL_ADC_ClearFlag_EOC(ADC1) • LL_DMA_ClearFlag_TCx(DMA_TypeDef* DMAx)

Table 21. Available function formats

Item	Action	Format
Flag	Get	*LL_PPP_IsActiveFlag_BITNAME*
	Clear	*LL_PPP_ClearFlag_BITNAME*
Interrupts	Enable	*LL_PPP_EnableIT_BITNAME*
	Disable	*LL_PPP_DisableIT_BITNAME*
	Get	*LL_PPP_IsEnabledIT_BITNAME*
DMA	Enable	*LL_PPP_EnableDMAReq_BITNAME*
	Disable	*LL_PPP_DisableDMAReq_BITNAME*
	Get	*LL_PPP_IsEnabledDMAReq_BITNAME*

Note: BITNAME refers to the peripheral register bit name as described in the product line reference manual.

- **Peripheral clock activation/deactivation management**: Enable/Disable/Reset a peripheral clock

Table 22. Peripheral clock activation/deactivation management

Name	Examples
LL_BUS_GRPx_ActionClock{Mode}	• *LL_AHB2_GRP1_EnableClock (LL_AHB2_GRP1_PERIPH_GPIOA| LL_AHB2_GRP1_PERIPH_GPIOB)*

Name	Examples
	• *LL_APB1_GRP1_EnableClockSleep (LL_APB1_GRP1_PERIPH_DAC1)*

Note: 'x' corresponds to the group index and refers to the index of the modified register on a given bus. 'bus' corresponds to the bus name.

- ***Peripheral activation/deactivation management*** : Enable/disable a peripheral or activate/deactivate specific peripheral features

Table 23. Peripheral activation/deactivation management

Name	Examples
LL_PPP{_CATEGORY}_Action{Item} *LL_PPP{_CATEGORY}_IsItemAction*	• *LL_ADC_Enable ()* • *LL_ADC_StartCalibration();* • *LL_ADC_IsCalibrationOnGoing;* • *LL_RCC_HSI_Enable ()* • *LL_RCC_HSI_IsReady()*

- ***Peripheral configuration management*** : Set/get a peripheral configuration settings

Table 24. Peripheral configuration management

Name	Examples
LL_PPP{_CATEGORY}_Set{ or Get}ConfigItem	*LL_USART_SetBaudRate (USART2, Clock, LL_USART_BAUDRATE_9600)*

- ***Peripheral register management*** : Write/read the content of a register/retrun DMA relative register address

Table 25. Peripheral register management

Name
LL_PPP_WriteReg(__INSTANCE__, __REG__, __VALUE__)
LL_PPP_ReadReg(__INSTANCE__, __REG__)
*LL_PPP_DMA_GetRegAddr (PPP_TypeDef *PPPx,{Sub Instance if any ex: Channel} , {uint32_t Propriety})*

Note: The Propriety is a variable used to identify the DMA transfer direction or the data register type.

5 Cohabiting of HAL and LL

The low-ayer APIs are designed to be used in standalone mode or combined with the HAL. They cannot be automatically used with the HAL for the same peripheral instance. If you use the LL APIs for a specific instance, you can still use the HAL APIs for other instances. Be careful that the low-layer APIs might overwrite some registers which content is mirrored in the HAL handles.

5.1 Low-layer driver used in Standalone mode

The low-layer APIs can be used without calling the HAL driver services. This is done by simply including stm32l4xx_ll_ppp.h in the application files. The LL APIs for a given peripheral are called by executing the same sequence as the one recommended by the programming model in the corresponding product line reference manual. In this case the HAL drivers associated to the used peripheral can be removed from the workspace. However the STM32CubeL4 framework should be used in the same way as in the HAL drivers case which means that System file, startup file and CMSIS should always be used.

Note: When the BSP drivers are included, the used HAL drivers associated with the BSP functions drivers should be included in the workspace, even if they are not used by the application layer.

5.2 Mixed use of low-layer APIs and HAL drivers

In this case the low-layer APIs are used in conjunction with the HAL drivers to achieve direct and register level based operations.

Mixed use is allowed, however some consideration should be taken into account:

- It is recommended to avoid using simultaneously the HAL APIs and the combination of low-layer APIs for a given peripheral instance. If this is the case, one or more private fields in the HAL PPP handle structure should be updated accordingly.
- For operations and processes that do not alter the handle fields including the initialization structure, the HAL driver APIs and the low-layer services can be used together for the same peripheral instance.
- The low-layer drivers can be used without any restriction with all the HAL drivers that are not based on handle objects (RCC, common HAL, flash and GPIO).

Several examples showing how to use HAL and LL in the same application are provided within stm32l4 firmware package (refer to Examples_MIX projects).

Note:

1. *When the HAL Init/DeInit APIs are not used and are replaced by the low-layer macros, the InitMsp() functions are not called and the MSP initialization should be done in the user application.*
2. *When process APIs are not used and the corresponding function is performed through the low-layer APIs, the callbacks are not called and post processing or error management should be done by the user application.*
3. *When the LL APIs is used for process operations, the IRQ handler HAL APIs cannot be called and the IRQ should be implemented by the user application. Each LL driver implements the macros needed to read and clear the associated interrupt flags.*

6 HAL System Driver

6.1 HAL Firmware driver API description

The following section lists the various functions of the HAL library.

6.1.1 How to use this driver

The common HAL driver contains a set of generic and common APIs that can be used by the PPP peripheral drivers and the user to start using the HAL.

The HAL contains two APIs' categories:

- Common HAL APIs
- Services HAL APIs

6.1.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the Flash interface, the NVIC allocation and initial time base clock configuration.
- De-initialize common part of the HAL.
- Configure the time base source to have 1ms time base with a dedicated Tick interrupt priority.
  - SysTick timer is used by default as source of time base, but user can eventually implement his proper time base source (a general purpose timer for example or other time source), keeping in mind that Time base duration should be kept 1ms since PPP_TIMEOUT_VALUEs are defined and handled in milliseconds basis.
  - Time base configuration function (HAL_InitTick ()) is called automatically at the beginning of the program after reset by HAL_Init() or at any time when clock is configured, by HAL_RCC_ClockConfig().
  - Source of time base is configured to generate interrupts at regular time intervals. Care must be taken if HAL_Delay() is called from a peripheral ISR process, the Tick interrupt line must have higher priority (numerically lower) than the peripheral interrupt. Otherwise the caller ISR process will be blocked.
  - functions affecting time base configurations are declared as __weak to make override possible in case of other implementations in user file.

This section contains the following APIs:

- ***HAL_Init***
- ***HAL_DeInit***
- ***HAL_MspInit***
- ***HAL_MspDeInit***
- ***HAL_InitTick***

6.1.3 HAL Control functions

This section provides functions allowing to:

- Provide a tick value in millisecond
- Provide a blocking delay in millisecond
- Suspend the time base source interrupt
- Resume the time base source interrupt
- Get the HAL API driver version
- Get the device identifier
- Get the device revision identifier

This section contains the following APIs:

- ***HAL_IncTick***
- ***HAL_GetTick***
- ***HAL_GetTickPrio***

- *HAL_SetTickFreq*
- *HAL_GetTickFreq*
- *HAL_Delay*
- *HAL_SuspendTick*
- *HAL_ResumeTick*
- *HAL_GetHalVersion*
- *HAL_GetREVID*
- *HAL_GetDEVID*
- *HAL_GetUIDw0*
- *HAL_GetUIDw1*
- *HAL_GetUIDw2*

6.1.4 HAL Debug functions

This section provides functions allowing to:

- Enable/Disable Debug module during SLEEP mode
- Enable/Disable Debug module during STOP0/STOP1/STOP2 modes
- Enable/Disable Debug module during STANDBY mode

This section contains the following APIs:

- *HAL_DBGMCU_EnableDBGSleepMode*
- *HAL_DBGMCU_DisableDBGSleepMode*
- *HAL_DBGMCU_EnableDBGStopMode*
- *HAL_DBGMCU_DisableDBGStopMode*
- *HAL_DBGMCU_EnableDBGStandbyMode*
- *HAL_DBGMCU_DisableDBGStandbyMode*

6.1.5 HAL SYSCFG configuration functions

This section provides functions allowing to:

- Start a hardware SRAM2 erase operation
- Enable/Disable the Internal FLASH Bank Swapping
- Configure the Voltage reference buffer
- Enable/Disable the Voltage reference buffer
- Enable/Disable the I/O analog switch voltage booster

This section contains the following APIs:

- *HAL_SYSCFG_SRAM2Erase*
- *HAL_SYSCFG_EnableMemorySwappingBank*
- *HAL_SYSCFG_DisableMemorySwappingBank*
- *HAL_SYSCFG_VREFBUF_VoltageScalingConfig*
- *HAL_SYSCFG_VREFBUF_HighImpedanceConfig*
- *HAL_SYSCFG_VREFBUF_TrimmingConfig*
- *HAL_SYSCFG_EnableVREFBUF*
- *HAL_SYSCFG_DisableVREFBUF*
- *HAL_SYSCFG_EnableIOAnalogSwitchBooster*
- *HAL_SYSCFG_DisableIOAnalogSwitchBooster*

6.1.6 Detailed description of functions

`HAL_Init`

Function name

HAL_StatusTypeDef HAL_Init (void)

Function description

Configure the Flash prefetch, the Instruction and Data caches, the time base source, NVIC and any required global low level hardware by calling the HAL_MspInit() callback function to be optionally defined in user file stm32l4xx_hal_msp.c.

Return values

- **HAL:** status

Notes

- HAL_Init() function is called at the beginning of program after reset and before the clock configuration.
- In the default implementation the System Timer (Systick) is used as source of time base. The Systick configuration is based on MSI clock, as MSI is the clock used after a system Reset and the NVIC configuration is set to Priority group 4. Once done, time base tick starts incrementing: the tick variable counter is incremented each 1ms in the SysTick_Handler() interrupt handler.

`HAL_DeInit`

Function name

HAL_StatusTypeDef HAL_DeInit (void)

Function description

De-initialize common part of the HAL and stop the source of time base.

Return values

- **HAL:** status

Notes

- This function is optional.

`HAL_MspInit`

Function name

void HAL_MspInit (void)

Function description

Initialize the MSP.

Return values

- **None:**

`HAL_MspDeInit`

Function name

void HAL_MspDeInit (void)

Function description

DeInitialize the MSP.

Return values

- **None:**

HAL_InitTick

Function name

HAL_StatusTypeDef HAL_InitTick (uint32_t TickPriority)

Function description

This function configures the source of the time base: The time source is configured to have 1ms time base with a dedicated Tick interrupt priority.

Parameters

- **TickPriority:** Tick interrupt priority.

Return values

- **HAL:** status

Notes

- This function is called automatically at the beginning of program after reset by HAL_Init() or at any time when clock is reconfigured by HAL_RCC_ClockConfig().
- In the default implementation, SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals. Care must be taken if HAL_Delay() is called from a peripheral ISR process, The SysTick interrupt must have higher priority (numerically lower) than the peripheral interrupt. Otherwise the caller ISR process will be blocked. The function is declared as __weak to be overwritten in case of other implementation in user file.

HAL_IncTick

Function name

void HAL_IncTick (void)

Function description

This function is called to increment a global variable "uwTick" used as application time base.

Return values

- **None:**

Notes

- In the default implementation, this variable is incremented each 1ms in SysTick ISR.
- This function is declared as __weak to be overwritten in case of other implementations in user file.

HAL_Delay

Function name

void HAL_Delay (uint32_t Delay)

Function description

This function provides minimum delay (in milliseconds) based on variable incremented.

Parameters

- **Delay:** specifies the delay time length, in milliseconds.

Return values

- **None:**

Notes

- In the default implementation , SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals where uwTick is incremented.
- This function is declared as __weak to be overwritten in case of other implementations in user file.

`HAL_GetTick`

Function name

uint32_t HAL_GetTick (void)

Function description

Provide a tick value in millisecond.

Return values

- **tick:** value

Notes

- This function is declared as __weak to be overwritten in case of other implementations in user file.

`HAL_GetTickPrio`

Function name

uint32_t HAL_GetTickPrio (void)

Function description

This function returns a tick priority.

Return values

- **tick:** priority

`HAL_SetTickFreq`

Function name

HAL_StatusTypeDef HAL_SetTickFreq (uint32_t Freq)

Function description

Set new tick Freq.

Parameters

- **Freq:** tick frequency

Return values

- **HAL:** status

`HAL_GetTickFreq`

Function name

uint32_t HAL_GetTickFreq (void)

Function description

Return tick frequency.

Return values

- **tick:** period in Hz

HAL_SuspendTick

Function name

void HAL_SuspendTick (void)

Function description

Suspend Tick increment.

Return values

- **None:**

Notes

- In the default implementation , SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals. Once HAL_SuspendTick() is called, the SysTick interrupt will be disabled and so Tick increment is suspended.
- This function is declared as __weak to be overwritten in case of other implementations in user file.

HAL_ResumeTick

Function name

void HAL_ResumeTick (void)

Function description

Resume Tick increment.

Return values

- **None:**

Notes

- In the default implementation , SysTick timer is the source of time base. It is used to generate interrupts at regular time intervals. Once HAL_ResumeTick() is called, the SysTick interrupt will be enabled and so Tick increment is resumed.
- This function is declared as __weak to be overwritten in case of other implementations in user file.

HAL_GetHalVersion

Function name

uint32_t HAL_GetHalVersion (void)

Function description

Return the HAL revision.

Return values

- **version:** : 0xXYZR (8bits for each decimal, R for RC)

HAL_GetREVID

Function name

uint32_t HAL_GetREVID (void)

Function description

Return the device revision identifier.

Return values

- **Device:** revision identifier

HAL_GetDEVID

Function name

uint32_t HAL_GetDEVID (void)

Function description

Return the device identifier.

Return values

- **Device:** identifier

HAL_GetUIDw0

Function name

uint32_t HAL_GetUIDw0 (void)

Function description

Return the first word of the unique device identifier (UID based on 96 bits)

Return values

- **Device:** identifier

HAL_GetUIDw1

Function name

uint32_t HAL_GetUIDw1 (void)

Function description

Return the second word of the unique device identifier (UID based on 96 bits)

Return values

- **Device:** identifier

HAL_GetUIDw2

Function name

uint32_t HAL_GetUIDw2 (void)

Function description

Return the third word of the unique device identifier (UID based on 96 bits)

Return values

- **Device:** identifier

HAL_DBGMCU_EnableDBGSleepMode

Function name

void HAL_DBGMCU_EnableDBGSleepMode (void)

Function description

Enable the Debug Module during SLEEP mode.

Return values

- **None:**

HAL_DBGMCU_DisableDBGSleepMode

Function name

void HAL_DBGMCU_DisableDBGSleepMode (void)

Function description

Disable the Debug Module during SLEEP mode.

Return values

- **None:**

HAL_DBGMCU_EnableDBGStopMode

Function name

void HAL_DBGMCU_EnableDBGStopMode (void)

Function description

Enable the Debug Module during STOP0/STOP1/STOP2 modes.

Return values

- **None:**

HAL_DBGMCU_DisableDBGStopMode

Function name

void HAL_DBGMCU_DisableDBGStopMode (void)

Function description

Disable the Debug Module during STOP0/STOP1/STOP2 modes.

Return values

- **None:**

HAL_DBGMCU_EnableDBGStandbyMode

Function name

void HAL_DBGMCU_EnableDBGStandbyMode (void)

Function description

Enable the Debug Module during STANDBY mode.

Return values

- **None:**

HAL_DBGMCU_DisableDBGStandbyMode

Function name

void HAL_DBGMCU_DisableDBGStandbyMode (void)

Function description

Disable the Debug Module during STANDBY mode.

Return values

- **None:**

HAL_SYSCFG_SRAM2Erase

Function name

void HAL_SYSCFG_SRAM2Erase (void)

Function description

Start a hardware SRAM2 erase operation.

Return values

- **None:**

Notes

- As long as SRAM2 is not erased the SRAM2ER bit will be set. This bit is automatically reset at the end of the SRAM2 erase operation.

HAL_SYSCFG_EnableMemorySwappingBank

Function name

void HAL_SYSCFG_EnableMemorySwappingBank (void)

Function description

Enable the Internal FLASH Bank Swapping.

Return values

- **None:**

Notes

- This function can be used only for STM32L4xx devices.
- Flash Bank2 mapped at 0x08000000 (and aliased @0x00000000) and Flash Bank1 mapped at 0x08100000 (and aliased at 0x00100000)

HAL_SYSCFG_DisableMemorySwappingBank

Function name

void HAL_SYSCFG_DisableMemorySwappingBank (void)

Function description

Disable the Internal FLASH Bank Swapping.

Return values

- **None:**

Notes

- This function can be used only for STM32L4xx devices.
- The default state : Flash Bank1 mapped at 0x08000000 (and aliased @0x0000 0000) and Flash Bank2 mapped at 0x08100000 (and aliased at 0x00100000)

HAL_SYSCFG_VREFBUF_VoltageScalingConfig

Function name

void HAL_SYSCFG_VREFBUF_VoltageScalingConfig (uint32_t VoltageScaling)

Function description

Configure the internal voltage reference buffer voltage scale.

Parameters

- **VoltageScaling:** specifies the output voltage to achieve This parameter can be one of the following values:
  - SYSCFG_VREFBUF_VOLTAGE_SCALE0: VREF_OUT1 around 2.048 V. This requires VDDA equal to or higher than 2.4 V.
  - SYSCFG_VREFBUF_VOLTAGE_SCALE1: VREF_OUT2 around 2.5 V. This requires VDDA equal to or higher than 2.8 V.

Return values

- **None:**

`HAL_SYSCFG_VREFBUF_HighImpedanceConfig`

Function name

void HAL_SYSCFG_VREFBUF_HighImpedanceConfig (uint32_t Mode)

Function description

Configure the internal voltage reference buffer high impedance mode.

Parameters

- **Mode:** specifies the high impedance mode This parameter can be one of the following values:
  - SYSCFG_VREFBUF_HIGH_IMPEDANCE_DISABLE: VREF+ pin is internally connect to VREFINT output.
  - SYSCFG_VREFBUF_HIGH_IMPEDANCE_ENABLE: VREF+ pin is high impedance.

Return values

- **None:**

`HAL_SYSCFG_VREFBUF_TrimmingConfig`

Function name

void HAL_SYSCFG_VREFBUF_TrimmingConfig (uint32_t TrimmingValue)

Function description

Tune the Internal Voltage Reference buffer (VREFBUF).

Return values

- **None:**

`HAL_SYSCFG_EnableVREFBUF`

Function name

HAL_StatusTypeDef HAL_SYSCFG_EnableVREFBUF (void)

Function description

Enable the Internal Voltage Reference buffer (VREFBUF).

Return values

- **HAL_OK/HAL_TIMEOUT:**

`HAL_SYSCFG_DisableVREFBUF`

Function name

void HAL_SYSCFG_DisableVREFBUF (void)

Function description

Disable the Internal Voltage Reference buffer (VREFBUF).

Return values

- **None:**

`HAL_SYSCFG_EnableIOAnalogSwitchBooster`

Function name

void HAL_SYSCFG_EnableIOAnalogSwitchBooster (void)

Function description

Enable the I/O analog switch voltage booster.

Return values

- **None:**

`HAL_SYSCFG_DisableIOAnalogSwitchBooster`

Function name

void HAL_SYSCFG_DisableIOAnalogSwitchBooster (void)

Function description

Disable the I/O analog switch voltage booster.

Return values

- **None:**

6.2 HAL Firmware driver defines

The following section lists the various define and macros of the module.

6.2.1 HAL

HAL

DBGMCU Exported Macros

__HAL_DBGMCU_FREEZE_TIM2

__HAL_DBGMCU_UNFREEZE_TIM2

__HAL_DBGMCU_FREEZE_TIM3

__HAL_DBGMCU_UNFREEZE_TIM3

__HAL_DBGMCU_FREEZE_TIM4

__HAL_DBGMCU_UNFREEZE_TIM4

__HAL_DBGMCU_FREEZE_TIM5

__HAL_DBGMCU_UNFREEZE_TIM5

__HAL_DBGMCU_FREEZE_TIM6

__HAL_DBGMCU_UNFREEZE_TIM6

__HAL_DBGMCU_FREEZE_TIM7

__HAL_DBGMCU_UNFREEZE_TIM7

__HAL_DBGMCU_FREEZE_RTC

__HAL_DBGMCU_UNFREEZE_RTC

__HAL_DBGMCU_FREEZE_WWDG

__HAL_DBGMCU_UNFREEZE_WWDG

__HAL_DBGMCU_FREEZE_IWDG

__HAL_DBGMCU_UNFREEZE_IWDG

__HAL_DBGMCU_FREEZE_I2C1_TIMEOUT

__HAL_DBGMCU_UNFREEZE_I2C1_TIMEOUT

__HAL_DBGMCU_FREEZE_I2C2_TIMEOUT

__HAL_DBGMCU_UNFREEZE_I2C2_TIMEOUT

__HAL_DBGMCU_FREEZE_I2C3_TIMEOUT

__HAL_DBGMCU_UNFREEZE_I2C3_TIMEOUT

__HAL_DBGMCU_FREEZE_I2C4_TIMEOUT

__HAL_DBGMCU_UNFREEZE_I2C4_TIMEOUT

__HAL_DBGMCU_FREEZE_CAN1

__HAL_DBGMCU_UNFREEZE_CAN1

__HAL_DBGMCU_FREEZE_LPTIM1

__HAL_DBGMCU_UNFREEZE_LPTIM1

__HAL_DBGMCU_FREEZE_LPTIM2

__HAL_DBGMCU_UNFREEZE_LPTIM2

__HAL_DBGMCU_FREEZE_TIM1

__HAL_DBGMCU_UNFREEZE_TIM1

__HAL_DBGMCU_FREEZE_TIM8

__HAL_DBGMCU_UNFREEZE_TIM8

__HAL_DBGMCU_FREEZE_TIM15

__HAL_DBGMCU_UNFREEZE_TIM15

__HAL_DBGMCU_FREEZE_TIM16

__HAL_DBGMCU_UNFREEZE_TIM16

__HAL_DBGMCU_FREEZE_TIM17

__HAL_DBGMCU_UNFREEZE_TIM17

HAL state definition

HAL_SMBUS_STATE_RESET

SMBUS not yet initialized or disabled

HAL_SMBUS_STATE_READY

SMBUS initialized and ready for use

HAL_SMBUS_STATE_BUSY

SMBUS internal process is ongoing

HAL_SMBUS_STATE_MASTER_BUSY_TX

Master Data Transmission process is ongoing

HAL_SMBUS_STATE_MASTER_BUSY_RX

Master Data Reception process is ongoing

HAL_SMBUS_STATE_SLAVE_BUSY_TX

Slave Data Transmission process is ongoing

HAL_SMBUS_STATE_SLAVE_BUSY_RX

Slave Data Reception process is ongoing

HAL_SMBUS_STATE_TIMEOUT

Timeout state

HAL_SMBUS_STATE_ERROR

Reception process is ongoing

HAL_SMBUS_STATE_LISTEN

Address Listen Mode is ongoing

Tick Frequency

HAL_TICK_FREQ_10HZ

HAL_TICK_FREQ_100HZ

HAL_TICK_FREQ_1KHZ

HAL_TICK_FREQ_DEFAULT

Boot Mode

SYSCFG_BOOT_MAINFLASH

SYSCFG_BOOT_SYSTEMFLASH

SYSCFG_BOOT_FMC

SYSCFG_BOOT_SRAM

SYSCFG_BOOT_OCTOPSPI1

SYSCFG_BOOT_OCTOPSPI2

SYSCFG Exported Macros

__HAL_SYSCFG_REMAPMEMORY_FLASH

__HAL_SYSCFG_REMAPMEMORY_SYSTEMFLASH

__HAL_SYSCFG_REMAPMEMORY_SRAM

__HAL_SYSCFG_REMAPMEMORY_FMC

__HAL_SYSCFG_REMAPMEMORY_OCTOSPI1

__HAL_SYSCFG_REMAPMEMORY_OCTOSPI2

__HAL_SYSCFG_GET_BOOT_MODE

Description:

- Return the boot mode as configured by user.

Return value:

- The: boot mode as configured by user. The returned value can be one of the following values:
  - SYSCFG_BOOT_MAINFLASH
  - SYSCFG_BOOT_SYSTEMFLASH
  - SYSCFG_BOOT_SRAM

__HAL_SYSCFG_SRAM2_WRP_1_31_ENABLE

Description:

- SRAM2 page 0 to 31 write protection enable macro.

Parameters:

- __SRAM2WRP__: This parameter can be a combination of values of

Notes:

- Write protection can only be disabled by a system reset

__HAL_SYSCFG_SRAM2_WRP_32_63_ENABLE

Description:

- SRAM2 page 32 to 63 write protection enable macro.

Parameters:

- __SRAM2WRP__: This parameter can be a combination of values of

Notes:

- Write protection can only be disabled by a system reset

__HAL_SYSCFG_SRAM2_WRP_UNLOCK

Notes:

- Writing a wrong key reactivates the write protection

__HAL_SYSCFG_SRAM2_ERASE

Notes:

- __SYSCFG_GET_FLAG(SYSCFG_FLAG_SRAM2_BUSY) may be used to check end of erase

__HAL_SYSCFG_FPU_INTERRUPT_ENABLE

Description:

- Floating Point Unit interrupt enable/disable macros.

Parameters:

- __INTERRUPT__: This parameter can be a value of

__HAL_SYSCFG_FPU_INTERRUPT_DISABLE

__HAL_SYSCFG_BREAK_ECC_LOCK

Notes:

- The selected configuration is locked and can be unlocked only by system reset.

Enable and lock the connection of Flash ECC error connection to TIM1/8/15/16/17 Break input.

__HAL_SYSCFG_BREAK_LOCKUP_LOCK

Notes:

- The selected configuration is locked and can be unlocked only by system reset.

Enable and lock the connection of Cortex-M4 LOCKUP (Hardfault) output to TIM1/8/15/16/17 Break input.

__HAL_SYSCFG_BREAK_PVD_LOCK

Notes:

- The selected configuration is locked and can be unlocked only by system reset.

Enable and lock the PVD connection to Timer1/8/15/16/17 Break input, as well as the PVDE and PLS[2:0] in the PWR_CR2 register.

__HAL_SYSCFG_BREAK_SRAM2PARITY_LOCK

Notes:

- The selected configuration is locked and can be unlocked by system reset.

Enable and lock the SRAM2 parity error signal connection to TIM1/8/15/16/17 Break input.

__HAL_SYSCFG_GET_FLAG

Description:

- Check SYSCFG flag is set or not.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SYSCFG_FLAG_SRAM2_PE SRAM2 Parity Error Flag
  - SYSCFG_FLAG_SRAM2_BUSY SRAM2 Erase Ongoing

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_SYSCFG_CLEAR_FLAG

__HAL_SYSCFG_FASTMODEPLUS_ENABLE

Description:

- Fast-mode Plus driving capability enable/disable macros.

Parameters:

- __FASTMODEPLUS__: This parameter can be a value of :
  - SYSCFG_FASTMODEPLUS_PB6 Fast-mode Plus driving capability activation on PB6
  - SYSCFG_FASTMODEPLUS_PB7 Fast-mode Plus driving capability activation on PB7
  - SYSCFG_FASTMODEPLUS_PB8 Fast-mode Plus driving capability activation on PB8
  - SYSCFG_FASTMODEPLUS_PB9 Fast-mode Plus driving capability activation on PB9

__HAL_SYSCFG_FASTMODEPLUS_DISABLE

Fast-mode Plus on GPIO

SYSCFG_FASTMODEPLUS_PB6

Enable Fast-mode Plus on PB6

SYSCFG_FASTMODEPLUS_PB7

Enable Fast-mode Plus on PB7

SYSCFG_FASTMODEPLUS_PB8

Enable Fast-mode Plus on PB8

SYSCFG_FASTMODEPLUS_PB9

Enable Fast-mode Plus on PB9

Flags

SYSCFG_FLAG_SRAM2_PE

SRAM2 parity error

SYSCFG_FLAG_SRAM2_BUSY

SRAM2 busy by erase operation

FPU Interrupts

SYSCFG_IT_FPU_IOC

Floating Point Unit Invalid operation Interrupt

SYSCFG_IT_FPU_DZC

Floating Point Unit Divide-by-zero Interrupt

SYSCFG_IT_FPU_UFC

Floating Point Unit Underflow Interrupt

SYSCFG_IT_FPU_OFC

Floating Point Unit Overflow Interrupt

SYSCFG_IT_FPU_IDC

Floating Point Unit Input denormal Interrupt

SYSCFG_IT_FPU_IXC

Floating Point Unit Inexact Interrupt

SRAM2 Page Write protection (0 to 31)

SYSCFG_SRAM2WRP_PAGE0

SRAM2 Write protection page 0

SYSCFG_SRAM2WRP_PAGE1

SRAM2 Write protection page 1

SYSCFG_SRAM2WRP_PAGE2

SRAM2 Write protection page 2

SYSCFG_SRAM2WRP_PAGE3

SRAM2 Write protection page 3

SYSCFG_SRAM2WRP_PAGE4

SRAM2 Write protection page 4

SYSCFG_SRAM2WRP_PAGE5

SRAM2 Write protection page 5

SYSCFG_SRAM2WRP_PAGE6

SRAM2 Write protection page 6

SYSCFG_SRAM2WRP_PAGE7

SRAM2 Write protection page 7

SYSCFG_SRAM2WRP_PAGE8

SRAM2 Write protection page 8

SYSCFG_SRAM2WRP_PAGE9

SRAM2 Write protection page 9

SYSCFG_SRAM2WRP_PAGE10

SRAM2 Write protection page 10

SYSCFG_SRAM2WRP_PAGE11

SRAM2 Write protection page 11

SYSCFG_SRAM2WRP_PAGE12

SRAM2 Write protection page 12

SYSCFG_SRAM2WRP_PAGE13

SRAM2 Write protection page 13

SYSCFG_SRAM2WRP_PAGE14

SRAM2 Write protection page 14

SYSCFG_SRAM2WRP_PAGE15

SRAM2 Write protection page 15

SYSCFG_SRAM2WRP_PAGE16

SRAM2 Write protection page 16

SYSCFG_SRAM2WRP_PAGE17

SRAM2 Write protection page 17

SYSCFG_SRAM2WRP_PAGE18

SRAM2 Write protection page 18

SYSCFG_SRAM2WRP_PAGE19

SRAM2 Write protection page 19

SYSCFG_SRAM2WRP_PAGE20

SRAM2 Write protection page 20

SYSCFG_SRAM2WRP_PAGE21

SRAM2 Write protection page 21

SYSCFG_SRAM2WRP_PAGE22

SRAM2 Write protection page 22

SYSCFG_SRAM2WRP_PAGE23

SRAM2 Write protection page 23

SYSCFG_SRAM2WRP_PAGE24

SRAM2 Write protection page 24

SYSCFG_SRAM2WRP_PAGE25

SRAM2 Write protection page 25

SYSCFG_SRAM2WRP_PAGE26

SRAM2 Write protection page 26

SYSCFG_SRAM2WRP_PAGE27

SRAM2 Write protection page 27

SYSCFG_SRAM2WRP_PAGE28

SRAM2 Write protection page 28

SYSCFG_SRAM2WRP_PAGE29

SRAM2 Write protection page 29

SYSCFG_SRAM2WRP_PAGE30

SRAM2 Write protection page 30

SYSCFG_SRAM2WRP_PAGE31

SRAM2 Write protection page 31

SRAM2 Page Write protection (32 to 63)

SYSCFG_SRAM2WRP_PAGE32

SRAM2 Write protection page 32

SYSCFG_SRAM2WRP_PAGE33

SRAM2 Write protection page 33

SYSCFG_SRAM2WRP_PAGE34

SRAM2 Write protection page 34

SYSCFG_SRAM2WRP_PAGE35

SRAM2 Write protection page 35

SYSCFG_SRAM2WRP_PAGE36

SRAM2 Write protection page 36

SYSCFG_SRAM2WRP_PAGE37

SRAM2 Write protection page 37

SYSCFG_SRAM2WRP_PAGE38

SRAM2 Write protection page 38

SYSCFG_SRAM2WRP_PAGE39

SRAM2 Write protection page 39

SYSCFG_SRAM2WRP_PAGE40

SRAM2 Write protection page 40

SYSCFG_SRAM2WRP_PAGE41

SRAM2 Write protection page 41

SYSCFG_SRAM2WRP_PAGE42

SRAM2 Write protection page 42

SYSCFG_SRAM2WRP_PAGE43

SRAM2 Write protection page 43

SYSCFG_SRAM2WRP_PAGE44

SRAM2 Write protection page 44

SYSCFG_SRAM2WRP_PAGE45

SRAM2 Write protection page 45

SYSCFG_SRAM2WRP_PAGE46

SRAM2 Write protection page 46

SYSCFG_SRAM2WRP_PAGE47

SRAM2 Write protection page 47

SYSCFG_SRAM2WRP_PAGE48

SRAM2 Write protection page 48

SYSCFG_SRAM2WRP_PAGE49

SRAM2 Write protection page 49

SYSCFG_SRAM2WRP_PAGE50

SRAM2 Write protection page 50

SYSCFG_SRAM2WRP_PAGE51

SRAM2 Write protection page 51

SYSCFG_SRAM2WRP_PAGE52

SRAM2 Write protection page 52

SYSCFG_SRAM2WRP_PAGE53

SRAM2 Write protection page 53

SYSCFG_SRAM2WRP_PAGE54

SRAM2 Write protection page 54

SYSCFG_SRAM2WRP_PAGE55

SRAM2 Write protection page 55

SYSCFG_SRAM2WRP_PAGE56

SRAM2 Write protection page 56

SYSCFG_SRAM2WRP_PAGE57

SRAM2 Write protection page 57

SYSCFG_SRAM2WRP_PAGE58

SRAM2 Write protection page 58

SYSCFG_SRAM2WRP_PAGE59

SRAM2 Write protection page 59

SYSCFG_SRAM2WRP_PAGE60

SRAM2 Write protection page 60

SYSCFG_SRAM2WRP_PAGE61

SRAM2 Write protection page 61

SYSCFG_SRAM2WRP_PAGE62

SRAM2 Write protection page 62

SYSCFG_SRAM2WRP_PAGE63

SRAM2 Write protection page 63

VREFBUF High Impedance

SYSCFG_VREFBUF_HIGH_IMPEDANCE_DISABLE

VREF_plus pin is internally connected to Voltage reference buffer output

SYSCFG_VREFBUF_HIGH_IMPEDANCE_ENABLE

VREF_plus pin is high impedance

VREFBUF Voltage Scale

SYSCFG_VREFBUF_VOLTAGE_SCALE0

Voltage reference scale 0 (VREF_OUT1)

SYSCFG_VREFBUF_VOLTAGE_SCALE1

Voltage reference scale 1 (VREF_OUT2)

7 HAL ADC Generic Driver

7.1 ADC Firmware driver registers structures

7.1.1 ADC_OversamplingTypeDef

ADC_OversamplingTypeDef is defined in the stm32l4xx_hal_adc.h

Data Fields

- ***uint32_t Ratio***
- ***uint32_t RightBitShift***
- ***uint32_t TriggeredMode***
- ***uint32_t OversamplingStopReset***

Field Documentation

- ***uint32_t ADC_OversamplingTypeDef::Ratio***
  Configures the oversampling ratio. This parameter can be a value of ***ADC_HAL_EC_OVS_RATIO***
- ***uint32_t ADC_OversamplingTypeDef::RightBitShift***
  Configures the division coefficient for the Oversampler. This parameter can be a value of ***ADC_HAL_EC_OVS_SHIFT***
- ***uint32_t ADC_OversamplingTypeDef::TriggeredMode***
  Selects the regular triggered oversampling mode. This parameter can be a value of ***ADC_HAL_EC_OVS_DISCONT_MODE***
- ***uint32_t ADC_OversamplingTypeDef::OversamplingStopReset***
  Selects the regular oversampling mode. The oversampling is either temporary stopped or reset upon an injected sequence interruption. If oversampling is enabled on both regular and injected groups, this parameter is discarded and forced to setting "ADC_REGOVERSAMPLING_RESUMED_MODE" (the oversampling buffer is zeroed during injection sequence). This parameter can be a value of ***ADC_HAL_EC_OVS_SCOPE_REG***

7.1.2 ADC_InitTypeDef

ADC_InitTypeDef is defined in the stm32l4xx_hal_adc.h

Data Fields

- ***uint32_t ClockPrescaler***
- ***uint32_t Resolution***
- ***uint32_t DataAlign***
- ***uint32_t ScanConvMode***
- ***uint32_t EOCSelection***
- ***FunctionalState LowPowerAutoWait***
- ***FunctionalState ContinuousConvMode***
- ***uint32_t NbrOfConversion***
- ***FunctionalState DiscontinuousConvMode***
- ***uint32_t NbrOfDiscConversion***
- ***uint32_t ExternalTrigConv***
- ***uint32_t ExternalTrigConvEdge***
- ***FunctionalState DMAContinuousRequests***
- ***uint32_t Overrun***
- ***FunctionalState OversamplingMode***
- ***ADC_OversamplingTypeDef Oversampling***
- ***uint32_t DFSDMConfig***

Field Documentation

- ***uint32_t ADC_InitTypeDef::ClockPrescaler***

  Select ADC clock source (synchronous clock derived from APB clock or asynchronous clock derived from system clock or PLL (Refer to reference manual for list of clocks available)) and clock prescaler. This parameter can be a value of ***ADC_HAL_EC_COMMON_CLOCK_SOURCE***. Note: The ADC clock configuration is common to all ADC instances. Note: In case of usage of channels on injected group, ADC frequency should be lower than AHB clock frequency /4 for resolution 12 or 10 bits, AHB clock frequency /3 for resolution 8 bits, AHB clock frequency /2 for resolution 6 bits. Note: In case of synchronous clock mode based on HCLK/1, the configuration must be enabled only if the system clock has a 50% duty clock cycle (APB prescaler configured inside RCC must be bypassed and PCLK clock must have 50% duty cycle). Refer to reference manual for details. Note: In case of usage of asynchronous clock, the selected clock must be preliminarily enabled at RCC top level. Note: This parameter can be modified only if all ADC instances are disabled.

- ***uint32_t ADC_InitTypeDef::Resolution***

  Configure the ADC resolution. This parameter can be a value of ***ADC_HAL_EC_RESOLUTION***

- ***uint32_t ADC_InitTypeDef::DataAlign***

  Specify ADC data alignment in conversion data register (right or left). Refer to reference manual for alignments formats versus resolutions. This parameter can be a value of ***ADC_HAL_EC_DATA_ALIGN***

- ***uint32_t ADC_InitTypeDef::ScanConvMode***

  Configure the sequencer of ADC groups regular and injected. This parameter can be associated to parameter 'DiscontinuousConvMode' to have main sequence subdivided in successive parts. If disabled: Conversion is performed in single mode (one channel converted, the one defined in rank 1). Parameters 'NbrOfConversion' and 'InjectedNbrOfConversion' are discarded (equivalent to set to 1). If enabled: Conversions are performed in sequence mode (multiple ranks defined by 'NbrOfConversion' or 'InjectedNbrOfConversion' and rank of each channel in sequencer). Scan direction is upward: from rank 1 to rank 'n'. This parameter can be a value of ***ADC_Scan_mode***

- ***uint32_t ADC_InitTypeDef::EOCSelection***

  Specify which EOC (End Of Conversion) flag is used for conversion by polling and interruption: end of unitary conversion or end of sequence conversions. This parameter can be a value of ***ADC_EOCSelection***.

- ***FunctionalState ADC_InitTypeDef::LowPowerAutoWait***

  Select the dynamic low power Auto Delay: new conversion start only when the previous conversion (for ADC group regular) or previous sequence (for ADC group injected) has been retrieved by user software, using function **HAL_ADC_GetValue()** or **HAL_ADCEx_InjectedGetValue()**. This feature automatically adapts the frequency of ADC conversions triggers to the speed of the system that reads the data. Moreover, this avoids risk of overrun for low frequency applications. This parameter can be set to ENABLE or DISABLE. Note: Do not use with interruption or DMA (**HAL_ADC_Start_IT()**, **HAL_ADC_Start_DMA()**) since they clear immediately the EOC flag to free the IRQ vector sequencer. Do use with polling: 1. Start conversion with **HAL_ADC_Start()**, 2. Later on, when ADC conversion data is needed: use **HAL_ADC_PollForConversion()** to ensure that conversion is completed and **HAL_ADC_GetValue()** to retrieve conversion result and trig another conversion start. (in case of usage of ADC group injected, use the equivalent functions HAL_ADCExInjected_Start(), **HAL_ADCEx_InjectedGetValue()**, ...).

- ***FunctionalState ADC_InitTypeDef::ContinuousConvMode***

  Specify whether the conversion is performed in single mode (one conversion) or continuous mode for ADC group regular, after the first ADC conversion start trigger occurred (software start or external trigger). This parameter can be set to ENABLE or DISABLE.

- ***uint32_t ADC_InitTypeDef::NbrOfConversion***

  Specify the number of ranks that will be converted within the regular group sequencer. To use the regular group sequencer and convert several ranks, parameter 'ScanConvMode' must be enabled. This parameter must be a number between Min_Data = 1 and Max_Data = 16. Note: This parameter must be modified when no conversion is on going on regular group (ADC disabled, or ADC enabled without continuous mode or external trigger that could launch a conversion).

- ***FunctionalState ADC_InitTypeDef::DiscontinuousConvMode***

  Specify whether the conversions sequence of ADC group regular is performed in Complete-sequence/ Discontinuous-sequence (main sequence subdivided in successive parts). Discontinuous mode is used only if sequencer is enabled (parameter 'ScanConvMode'). If sequencer is disabled, this parameter is discarded. Discontinuous mode can be enabled only if continuous mode is disabled. If continuous mode is enabled, this parameter setting is discarded. This parameter can be set to ENABLE or DISABLE.

- ***uint32_t ADC_InitTypeDef::NbrOfDiscConversion***

  Specifies the number of discontinuous conversions in which the main sequence of ADC group regular (parameter NbrOfConversion) will be subdivided. If parameter 'DiscontinuousConvMode' is disabled, this parameter is discarded. This parameter must be a number between Min_Data = 1 and Max_Data = 8.
- ***uint32_t ADC_InitTypeDef::ExternalTrigConv***

  Select the external event source used to trigger ADC group regular conversion start. If set to ADC_SOFTWARE_START, external triggers are disabled and software trigger is used instead. This parameter can be a value of ***ADC_regular_external_trigger_source***. Caution: external trigger source is common to all ADC instances.
- ***uint32_t ADC_InitTypeDef::ExternalTrigConvEdge***

  Select the external event edge used to trigger ADC group regular conversion start. If trigger source is set to ADC_SOFTWARE_START, this parameter is discarded. This parameter can be a value of ***ADC_regular_external_trigger_edge***
- ***FunctionalState ADC_InitTypeDef::DMAContinuousRequests***

  Specify whether the DMA requests are performed in one shot mode (DMA transfer stops when number of conversions is reached) or in continuous mode (DMA transfer unlimited, whatever number of conversions). This parameter can be set to ENABLE or DISABLE. Note: In continuous mode, DMA must be configured in circular mode. Otherwise an overrun will be triggered when DMA buffer maximum pointer is reached.
- ***uint32_t ADC_InitTypeDef::Overrun***

  Select the behavior in case of overrun: data overwritten or preserved (default). This parameter applies to ADC group regular only. This parameter can be a value of ***ADC_HAL_EC_REG_OVR_DATA_BEHAVIOR***. Note: In case of overrun set to data preserved and usage with programming model with interruption (HAL_Start_IT()): ADC IRQ handler has to clear end of conversion flags, this induces the release of the preserved data. If needed, this data can be saved in function **HAL_ADC_ConvCpltCallback()**, placed in user program code (called before end of conversion flags clear). Note: Error reporting with respect to the conversion mode:
  - Usage with ADC conversion by polling for event or interruption: Error is reported only if overrun is set to data preserved. If overrun is set to data overwritten, user can willingly not read all the converted data, this is not considered as an erroneous case.
  - Usage with ADC conversion by DMA: Error is reported whatever overrun setting (DMA is expected to process all data from data register).
- ***FunctionalState ADC_InitTypeDef::OversamplingMode***

  Specify whether the oversampling feature is enabled or disabled. This parameter can be set to ENABLE or DISABLE. Note: This parameter can be modified only if there is no conversion is ongoing on ADC groups regular and injected
- ***ADC_OversamplingTypeDef ADC_InitTypeDef::Oversampling***

  Specify the Oversampling parameters. Caution: this setting overwrites the previous oversampling configuration if oversampling is already enabled.
- ***uint32_t ADC_InitTypeDef::DFSDMConfig***

  Specify whether ADC conversion data is sent directly to DFSDM. This parameter can be a value of ***ADC_HAL_EC_REG_DFSDM_TRANSFER***. Note: This parameter can be modified only if there is no conversion is ongoing (both ADSTART and JADSTART cleared).

7.1.3 ADC_ChannelConfTypeDef

ADC_ChannelConfTypeDef is defined in the stm32l4xx_hal_adc.h

Data Fields

- ***uint32_t Channel***
- ***uint32_t Rank***
- ***uint32_t SamplingTime***
- ***uint32_t SingleDiff***
- ***uint32_t OffsetNumber***
- ***uint32_t Offset***

Field Documentation

- ***uint32_t ADC_ChannelConfTypeDef::Channel***

  Specify the channel to configure into ADC regular group. This parameter can be a value of ***ADC_HAL_EC_CHANNEL*** Note: Depending on devices and ADC instances, some channels may not be available on device package pins. Refer to device datasheet for channels availability.
- ***uint32_t ADC_ChannelConfTypeDef::Rank***

  Specify the rank in the regular group sequencer. This parameter can be a value of ***ADC_HAL_EC_REG_SEQ_RANKS*** Note: to disable a channel or change order of conversion sequencer, rank containing a previous channel setting can be overwritten by the new channel setting (or parameter number of conversions adjusted)
- ***uint32_t ADC_ChannelConfTypeDef::SamplingTime***

  Sampling time value to be set for the selected channel. Unit: ADC clock cycles Conversion time is the addition of sampling time and processing time (12.5 ADC clock cycles at ADC resolution 12 bits, 10.5 cycles at 10 bits, 8.5 cycles at 8 bits, 6.5 cycles at 6 bits). This parameter can be a value of ***ADC_HAL_EC_CHANNEL_SAMPLINGTIME*** Caution: This parameter applies to a channel that can be used into regular and/or injected group. It overwrites the last setting. Note: In case of usage of internal measurement channels (VrefInt/Vbat/TempSensor), sampling time constraints must be respected (sampling time can be adjusted in function of ADC clock frequency and sampling time setting) Refer to device datasheet for timings values.
- ***uint32_t ADC_ChannelConfTypeDef::SingleDiff***

  Select single-ended or differential input. In differential mode: Differential measurement is carried out between the selected channel 'i' (positive input) and channel 'i+1' (negative input). Only channel 'i' has to be configured, channel 'i+1' is configured automatically. This parameter must be a value of ***ADC_HAL_EC_CHANNEL_SINGLE_DIFF_ENDING*** Caution: This parameter applies to a channel that can be used in a regular and/or injected group. It overwrites the last setting. Note: Refer to Reference Manual to ensure the selected channel is available in differential mode. Note: When configuring a channel 'i' in differential mode, the channel 'i+1' is not usable separately. Note: This parameter must be modified when ADC is disabled (before ADC start conversion or after ADC stop conversion). If ADC is enabled, this parameter setting is bypassed without error reporting (as it can be the expected behavior in case of another parameter update on the fly)
- ***uint32_t ADC_ChannelConfTypeDef::OffsetNumber***

  Select the offset number This parameter can be a value of ***ADC_HAL_EC_OFFSET_NB*** Caution: Only one offset is allowed per channel. This parameter overwrites the last setting.
- ***uint32_t ADC_ChannelConfTypeDef::Offset***

  Define the offset to be subtracted from the raw converted data. Offset value must be a positive number. Depending of ADC resolution selected (12, 10, 8 or 6 bits), this parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF, 0x3FF, 0xFF or 0x3F respectively. Note: This parameter must be modified when no conversion is on going on both regular and injected groups (ADC disabled, or ADC enabled without continuous mode or external trigger that could launch a conversion).

7.1.4 ADC_AnalogWDGConfTypeDef

ADC_AnalogWDGConfTypeDef is defined in the stm32l4xx_hal_adc.h

Data Fields

- ***uint32_t WatchdogNumber***
- ***uint32_t WatchdogMode***
- ***uint32_t Channel***
- ***FunctionalState ITMode***
- ***uint32_t HighThreshold***
- ***uint32_t LowThreshold***

Field Documentation

- ***uint32_t ADC_AnalogWDGConfTypeDef::WatchdogNumber***

  Select which ADC analog watchdog is monitoring the selected channel. For Analog Watchdog 1: Only 1 channel can be monitored (or overall group of channels by setting parameter 'WatchdogMode') For Analog Watchdog 2 and 3: Several channels can be monitored (by successive calls of '**HAL_ADC_AnalogWDGConfig()**' for each channel) This parameter can be a value of ***ADC_HAL_EC_AWD_NUMBER***.

- ***uint32_t ADC_AnalogWDGConfTypeDef::WatchdogMode***

  Configure the ADC analog watchdog mode: single/all/none channels. For Analog Watchdog 1: Configure the ADC analog watchdog mode: single channel or all channels, ADC groups regular and-or injected. For Analog Watchdog 2 and 3: Several channels can be monitored by applying successively the AWD init structure. Channels on ADC group regular and injected are not differentiated: Set value 'ADC_ANALOGWATCHDOG_SINGLE_xxx' to monitor 1 channel, value 'ADC_ANALOGWATCHDOG_ALL_xxx' to monitor all channels, 'ADC_ANALOGWATCHDOG_NONE' to monitor no channel. This parameter can be a value of ***ADC_analog_watchdog_mode***.
- ***uint32_t ADC_AnalogWDGConfTypeDef::Channel***

  Select which ADC channel to monitor by analog watchdog. For Analog Watchdog 1: this parameter has an effect only if parameter 'WatchdogMode' is configured on single channel (only 1 channel can be monitored). For Analog Watchdog 2 and 3: Several channels can be monitored. To use this feature, call successively the function **HAL_ADC_AnalogWDGConfig()** for each channel to be added (or removed with value 'ADC_ANALOGWATCHDOG_NONE'). This parameter can be a value of ***ADC_HAL_EC_CHANNEL***.
- ***FunctionalState ADC_AnalogWDGConfTypeDef::ITMode***

  Specify whether the analog watchdog is configured in interrupt or polling mode. This parameter can be set to ENABLE or DISABLE
- ***uint32_t ADC_AnalogWDGConfTypeDef::HighThreshold***

  Configure the ADC analog watchdog High threshold value. Depending of ADC resolution selected (12, 10, 8 or 6 bits), this parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF, 0x3FF, 0xFF or 0x3F respectively. Note: Analog watchdog 2 and 3 are limited to a resolution of 8 bits: if ADC resolution is 12 bits the 4 LSB are ignored, if ADC resolution is 10 bits the 2 LSB are ignored. Note: If ADC oversampling is enabled, ADC analog watchdog thresholds are impacted: the comparison of analog watchdog thresholds is done on oversampling final computation (after ratio and shift application): ADC data register bitfield [15:4] (12 most significant bits).
- ***uint32_t ADC_AnalogWDGConfTypeDef::LowThreshold***

  Configures the ADC analog watchdog Low threshold value. Depending of ADC resolution selected (12, 10, 8 or 6 bits), this parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF, 0x3FF, 0xFF or 0x3F respectively. Note: Analog watchdog 2 and 3 are limited to a resolution of 8 bits: if ADC resolution is 12 bits the 4 LSB are ignored, if ADC resolution is 10 bits the 2 LSB are ignored. Note: If ADC oversampling is enabled, ADC analog watchdog thresholds are impacted: the comparison of analog watchdog thresholds is done on oversampling final computation (after ratio and shift application): ADC data register bitfield [15:4] (12 most significant bits).

7.1.5 ADC_InjectionConfigTypeDef

ADC_InjectionConfigTypeDef is defined in the stm32l4xx_hal_adc.h

Data Fields

- ***uint32_t ContextQueue***
- ***uint32_t ChannelCount***

Field Documentation

- ***uint32_t ADC_InjectionConfigTypeDef::ContextQueue***

  Injected channel configuration context: build-up over each **HAL_ADCEx_InjectedConfigChannel()** call to finally initialize JSQR register at **HAL_ADCEx_InjectedConfigChannel()** last call
- ***uint32_t ADC_InjectionConfigTypeDef::ChannelCount***

  Number of channels in the injected sequence

7.1.6 ADC_HandleTypeDef

ADC_HandleTypeDef is defined in the stm32l4xx_hal_adc.h

Data Fields

- ***ADC_TypeDef * Instance***
- ***ADC_InitTypeDef Init***
- ***DMA_HandleTypeDef * DMA_Handle***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t State***
- ***__IO uint32_t ErrorCode***

- ***ADC_InjectionConfigTypeDef InjectionConfig***

Field Documentation

- ***ADC_TypeDef* ADC_HandleTypeDef::Instance***
  Register base address
- ***ADC_InitTypeDef ADC_HandleTypeDef::Init***
  ADC initialization parameters and regular conversions setting
- ***DMA_HandleTypeDef* ADC_HandleTypeDef::DMA_Handle***
  Pointer DMA Handler
- ***HAL_LockTypeDef ADC_HandleTypeDef::Lock***
  ADC locking object
- ***__IO uint32_t ADC_HandleTypeDef::State***
  ADC communication state (bitmap of ADC states)
- ***__IO uint32_t ADC_HandleTypeDef::ErrorCode***
  ADC Error code
- ***ADC_InjectionConfigTypeDef ADC_HandleTypeDef::InjectionConfig***
  ADC injected channel configuration build-up structure

7.2 ADC Firmware driver API description

The following section lists the various functions of the ADC library.

7.2.1 ADC peripheral features

- 12-bit, 10-bit, 8-bit or 6-bit configurable resolution.
- Interrupt generation at the end of regular conversion and in case of analog watchdog or overrun events.
- Single and continuous conversion modes.
- Scan mode for conversion of several channels sequentially.
- Data alignment with in-built data coherency.
- Programmable sampling time (channel wise)
- External trigger (timer or EXTI) with configurable polarity
- DMA request generation for transfer of conversions data of regular group.
- Configurable delay between conversions in Dual interleaved mode.
- ADC channels selectable single/differential input.
- ADC offset shared on 4 offset instances.
- ADC calibration
- ADC conversion of regular group.
- ADC supply requirements: 1.62 V to 3.6 V.
- ADC input range: from Vref- (connected to Vssa) to Vref+ (connected to Vdda or to an external voltage reference).

7.2.2 How to use this driver

Configuration of top level parameters related to ADC

1. Enable the ADC interface
   - As prerequisite, ADC clock must be configured at RCC top level.
   - Two clock settings are mandatory:
     - ADC clock (core clock, also possibly conversion clock).
     - ADC clock (conversions clock). Two possible clock sources: synchronous clock derived from APB clock or asynchronous clock derived from system clock, PLLSAI1 or the PLLSAI2 running up to 80MHz.
     - Example: Into HAL_ADC_MspInit() (recommended code location) or with other device clock parameters configuration:
     - __HAL_RCC_ADC_CLK_ENABLE(); (mandatory) RCC_ADCCLKSOURCE_PLL enable: (optional: if asynchronous clock selected)
     - RCC_PeriphClkInitTypeDef RCC_PeriphClkInit;
     - PeriphClkInit.PeriphClockSelection = RCC_PERIPHCLK_ADC;
     - PeriphClkInit.AdcClockSelection = RCC_ADCCLKSOURCE_PLL;
     - HAL_RCCEx_PeriphCLKConfig(&PeriphClkInit);
   - ADC clock source and clock prescaler are configured at ADC level with parameter "ClockPrescaler" using function HAL_ADC_Init().
2. ADC pins configuration
   - Enable the clock for the ADC GPIOs using macro __HAL_RCC_GPIOx_CLK_ENABLE()
   - Configure these ADC pins in analog mode using function HAL_GPIO_Init()
3. Optionally, in case of usage of ADC with interruptions:
   - Configure the NVIC for ADC using function HAL_NVIC_EnableIRQ(ADCx_IRQn)
   - Insert the ADC interruption handler function HAL_ADC_IRQHandler() into the function of corresponding ADC interruption vector ADCx_IRQHandler().
4. Optionally, in case of usage of DMA:
   - Configure the DMA (DMA channel, mode normal or circular, ...) using function HAL_DMA_Init().
   - Configure the NVIC for DMA using function HAL_NVIC_EnableIRQ(DMAx_Channelx_IRQn)
   - Insert the ADC interruption handler function HAL_ADC_IRQHandler() into the function of corresponding DMA interruption vector DMAx_Channelx_IRQHandler().

Configuration of ADC, group regular, channels parameters

1. Configure the ADC parameters (resolution, data alignment, ...) and regular group parameters (conversion trigger, sequencer, ...) using function HAL_ADC_Init().
2. Configure the channels for regular group parameters (channel number, channel rank into sequencer, ..., into regular group) using function HAL_ADC_ConfigChannel().
3. Optionally, configure the analog watchdog parameters (channels monitored, thresholds, ...) using function HAL_ADC_AnalogWDGConfig().

Execution of ADC conversions

1. Optionally, perform an automatic ADC calibration to improve the conversion accuracy using function HAL_ADCEx_Calibration_Start().

2. ADC driver can be used among three modes: polling, interruption, transfer by DMA.
   - ADC conversion by polling:
     - Activate the ADC peripheral and start conversions using function HAL_ADC_Start()
     - Wait for ADC conversion completion using function HAL_ADC_PollForConversion()
     - Retrieve conversion results using function HAL_ADC_GetValue()
     - Stop conversion and disable the ADC peripheral using function HAL_ADC_Stop()
   - ADC conversion by interruption:
     - Activate the ADC peripheral and start conversions using function HAL_ADC_Start_IT()
     - Wait for ADC conversion completion by call of function HAL_ADC_ConvCpltCallback() (this function must be implemented in user program)
     - Retrieve conversion results using function HAL_ADC_GetValue()
     - Stop conversion and disable the ADC peripheral using function HAL_ADC_Stop_IT()
   - ADC conversion with transfer by DMA:
     - Activate the ADC peripheral and start conversions using function HAL_ADC_Start_DMA()
     - Wait for ADC conversion completion by call of function HAL_ADC_ConvCpltCallback() or HAL_ADC_ConvHalfCpltCallback() (these functions must be implemented in user program)
     - Conversion results are automatically transferred by DMA into destination variable address.
     - Stop conversion and disable the ADC peripheral using function HAL_ADC_Stop_DMA()

Note: Callback functions must be implemented in user program:

- *HAL_ADC_ErrorCallback()*
- *HAL_ADC_LevelOutOfWindowCallback() (callback of analog watchdog)*
- *HAL_ADC_ConvCpltCallback()*
- *HAL_ADC_ConvHalfCpltCallback*

Deinitialization of ADC

1. Disable the ADC interface
   - ADC clock can be hard reset and disabled at RCC top level.
   - Hard reset of ADC peripherals using macro __ADCx_FORCE_RESET(), __ADCx_RELEASE_RESET().
   - ADC clock disable using the equivalent macro/functions as configuration step.
     - Example: Into HAL_ADC_MspDeInit() (recommended code location) or with other device clock parameters configuration:
     - RCC_OscInitStructure.OscillatorType = RCC_OSCILLATORTYPE_HSI14;
     - RCC_OscInitStructure.HSI14State = RCC_HSI14_OFF; (if not used for system clock)
     - HAL_RCC_OscConfig(&RCC_OscInitStructure);
2. ADC pins configuration
   - Disable the clock for the ADC GPIOs using macro __HAL_RCC_GPIOx_CLK_DISABLE()
3. Optionally, in case of usage of ADC with interruptions:
   - Disable the NVIC for ADC using function HAL_NVIC_EnableIRQ(ADCx_IRQn)
4. Optionally, in case of usage of DMA:
   - Deinitialize the DMA using function HAL_DMA_Init().
   - Disable the NVIC for DMA using function HAL_NVIC_EnableIRQ(DMAx_Channelx_IRQn)

Callback registration

The compilation flag USE_HAL_ADC_REGISTER_CALLBACKS, when set to 1, allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_ADC_RegisterCallback() to register an interrupt callback.

Function @ref HAL_ADC_RegisterCallback() allows to register following callbacks:

- ConvCpltCallback : ADC conversion complete callback
- ConvHalfCpltCallback : ADC conversion DMA half-transfer callback

- LevelOutOfWindowCallback : ADC analog watchdog 1 callback
- ErrorCallback : ADC error callback
- InjectedConvCpltCallback : ADC group injected conversion complete callback
- InjectedQueueOverflowCallback : ADC group injected context queue overflow callback
- LevelOutOfWindow2Callback : ADC analog watchdog 2 callback
- LevelOutOfWindow3Callback : ADC analog watchdog 3 callback
- EndOfSamplingCallback : ADC end of sampling callback
- MspInitCallback : ADC Msp Init callback
- MspDeInitCallback : ADC Msp DeInit callback This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_ADC_UnRegisterCallback to reset a callback to the default weak function.

@ref HAL_ADC_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- ConvCpltCallback : ADC conversion complete callback
- ConvHalfCpltCallback : ADC conversion DMA half-transfer callback
- LevelOutOfWindowCallback : ADC analog watchdog 1 callback
- ErrorCallback : ADC error callback
- InjectedConvCpltCallback : ADC group injected conversion complete callback
- InjectedQueueOverflowCallback : ADC group injected context queue overflow callback
- LevelOutOfWindow2Callback : ADC analog watchdog 2 callback
- LevelOutOfWindow3Callback : ADC analog watchdog 3 callback
- EndOfSamplingCallback : ADC end of sampling callback
- MspInitCallback : ADC Msp Init callback
- MspDeInitCallback : ADC Msp DeInit callback

By default, after the @ref HAL_ADC_Init() and when the state is @ref HAL_ADC_STATE_RESET all callbacks are set to the corresponding weak functions: examples @ref HAL_ADC_ConvCpltCallback(), @ref HAL_ADC_ErrorCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the @ref HAL_ADC_Init()/ @ref HAL_ADC_DeInit() only when these callbacks are null (not registered beforehand).

If MspInit or MspDeInit are not null, the @ref HAL_ADC_Init()/ @ref HAL_ADC_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state.

Callbacks can be registered/unregistered in @ref HAL_ADC_STATE_READY state only. Exception done MspInit/ MspDeInit functions that can be registered/unregistered in @ref HAL_ADC_STATE_READY or @ref HAL_ADC_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/ DeInit.

Then, the user first registers the MspInit/MspDeInit user callbacks using @ref HAL_ADC_RegisterCallback() before calling @ref HAL_ADC_DeInit() or @ref HAL_ADC_Init() function.

When the compilation flag USE_HAL_ADC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

7.2.3 Peripheral Control functions

This section provides functions allowing to:

- Configure channels on regular group
- Configure the analog watchdog

This section contains the following APIs:

- ***HAL_ADC_ConfigChannel***
- ***HAL_ADC_AnalogWDGConfig***

7.2.4 Peripheral state and errors functions

This subsection provides functions to get in run-time the status of the peripheral.

- Check the ADC state

- Check the ADC error code

This section contains the following APIs:

- ***HAL_ADC_GetState***
- ***HAL_ADC_GetError***

7.2.5 Detailed description of functions

`HAL_ADC_Init`

Function name

HAL_StatusTypeDef HAL_ADC_Init (ADC_HandleTypeDef * hadc)

Function description

Initialize the ADC peripheral and regular group according to parameters specified in structure "ADC_InitTypeDef".

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- As prerequisite, ADC clock must be configured at RCC top level (refer to description of RCC configuration for ADC in header of this file).
- Possibility to update parameters on the fly: This function initializes the ADC MSP (HAL_ADC_MspInit()) only when coming from ADC state reset. Following calls to this function can be used to reconfigure some parameters of ADC_InitTypeDef structure on the fly, without modifying MSP configuration. If ADC MSP has to be modified again, HAL_ADC_DeInit() must be called before HAL_ADC_Init(). The setting of these parameters is conditioned to ADC state. For parameters constraints, see comments of structure "ADC_InitTypeDef".
- This function configures the ADC within 2 scopes: scope of entire ADC and scope of regular group. For parameters details, see comments of structure "ADC_InitTypeDef".
- Parameters related to common ADC registers (ADC clock mode) are set only if all ADCs are disabled. If this is not the case, these common parameters setting are bypassed without error reporting: it can be the intended behaviour in case of update of a parameter of ADC_InitTypeDef on the fly, without disabling the other ADCs.

`HAL_ADC_DeInit`

Function name

HAL_StatusTypeDef HAL_ADC_DeInit (ADC_HandleTypeDef * hadc)

Function description

Deinitialize the ADC peripheral registers to their default reset values, with deinitialization of the ADC MSP.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- For devices with several ADCs: reset of ADC common registers is done only if all ADCs sharing the same common group are disabled. (function "HAL_ADC_MspDeInit()" is also called under the same conditions: all ADC instances use the same core clock at RCC level, disabling the core clock reset all ADC instances). If this is not the case, reset of these common parameters reset is bypassed without error reporting: it can be the intended behavior in case of reset of a single ADC while the other ADCs sharing the same common group is still running.
- By default, HAL_ADC_DeInit() set ADC in mode deep power-down: this saves more power by reducing leakage currents and is particularly interesting before entering MCU low-power modes.

`HAL_ADC_MspInit`

Function name

void HAL_ADC_MspInit (ADC_HandleTypeDef * hadc)

Function description

Initialize the ADC MSP.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

`HAL_ADC_MspDeInit`

Function name

void HAL_ADC_MspDeInit (ADC_HandleTypeDef * hadc)

Function description

DeInitialize the ADC MSP.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

Notes

- All ADC instances use the same core clock at RCC level, disabling the core clock reset all ADC instances).

`HAL_ADC_Start`

Function name

HAL_StatusTypeDef HAL_ADC_Start (ADC_HandleTypeDef * hadc)

Function description

Enable ADC, start conversion of regular group.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- Interruptions enabled in this function: None.
- Case of multimode enabled (when multimode feature is available): if ADC is Slave, ADC is enabled but conversion is not started, if ADC is master, ADC is enabled and multimode conversion is started.

`HAL_ADC_Stop`

Function name

HAL_StatusTypeDef HAL_ADC_Stop (ADC_HandleTypeDef * hadc)

Function description

Stop ADC conversion of regular group (and injected channels in case of auto_injection mode), disable ADC peripheral.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

Notes

- : ADC peripheral disable is forcing stop of potential conversion on injected group. If injected group is under use, it should be preliminarily stopped using HAL_ADCEx_InjectedStop function.

`HAL_ADC_PollForConversion`

Function name

HAL_StatusTypeDef HAL_ADC_PollForConversion (ADC_HandleTypeDef * hadc, uint32_t Timeout)

Function description

Wait for regular group conversion to be completed.

Parameters

- **hadc:** ADC handle
- **Timeout:** Timeout value in millisecond.

Return values

- **HAL:** status

Notes

- ADC conversion flags EOS (end of sequence) and EOC (end of conversion) are cleared by this function, with an exception: if low power feature "LowPowerAutoWait" is enabled, flags are not cleared to not interfere with this feature until data register is read using function HAL_ADC_GetValue().
- This function cannot be used in a particular setup: ADC configured in DMA mode and polling for end of each conversion (ADC init parameter "EOCSelection" set to ADC_EOC_SINGLE_CONV). In this case, DMA resets the flag EOC and polling cannot be performed on each conversion. Nevertheless, polling can still be performed on the complete sequence (ADC init parameter "EOCSelection" set to ADC_EOC_SEQ_CONV).

`HAL_ADC_PollForEvent`

Function name

HAL_StatusTypeDef HAL_ADC_PollForEvent (ADC_HandleTypeDef * hadc, uint32_t EventType, uint32_t Timeout)

Function description

Poll for ADC event.

Parameters

- **hadc:** ADC handle
- **EventType:** the ADC event type. This parameter can be one of the following values:
  - ADC_EOSMP_EVENT ADC End of Sampling event
  - ADC_AWD1_EVENT ADC Analog watchdog 1 event (main analog watchdog, present on all STM32 devices)
  - ADC_AWD2_EVENT ADC Analog watchdog 2 event (additional analog watchdog, not present on all STM32 families)
  - ADC_AWD3_EVENT ADC Analog watchdog 3 event (additional analog watchdog, not present on all STM32 families)
  - ADC_OVR_EVENT ADC Overrun event
  - ADC_JQOVF_EVENT ADC Injected context queue overflow event
- **Timeout:** Timeout value in millisecond.

Return values

- **HAL:** status

Notes

- The relevant flag is cleared if found to be set, except for ADC_FLAG_OVR. Indeed, the latter is reset only if hadc->Init.Overrun field is set to ADC_OVR_DATA_OVERWRITTEN. Otherwise, data register may be potentially overwritten by a new converted data as soon as OVR is cleared. To reset OVR flag once the preserved data is retrieved, the user can resort to macro __HAL_ADC_CLEAR_FLAG(hadc, ADC_FLAG_OVR);

HAL_ADC_Start_IT

Function name

HAL_StatusTypeDef HAL_ADC_Start_IT (ADC_HandleTypeDef * hadc)

Function description

Enable ADC, start conversion of regular group with interruption.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- Interruptions enabled in this function according to initialization setting : EOC (end of conversion), EOS (end of sequence), OVR overrun. Each of these interruptions has its dedicated callback function.
- Case of multimode enabled (when multimode feature is available): HAL_ADC_Start_IT() must be called for ADC Slave first, then for ADC Master. For ADC Slave, ADC is enabled only (conversion is not started). For ADC Master, ADC is enabled and multimode conversion is started.
- To guarantee a proper reset of all interruptions once all the needed conversions are obtained, HAL_ADC_Stop_IT() must be called to ensure a correct stop of the IT-based conversions.
- By default, HAL_ADC_Start_IT() does not enable the End Of Sampling interruption. If required (e.g. in case of oversampling with trigger mode), the user must: 1. first clear the EOSMP flag if set with macro __HAL_ADC_CLEAR_FLAG(hadc, ADC_FLAG_EOSMP) 2. then enable the EOSMP interrupt with macro __HAL_ADC_ENABLE_IT(hadc, ADC_IT_EOSMP) before calling HAL_ADC_Start_IT().

HAL_ADC_Stop_IT

Function name

HAL_StatusTypeDef HAL_ADC_Stop_IT (ADC_HandleTypeDef * hadc)

Function description

Stop ADC conversion of regular group (and injected group in case of auto_injection mode), disable interrution of end-of-conversion, disable ADC peripheral.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

HAL_ADC_Start_DMA

Function name

HAL_StatusTypeDef HAL_ADC_Start_DMA (ADC_HandleTypeDef * hadc, uint32_t * pData, uint32_t Length)

Function description

Enable ADC, start conversion of regular group and transfer result through DMA.

Parameters

- **hadc:** ADC handle
- **pData:** Destination Buffer address.
- **Length:** Number of data to be transferred from ADC peripheral to memory

Return values

- **HAL:** status.

Notes

- Interruptions enabled in this function: overrun (if applicable), DMA half transfer, DMA transfer complete. Each of these interruptions has its dedicated callback function.
- Case of multimode enabled (when multimode feature is available): HAL_ADC_Start_DMA() is designed for single-ADC mode only. For multimode, the dedicated HAL_ADCEx_MultiModeStart_DMA() function must be used.

HAL_ADC_Stop_DMA

Function name

HAL_StatusTypeDef HAL_ADC_Stop_DMA (ADC_HandleTypeDef * hadc)

Function description

Stop ADC conversion of regular group (and injected group in case of auto_injection mode), disable ADC DMA transfer, disable ADC peripheral.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

Notes

- : ADC peripheral disable is forcing stop of potential conversion on ADC group injected. If ADC group injected is under use, it should be preliminarily stopped using HAL_ADCEx_InjectedStop function.
- Case of multimode enabled (when multimode feature is available): HAL_ADC_Stop_DMA() function is dedicated to single-ADC mode only. For multimode, the dedicated HAL_ADCEx_MultiModeStop_DMA() API must be used.

HAL_ADC_GetValue

Function name

uint32_t HAL_ADC_GetValue (ADC_HandleTypeDef * hadc)

Function description

Get ADC regular group conversion result.

Parameters

- **hadc:** ADC handle

Return values

- **ADC:** group regular conversion data

Notes

- Reading register DR automatically clears ADC flag EOC (ADC group regular end of unitary conversion).
- This function does not clear ADC flag EOS (ADC group regular end of sequence conversion). Occurrence of flag EOS rising: If sequencer is composed of 1 rank, flag EOS is equivalent to flag EOC.If sequencer is composed of several ranks, during the scan sequence flag EOC only is raised, at the end of the scan sequence both flags EOC and EOS are raised. To clear this flag, either use function: in programming model IT: HAL_ADC_IRQHandler(), in programming model polling: HAL_ADC_PollForConversion() or __HAL_ADC_CLEAR_FLAG(&hadc, ADC_FLAG_EOS).

HAL_ADC_IRQHandler

Function name

void HAL_ADC_IRQHandler (ADC_HandleTypeDef * hadc)

Function description

Handle ADC interrupt request.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADC_ConvCpltCallback

Function name

void HAL_ADC_ConvCpltCallback (ADC_HandleTypeDef * hadc)

Function description

Conversion complete callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADC_ConvHalfCpltCallback

Function name

void HAL_ADC_ConvHalfCpltCallback (ADC_HandleTypeDef * hadc)

Function description

Conversion DMA half-transfer callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADC_LevelOutOfWindowCallback

Function name

void HAL_ADC_LevelOutOfWindowCallback (ADC_HandleTypeDef * hadc)

Function description

Analog watchdog 1 callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADC_ErrorCallback

Function name

void HAL_ADC_ErrorCallback (ADC_HandleTypeDef * hadc)

Function description

ADC error callback in non-blocking mode (ADC conversion with interruption or transfer by DMA).

Parameters

- **hadc:** ADC handle

Return values

- **None:**

Notes

- In case of error due to overrun when using ADC with DMA transfer (HAL ADC handle parameter "ErrorCode" to state "HAL_ADC_ERROR_OVR"): Reinitialize the DMA using function "HAL_ADC_Stop_DMA()".If needed, restart a new ADC conversion using function "HAL_ADC_Start_DMA()" (this function is also clearing overrun flag)

HAL_ADC_ConfigChannel

Function name

HAL_StatusTypeDef HAL_ADC_ConfigChannel (ADC_HandleTypeDef * hadc, ADC_ChannelConfTypeDef * sConfig)

Function description

Configure a channel to be assigned to ADC group regular.

Parameters

- **hadc:** ADC handle
- **sConfig:** Structure of ADC channel assigned to ADC group regular.

Return values

- **HAL:** status

Notes

- In case of usage of internal measurement channels: Vbat/VrefInt/TempSensor. These internal paths can be disabled using function HAL_ADC_DeInit().
- Possibility to update parameters on the fly: This function initializes channel into ADC group regular, following calls to this function can be used to reconfigure some parameters of structure "ADC_ChannelConfTypeDef" on the fly, without resetting the ADC. The setting of these parameters is conditioned to ADC state: Refer to comments of structure "ADC_ChannelConfTypeDef".

HAL_ADC_AnalogWDGConfig

Function name

HAL_StatusTypeDef HAL_ADC_AnalogWDGConfig (ADC_HandleTypeDef * hadc, ADC_AnalogWDGConfTypeDef * AnalogWDGConfig)

Function description

Configure the analog watchdog.

Parameters

- **hadc:** ADC handle
- **AnalogWDGConfig:** Structure of ADC analog watchdog configuration

Return values

- **HAL:** status

Notes

- Possibility to update parameters on the fly: This function initializes the selected analog watchdog, successive calls to this function can be used to reconfigure some parameters of structure "ADC_AnalogWDGConfTypeDef" on the fly, without resetting the ADC. The setting of these parameters is conditioned to ADC state. For parameters constraints, see comments of structure "ADC_AnalogWDGConfTypeDef".
- On this STM32 serie, analog watchdog thresholds cannot be modified while ADC conversion is on going.

HAL_ADC_GetState

Function name

uint32_t HAL_ADC_GetState (ADC_HandleTypeDef * hadc)

Function description

Return the ADC handle state.

Parameters

- **hadc:** ADC handle

Return values

- **ADC:** handle state (bitfield on 32 bits)

Notes

- ADC state machine is managed by bitfields, ADC status must be compared with states bits. For example: " if ((HAL_ADC_GetState(hadc1) & HAL_ADC_STATE_REG_BUSY) != 0UL) " " if ((HAL_ADC_GetState(hadc1) & HAL_ADC_STATE_AWD1) != 0UL) "

HAL_ADC_GetError

Function name

uint32_t HAL_ADC_GetError (ADC_HandleTypeDef * hadc)

Function description

Return the ADC error code.

Parameters

- **hadc:** ADC handle

Return values

- **ADC:** error code (bitfield on 32 bits)

ADC_ConversionStop

Function name

HAL_StatusTypeDef ADC_ConversionStop (ADC_HandleTypeDef * hadc, uint32_t ConversionGroup)

Function description

Stop ADC conversion.

Parameters

- **hadc:** ADC handle
- **ConversionGroup:** ADC group regular and/or injected. This parameter can be one of the following values:
  - ADC_REGULAR_GROUP ADC regular conversion type.
  - ADC_INJECTED_GROUP ADC injected conversion type.
  - ADC_REGULAR_INJECTED_GROUP ADC regular and injected conversion type.

Return values

- **HAL:** status.

ADC_Enable

Function name

HAL_StatusTypeDef ADC_Enable (ADC_HandleTypeDef * hadc)

Function description

Enable the selected ADC.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

Notes

- Prerequisite condition to use this function: ADC must be disabled and voltage regulator must be enabled (done into HAL_ADC_Init()).

ADC_Disable

Function name

HAL_StatusTypeDef ADC_Disable (ADC_HandleTypeDef * hadc)

Function description

Disable the selected ADC.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

Notes

- Prerequisite condition to use this function: ADC conversions must be stopped.

`ADC_DMAConvCplt`

Function name

void ADC_DMAConvCplt (DMA_HandleTypeDef * hdma)

Function description

DMA transfer complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`ADC_DMAHalfConvCplt`

Function name

void ADC_DMAHalfConvCplt (DMA_HandleTypeDef * hdma)

Function description

DMA half transfer complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`ADC_DMAError`

Function name

void ADC_DMAError (DMA_HandleTypeDef * hdma)

Function description

DMA error callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

7.3 ADC Firmware driver defines

The following section lists the various define and macros of the module.

7.3.1 ADC

ADC

ADC Analog Watchdog Mode

ADC_ANALOGWATCHDOG_NONE

No analog watchdog selected

ADC_ANALOGWATCHDOG_SINGLE_REG

Analog watchdog applied to a regular group single channel

ADC_ANALOGWATCHDOG_SINGLE_INJEC

Analog watchdog applied to an injected group single channel

ADC_ANALOGWATCHDOG_SINGLE_REGINJEC

Analog watchdog applied to a regular and injected groups single channel

ADC_ANALOGWATCHDOG_ALL_REG

Analog watchdog applied to regular group all channels

ADC_ANALOGWATCHDOG_ALL_INJEC

Analog watchdog applied to injected group all channels

ADC_ANALOGWATCHDOG_ALL_REGINJEC

Analog watchdog applied to regular and injected groups all channels

ADCx CFGR fields

ADC_CFGR_FIELDS

ADCx CFGR sub fields

ADC_CFGR_FIELDS_2

ADC sequencer end of unitary conversion or sequence conversions

ADC_EOC_SINGLE_CONV

End of unitary conversion flag

ADC_EOC_SEQ_CONV

End of sequence conversions flag

ADC Error Code

HAL_ADC_ERROR_NONE

No error

HAL_ADC_ERROR_INTERNAL

ADC peripheral internal error (problem of clocking, enable/disable, erroneous state, ...)

HAL_ADC_ERROR_OVR

Overrun error

HAL_ADC_ERROR_DMA

DMA transfer error

HAL_ADC_ERROR_JQOVF

Injected context queue overflow error

ADC Event type

ADC_EOSMP_EVENT

ADC End of Sampling event

ADC_AWD1_EVENT

ADC Analog watchdog 1 event (main analog watchdog, present on all STM32 series)

ADC_AWD2_EVENT

ADC Analog watchdog 2 event (additional analog watchdog, not present on all STM32 series)

ADC_AWD3_EVENT

ADC Analog watchdog 3 event (additional analog watchdog, not present on all STM32 series)

ADC_OVR_EVENT

ADC overrun event

ADC_JQOVF_EVENT

ADC Injected Context Queue Overflow event

ADC Exported Constants

ADC_AWD_EVENT

ADC Analog watchdog 1 event: Naming for compatibility with other STM32 devices having only one analog watchdog

ADC flags definition

ADC_FLAG_RDY

ADC Ready flag

ADC_FLAG_EOSMP

ADC End of Sampling flag

ADC_FLAG_EOC

ADC End of Regular Conversion flag

ADC_FLAG_EOS

ADC End of Regular sequence of Conversions flag

ADC_FLAG_OVR

ADC overrun flag

ADC_FLAG_JEOC

ADC End of Injected Conversion flag

ADC_FLAG_JEOS

ADC End of Injected sequence of Conversions flag

ADC_FLAG_AWD1

ADC Analog watchdog 1 flag (main analog watchdog)

ADC_FLAG_AWD2

ADC Analog watchdog 2 flag (additional analog watchdog)

ADC_FLAG_AWD3

ADC Analog watchdog 3 flag (additional analog watchdog)

ADC_FLAG_JQOVF

ADC Injected Context Queue Overflow flag

ADC_FLAG_AWD

ADC Analog watchdog 1 flag: Naming for compatibility with other STM32 devices having only one analog watchdog

ADC_FLAG_ALL

ADC all flags

ADC_FLAG_POSTCONV_ALL

ADC post-conversion all flags

Analog watchdog - Analog watchdog number

ADC_ANALOGWATCHDOG_1

ADC analog watchdog number 1

ADC_ANALOGWATCHDOG_2

ADC analog watchdog number 2

ADC_ANALOGWATCHDOG_3

ADC analog watchdog number 3

ADC instance - Channel number

ADC_CHANNEL_0

ADC external channel (channel connected to GPIO pin) ADCx_IN0

ADC_CHANNEL_1

ADC external channel (channel connected to GPIO pin) ADCx_IN1

ADC_CHANNEL_2

ADC external channel (channel connected to GPIO pin) ADCx_IN2

ADC_CHANNEL_3

ADC external channel (channel connected to GPIO pin) ADCx_IN3

ADC_CHANNEL_4

ADC external channel (channel connected to GPIO pin) ADCx_IN4

ADC_CHANNEL_5

ADC external channel (channel connected to GPIO pin) ADCx_IN5

ADC_CHANNEL_6

ADC external channel (channel connected to GPIO pin) ADCx_IN6

ADC_CHANNEL_7

ADC external channel (channel connected to GPIO pin) ADCx_IN7

ADC_CHANNEL_8

ADC external channel (channel connected to GPIO pin) ADCx_IN8

ADC_CHANNEL_9

ADC external channel (channel connected to GPIO pin) ADCx_IN9

ADC_CHANNEL_10

ADC external channel (channel connected to GPIO pin) ADCx_IN10

ADC_CHANNEL_11

ADC external channel (channel connected to GPIO pin) ADCx_IN11

ADC_CHANNEL_12

ADC external channel (channel connected to GPIO pin) ADCx_IN12

ADC_CHANNEL_13

ADC external channel (channel connected to GPIO pin) ADCx_IN13

ADC_CHANNEL_14

ADC external channel (channel connected to GPIO pin) ADCx_IN14

ADC_CHANNEL_15

ADC external channel (channel connected to GPIO pin) ADCx_IN15

ADC_CHANNEL_16

ADC external channel (channel connected to GPIO pin) ADCx_IN16

ADC_CHANNEL_17

ADC external channel (channel connected to GPIO pin) ADCx_IN17

ADC_CHANNEL_18

ADC external channel (channel connected to GPIO pin) ADCx_IN18

ADC_CHANNEL_VREFINT

ADC internal channel connected to VrefInt: Internal voltage reference.

ADC_CHANNEL_TEMPSENSOR

ADC internal channel connected to Temperature sensor.

ADC_CHANNEL_VBAT

ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda.

ADC_CHANNEL_DAC1CH1

ADC internal channel connected to DAC1 channel 1, channel specific to ADC1. This channel is shared with ADC internal channel connected to temperature sensor, selection is done using function

ADC_CHANNEL_DAC1CH2

ADC internal channel connected to DAC1 channel 2, channel specific to ADC1. This channel is shared with ADC internal channel connected to Vbat, selection is done using function

Channel - Sampling time

ADC_SAMPLETIME_2CYCLES_5

Sampling time 2.5 ADC clock cycles

ADC_SAMPLETIME_6CYCLES_5

Sampling time 6.5 ADC clock cycles

ADC_SAMPLETIME_12CYCLES_5

Sampling time 12.5 ADC clock cycles

ADC_SAMPLETIME_24CYCLES_5

Sampling time 24.5 ADC clock cycles

ADC_SAMPLETIME_47CYCLES_5

Sampling time 47.5 ADC clock cycles

ADC_SAMPLETIME_92CYCLES_5

Sampling time 92.5 ADC clock cycles

ADC_SAMPLETIME_247CYCLES_5

Sampling time 247.5 ADC clock cycles

ADC_SAMPLETIME_640CYCLES_5

Sampling time 640.5 ADC clock cycles

ADC_SAMPLETIME_3CYCLES_5

Sampling time 3.5 ADC clock cycles. If selected, this sampling time replaces all sampling time 2.5 ADC clock cycles. These 2 sampling times cannot be used simultaneously.

Channel - Single or differential ending

ADC_SINGLE_ENDED

ADC channel ending set to single ended (literal also used to set calibration mode)

ADC_DIFFERENTIAL_ENDED

ADC channel ending set to differential (literal also used to set calibration mode)

ADC common - Clock source

ADC_CLOCK_SYNC_PCLK_DIV1

ADC synchronous clock derived from AHB clock without prescaler

ADC_CLOCK_SYNC_PCLK_DIV2

ADC synchronous clock derived from AHB clock with prescaler division by 2

ADC_CLOCK_SYNC_PCLK_DIV4

ADC synchronous clock derived from AHB clock with prescaler division by 4

ADC_CLOCK_ASYNC_DIV1

ADC asynchronous clock without prescaler

ADC_CLOCK_ASYNC_DIV2

ADC asynchronous clock with prescaler division by 2

ADC_CLOCK_ASYNC_DIV4

ADC asynchronous clock with prescaler division by 4

ADC_CLOCK_ASYNC_DIV6

ADC asynchronous clock with prescaler division by 6

ADC_CLOCK_ASYNC_DIV8

ADC asynchronous clock with prescaler division by 8

ADC_CLOCK_ASYNC_DIV10

ADC asynchronous clock with prescaler division by 10

ADC_CLOCK_ASYNC_DIV12

ADC asynchronous clock with prescaler division by 12

ADC_CLOCK_ASYNC_DIV16

ADC asynchronous clock with prescaler division by 16

ADC_CLOCK_ASYNC_DIV32

ADC asynchronous clock with prescaler division by 32

ADC_CLOCK_ASYNC_DIV64

ADC asynchronous clock with prescaler division by 64

ADC_CLOCK_ASYNC_DIV128

ADC asynchronous clock with prescaler division by 128

ADC_CLOCK_ASYNC_DIV256

ADC asynchronous clock with prescaler division by 256

ADC conversion data alignment

ADC_DATAALIGN_RIGHT

ADC conversion data alignment: right aligned (alignment on data register LSB bit 0)

ADC_DATAALIGN_LEFT

ADC conversion data alignment: left aligned (aligment on data register MSB bit 15)

ADC instance - Groups

ADC_REGULAR_GROUP

ADC group regular (available on all STM32 devices)

ADC_INJECTED_GROUP

ADC group injected (not available on all STM32 devices)

ADC_REGULAR_INJECTED_GROUP

ADC both groups regular and injected

ADC instance - Offset number

ADC_OFFSET_NONE

ADC offset disabled: no offset correction for the selected ADC channel

ADC_OFFSET_1

ADC offset number 1: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

ADC_OFFSET_2

ADC offset number 2: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

ADC_OFFSET_3

ADC offset number 3: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

ADC_OFFSET_4

ADC offset number 4: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

Oversampling - Discontinuous mode

ADC_TRIGGEREDMODE_SINGLE_TRIGGER

ADC oversampling discontinuous mode: continuous mode (all conversions of oversampling ratio are done from 1 trigger)

ADC_TRIGGEREDMODE_MULTI_TRIGGER

ADC oversampling discontinuous mode: discontinuous mode (each conversion of oversampling ratio needs a trigger)

Oversampling - Ratio

ADC_OVERSAMPLING_RATIO_2

ADC oversampling ratio of 2 (2 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_4

ADC oversampling ratio of 4 (4 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_8

ADC oversampling ratio of 8 (8 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_16

ADC oversampling ratio of 16 (16 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_32

ADC oversampling ratio of 32 (32 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_64

ADC oversampling ratio of 64 (64 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_128

ADC oversampling ratio of 128 (128 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

ADC_OVERSAMPLING_RATIO_256

ADC oversampling ratio of 256 (256 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

Oversampling - Oversampling scope for ADC group regular

ADC_REGOVERSAMPLING_CONTINUED_MODE

Oversampling buffer maintained during injection sequence

ADC_REGOVERSAMPLING_RESUMED_MODE

Oversampling buffer zeroed during injection sequence

Oversampling - Data shift

ADC_RIGHTBITSHIFT_NONE

ADC oversampling no shift (sum of the ADC conversions data is not divided to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_1

ADC oversampling shift of 1 (sum of the ADC conversions data is divided by 2 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_2

ADC oversampling shift of 2 (sum of the ADC conversions data is divided by 4 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_3

ADC oversampling shift of 3 (sum of the ADC conversions data is divided by 8 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_4

ADC oversampling shift of 4 (sum of the ADC conversions data is divided by 16 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_5

ADC oversampling shift of 5 (sum of the ADC conversions data is divided by 32 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_6

ADC oversampling shift of 6 (sum of the ADC conversions data is divided by 64 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_7

ADC oversampling shift of 7 (sum of the ADC conversions data is divided by 128 to result as the ADC oversampling conversion data)

ADC_RIGHTBITSHIFT_8

ADC oversampling shift of 8 (sum of the ADC conversions data is divided by 256 to result as the ADC oversampling conversion data)

ADC group regular - DFSDM transfer of ADC conversion data

ADC_DFSDM_MODE_DISABLE

ADC conversions are not transferred by DFSDM.

ADC_DFSDM_MODE_ENABLE

ADC conversion data are transfered to DFSDM for post processing. The ADC conversion data format must be 16-bit signed and right aligned, refer to reference manual. DFSDM transfer cannot be used if DMA transfer is enabled.

ADC group regular - Overrun behavior on conversion data

ADC_OVR_DATA_PRESERVED

ADC group regular behavior in case of overrun: data preserved

ADC_OVR_DATA_OVERWRITTEN

ADC group regular behavior in case of overrun: data overwritten

ADC group regular - Sequencer ranks

ADC_REGULAR_RANK_1

ADC group regular sequencer rank 1

ADC_REGULAR_RANK_2

ADC group regular sequencer rank 2

ADC_REGULAR_RANK_3

ADC group regular sequencer rank 3

ADC_REGULAR_RANK_4

ADC group regular sequencer rank 4

ADC_REGULAR_RANK_5

ADC group regular sequencer rank 5

ADC_REGULAR_RANK_6

ADC group regular sequencer rank 6

ADC_REGULAR_RANK_7

ADC group regular sequencer rank 7

ADC_REGULAR_RANK_8

ADC group regular sequencer rank 8

ADC_REGULAR_RANK_9

ADC group regular sequencer rank 9

ADC_REGULAR_RANK_10

ADC group regular sequencer rank 10

ADC_REGULAR_RANK_11

ADC group regular sequencer rank 11

ADC_REGULAR_RANK_12

ADC group regular sequencer rank 12

ADC_REGULAR_RANK_13

ADC group regular sequencer rank 13

ADC_REGULAR_RANK_14

ADC group regular sequencer rank 14

ADC_REGULAR_RANK_15

ADC group regular sequencer rank 15

ADC_REGULAR_RANK_16

ADC group regular sequencer rank 16

ADC instance - Resolution

ADC_RESOLUTION_12B

ADC resolution 12 bits

ADC_RESOLUTION_10B

ADC resolution 10 bits

ADC_RESOLUTION_8B

ADC resolution 8 bits

ADC_RESOLUTION_6B

ADC resolution 6 bits

HAL ADC macro to manage HAL ADC handle, IT and flags.

__HAL_ADC_RESET_HANDLE_STATE

Description:

- Reset ADC handle state.

Parameters:

- __HANDLE__: ADC handle

Return value:

- None

__HAL_ADC_ENABLE_IT

Description:

- Enable ADC interrupt.

Parameters:

- __HANDLE__: ADC handle
- __INTERRUPT__: ADC Interrupt This parameter can be one of the following values:
  - ADC_IT_RDY ADC Ready interrupt source
  - ADC_IT_EOSMP ADC End of Sampling interrupt source
  - ADC_IT_EOC ADC End of Regular Conversion interrupt source
  - ADC_IT_EOS ADC End of Regular sequence of Conversions interrupt source
  - ADC_IT_OVR ADC overrun interrupt source
  - ADC_IT_JEOC ADC End of Injected Conversion interrupt source
  - ADC_IT_JEOS ADC End of Injected sequence of Conversions interrupt source
  - ADC_IT_AWD1 ADC Analog watchdog 1 interrupt source (main analog watchdog)
  - ADC_IT_AWD2 ADC Analog watchdog 2 interrupt source (additional analog watchdog)
  - ADC_IT_AWD3 ADC Analog watchdog 3 interrupt source (additional analog watchdog)
  - ADC_IT_JQOVF ADC Injected Context Queue Overflow interrupt source.

Return value:

- None

__HAL_ADC_DISABLE_IT

Description:

- Disable ADC interrupt.

Parameters:

- __HANDLE__: ADC handle
- __INTERRUPT__: ADC Interrupt This parameter can be one of the following values:
  - ADC_IT_RDY ADC Ready interrupt source
  - ADC_IT_EOSMP ADC End of Sampling interrupt source
  - ADC_IT_EOC ADC End of Regular Conversion interrupt source
  - ADC_IT_EOS ADC End of Regular sequence of Conversions interrupt source
  - ADC_IT_OVR ADC overrun interrupt source
  - ADC_IT_JEOC ADC End of Injected Conversion interrupt source
  - ADC_IT_JEOS ADC End of Injected sequence of Conversions interrupt source
  - ADC_IT_AWD1 ADC Analog watchdog 1 interrupt source (main analog watchdog)
  - ADC_IT_AWD2 ADC Analog watchdog 2 interrupt source (additional analog watchdog)
  - ADC_IT_AWD3 ADC Analog watchdog 3 interrupt source (additional analog watchdog)
  - ADC_IT_JQOVF ADC Injected Context Queue Overflow interrupt source.

Return value:

- None

__HAL_ADC_GET_IT_SOURCE

Description:

- Checks if the specified ADC interrupt source is enabled or disabled.

Parameters:

- __HANDLE__: ADC handle
- __INTERRUPT__: ADC interrupt source to check This parameter can be one of the following values:
  - ADC_IT_RDY ADC Ready interrupt source
  - ADC_IT_EOSMP ADC End of Sampling interrupt source
  - ADC_IT_EOC ADC End of Regular Conversion interrupt source
  - ADC_IT_EOS ADC End of Regular sequence of Conversions interrupt source
  - ADC_IT_OVR ADC overrun interrupt source
  - ADC_IT_JEOC ADC End of Injected Conversion interrupt source
  - ADC_IT_JEOS ADC End of Injected sequence of Conversions interrupt source
  - ADC_IT_AWD1 ADC Analog watchdog 1 interrupt source (main analog watchdog)
  - ADC_IT_AWD2 ADC Analog watchdog 2 interrupt source (additional analog watchdog)
  - ADC_IT_AWD3 ADC Analog watchdog 3 interrupt source (additional analog watchdog)
  - ADC_IT_JQOVF ADC Injected Context Queue Overflow interrupt source.

Return value:

- State: of interruption (SET or RESET)

__HAL_ADC_GET_FLAG

Description:

- Check whether the specified ADC flag is set or not.

Parameters:

- __HANDLE__: ADC handle
- __FLAG__: ADC flag This parameter can be one of the following values:
  - ADC_FLAG_RDY ADC Ready flag
  - ADC_FLAG_EOSMP ADC End of Sampling flag
  - ADC_FLAG_EOC ADC End of Regular Conversion flag
  - ADC_FLAG_EOS ADC End of Regular sequence of Conversions flag
  - ADC_FLAG_OVR ADC overrun flag
  - ADC_FLAG_JEOC ADC End of Injected Conversion flag
  - ADC_FLAG_JEOS ADC End of Injected sequence of Conversions flag
  - ADC_FLAG_AWD1 ADC Analog watchdog 1 flag (main analog watchdog)
  - ADC_FLAG_AWD2 ADC Analog watchdog 2 flag (additional analog watchdog)
  - ADC_FLAG_AWD3 ADC Analog watchdog 3 flag (additional analog watchdog)
  - ADC_FLAG_JQOVF ADC Injected Context Queue Overflow flag.

Return value:

- State: of flag (TRUE or FALSE).

__HAL_ADC_CLEAR_FLAG

Description:

- Clear the specified ADC flag.

Parameters:

- __HANDLE__: ADC handle
- __FLAG__: ADC flag This parameter can be one of the following values:
  - ADC_FLAG_RDY ADC Ready flag
  - ADC_FLAG_EOSMP ADC End of Sampling flag
  - ADC_FLAG_EOC ADC End of Regular Conversion flag
  - ADC_FLAG_EOS ADC End of Regular sequence of Conversions flag
  - ADC_FLAG_OVR ADC overrun flag
  - ADC_FLAG_JEOC ADC End of Injected Conversion flag
  - ADC_FLAG_JEOS ADC End of Injected sequence of Conversions flag
  - ADC_FLAG_AWD1 ADC Analog watchdog 1 flag (main analog watchdog)
  - ADC_FLAG_AWD2 ADC Analog watchdog 2 flag (additional analog watchdog)
  - ADC_FLAG_AWD3 ADC Analog watchdog 3 flag (additional analog watchdog)
  - ADC_FLAG_JQOVF ADC Injected Context Queue Overflow flag.

Return value:

- None

HAL ADC helper macro

__HAL_ADC_CHANNEL_TO_DECIMAL_NB

Description:

- Helper macro to get ADC channel number in decimal format from literals ADC_CHANNEL_x.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - ADC_CHANNEL_0
  - ADC_CHANNEL_1 (7)
  - ADC_CHANNEL_2 (7)
  - ADC_CHANNEL_3 (7)
  - ADC_CHANNEL_4 (7)
  - ADC_CHANNEL_5 (7)
  - ADC_CHANNEL_6
  - ADC_CHANNEL_7
  - ADC_CHANNEL_8
  - ADC_CHANNEL_9
  - ADC_CHANNEL_10
  - ADC_CHANNEL_11
  - ADC_CHANNEL_12
  - ADC_CHANNEL_13
  - ADC_CHANNEL_14
  - ADC_CHANNEL_15
  - ADC_CHANNEL_16
  - ADC_CHANNEL_17
  - ADC_CHANNEL_18
  - ADC_CHANNEL_VREFINT (1)
  - ADC_CHANNEL_TEMPSENSOR (4)
  - ADC_CHANNEL_VBAT (4)
  - ADC_CHANNEL_DAC1CH1 (5)
  - ADC_CHANNEL_DAC1CH2 (5)
  - ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Value: between Min_Data=0 and Max_Data=18

Notes:

- Example: __HAL_ADC_CHANNEL_TO_DECIMAL_NB(ADC_CHANNEL_4) will return decimal number "4". The input can be a value from functions where a channel number is returned, either defined with number or with bitfield (only one bit must be set).

__HAL_ADC_DECIMAL_NB_TO_CHANNEL

Description:

- Helper macro to get ADC channel in literal format ADC_CHANNEL_x from number in decimal format.

Parameters:

- __DECIMAL_NB__: Value between Min_Data=0 and Max_Data=18

Return value:

- Returned: value can be one of the following values:
  - ADC_CHANNEL_0
  - ADC_CHANNEL_1 (7)
  - ADC_CHANNEL_2 (7)
  - ADC_CHANNEL_3 (7)
  - ADC_CHANNEL_4 (7)
  - ADC_CHANNEL_5 (7)
  - ADC_CHANNEL_6
  - ADC_CHANNEL_7
  - ADC_CHANNEL_8
  - ADC_CHANNEL_9
  - ADC_CHANNEL_10
  - ADC_CHANNEL_11
  - ADC_CHANNEL_12
  - ADC_CHANNEL_13
  - ADC_CHANNEL_14
  - ADC_CHANNEL_15
  - ADC_CHANNEL_16
  - ADC_CHANNEL_17
  - ADC_CHANNEL_18
  - ADC_CHANNEL_VREFINT (1)
  - ADC_CHANNEL_TEMPSENSOR (4)
  - ADC_CHANNEL_VBAT (4)
  - ADC_CHANNEL_DAC1CH1 (5)
  - ADC_CHANNEL_DAC1CH2 (5)
  - ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Notes:

- Example: __HAL_ADC_DECIMAL_NB_TO_CHANNEL(4) will return a data equivalent to "ADC_CHANNEL_4".

__HAL_ADC_IS_CHANNEL_INTERNAL

Description:

- Helper macro to determine whether the selected channel corresponds to literal definitions of driver.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - ADC_CHANNEL_0
  - ADC_CHANNEL_1 (7)
  - ADC_CHANNEL_2 (7)
  - ADC_CHANNEL_3 (7)
  - ADC_CHANNEL_4 (7)
  - ADC_CHANNEL_5 (7)
  - ADC_CHANNEL_6
  - ADC_CHANNEL_7
  - ADC_CHANNEL_8
  - ADC_CHANNEL_9
  - ADC_CHANNEL_10
  - ADC_CHANNEL_11
  - ADC_CHANNEL_12
  - ADC_CHANNEL_13
  - ADC_CHANNEL_14
  - ADC_CHANNEL_15
  - ADC_CHANNEL_16
  - ADC_CHANNEL_17
  - ADC_CHANNEL_18
  - ADC_CHANNEL_VREFINT (1)
  - ADC_CHANNEL_TEMPSENSOR (4)
  - ADC_CHANNEL_VBAT (4)
  - ADC_CHANNEL_DAC1CH1 (5)
  - ADC_CHANNEL_DAC1CH2 (5)
  - ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Value: "0" if the channel corresponds to a parameter definition of a ADC external channel (channel connected to a GPIO pin). Value "1" if the channel corresponds to a parameter definition of a ADC internal channel.

Notes:

- The different literal definitions of ADC channels are: ADC internal channel: ADC_CHANNEL_VREFINT, ADC_CHANNEL_TEMPSENSOR, ...ADC external channel (channel connected to a GPIO pin): ADC_CHANNEL_1, ADC_CHANNEL_2, ... The channel parameter must be a value defined from literal definition of a ADC internal channel (ADC_CHANNEL_VREFINT, ADC_CHANNEL_TEMPSENSOR, ...), ADC external channel (ADC_CHANNEL_1, ADC_CHANNEL_2, ...), must not be a value from functions where a channel number is returned from ADC registers, because internal and external channels share the same channel number in ADC registers. The differentiation is made only with parameters definitions of driver.

__HAL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL

Description:

- Helper macro to convert a channel defined from parameter definition of a ADC internal channel (ADC_CHANNEL_VREFINT, ADC_CHANNEL_TEMPSENSOR, ...), to its equivalent parameter definition of a ADC external channel (ADC_CHANNEL_1, ADC_CHANNEL_2, ...).

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - ADC_CHANNEL_0
  - ADC_CHANNEL_1 (7)
  - ADC_CHANNEL_2 (7)
  - ADC_CHANNEL_3 (7)
  - ADC_CHANNEL_4 (7)
  - ADC_CHANNEL_5 (7)
  - ADC_CHANNEL_6
  - ADC_CHANNEL_7
  - ADC_CHANNEL_8
  - ADC_CHANNEL_9
  - ADC_CHANNEL_10
  - ADC_CHANNEL_11
  - ADC_CHANNEL_12
  - ADC_CHANNEL_13
  - ADC_CHANNEL_14
  - ADC_CHANNEL_15
  - ADC_CHANNEL_16
  - ADC_CHANNEL_17
  - ADC_CHANNEL_18
  - ADC_CHANNEL_VREFINT (1)
  - ADC_CHANNEL_TEMPSENSOR (4)
  - ADC_CHANNEL_VBAT (4)
  - ADC_CHANNEL_DAC1CH1 (5)
  - ADC_CHANNEL_DAC1CH2 (5)
  - ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Returned: value can be one of the following values:
  - ADC_CHANNEL_0
  - ADC_CHANNEL_1
  - ADC_CHANNEL_2
  - ADC_CHANNEL_3
  - ADC_CHANNEL_4
  - ADC_CHANNEL_5
  - ADC_CHANNEL_6
  - ADC_CHANNEL_7
  - ADC_CHANNEL_8
  - ADC_CHANNEL_9
  - ADC_CHANNEL_10
  - ADC_CHANNEL_11

  - ADC_CHANNEL_12
  - ADC_CHANNEL_13
  - ADC_CHANNEL_14
  - ADC_CHANNEL_15
  - ADC_CHANNEL_16
  - ADC_CHANNEL_17
  - ADC_CHANNEL_18

Notes:

- The channel parameter can be, additionally to a value defined from parameter definition of a ADC internal channel (ADC_CHANNEL_VREFINT, ADC_CHANNEL_TEMPSENSOR, ...), a value defined from parameter definition of ADC external channel (ADC_CHANNEL_1, ADC_CHANNEL_2, ...) or a value from functions where a channel number is returned from ADC registers.

__HAL_ADC_IS_CHANNEL_INTERNAL_AVAILABLE

Description:

- Helper macro to determine whether the internal channel selected is available on the ADC instance selected.

Parameters:

- __ADC_INSTANCE__: ADC instance
- __CHANNEL__: This parameter can be one of the following values:
  - ADC_CHANNEL_VREFINT (1)
  - ADC_CHANNEL_TEMPSENSOR (4)
  - ADC_CHANNEL_VBAT (4)
  - ADC_CHANNEL_DAC1CH1 (5)
  - ADC_CHANNEL_DAC1CH2 (5)
  - ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Value: "0" if the internal channel selected is not available on the ADC instance selected. Value "1" if the internal channel selected is available on the ADC instance selected.

Notes:

- The channel parameter must be a value defined from parameter definition of a ADC internal channel (ADC_CHANNEL_VREFINT, ADC_CHANNEL_TEMPSENSOR, ...), must not be a value defined from parameter definition of ADC external channel (ADC_CHANNEL_1, ADC_CHANNEL_2, ...) or a value from functions where a channel number is returned from ADC registers, because internal and external channels share the same channel number in ADC registers. The differentiation is made only with parameters definitions of driver.

__HAL_ADC_COMMON_INSTANCE

Description:

- Helper macro to select the ADC common instance to which is belonging the selected ADC instance.

Parameters:

- __ADCx__: ADC instance

Return value:

- ADC: common register instance

Notes:

- ADC common register instance can be used for: Set parameters common to several ADC instancesMultimode (for devices with several ADC instances) Refer to functions having argument "ADCxy_COMMON" as parameter.

__HAL_ADC_IS_ENABLED_ALL_COMMON_INSTANCE

Description:

- Helper macro to check if all ADC instances sharing the same ADC common instance are disabled.

Parameters:

- __ADCXY_COMMON__: ADC common instance (can be set directly from CMSIS definition or by using helper macro

Return value:

- Value: "0" if all ADC instances sharing the same ADC common instance are disabled. Value "1" if at least one ADC instance sharing the same ADC common instance is enabled.

Notes:

- This check is required by functions with setting conditioned to ADC state: All ADC instances of the ADC common group must be disabled. Refer to functions having argument "ADCxy_COMMON" as parameter. On devices with only 1 ADC common instance, parameter of this macro is useless and can be ignored (parameter kept for compatibility with devices featuring several ADC common instances).

__HAL_ADC_DIGITAL_SCALE

Description:

- Helper macro to define the ADC conversion data full-scale digital value corresponding to the selected ADC resolution.

Parameters:

- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B

Return value:

- ADC: conversion data full-scale digital value

Notes:

- ADC conversion data full-scale corresponds to voltage range determined by analog voltage references Vref + and Vref- (refer to reference manual).

__HAL_ADC_CONVERT_DATA_RESOLUTION

Description:

- Helper macro to convert the ADC conversion data from a resolution to another resolution.

Parameters:

- __DATA__: ADC conversion data to be converted
- __ADC_RESOLUTION_CURRENT__: Resolution of to the data to be converted This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B
- __ADC_RESOLUTION_TARGET__: Resolution of the data after conversion This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B

Return value:

- ADC: conversion data to the requested resolution

__HAL_ADC_CALC_DATA_TO_VOLTAGE

Description:

- Helper macro to calculate the voltage (unit: mVolt) corresponding to a ADC conversion data (unit: digital value).

Parameters:

- __VREFANALOG_VOLTAGE__: Analog reference voltage (unit: mV)
- __ADC_DATA__: ADC conversion data (resolution 12 bits) (unit: digital value).
- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B

Return value:

- ADC: conversion data equivalent voltage value (unit: mVolt)

Notes:

- Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE().

__HAL_ADC_CALC_VREFANALOG_VOLTAGE

Description:

- Helper macro to calculate analog reference voltage (Vref+) (unit: mVolt) from ADC conversion data of internal voltage reference VrefInt.

Parameters:

- __VREFINT_ADC_DATA__: ADC conversion data (resolution 12 bits) of internal voltage reference VrefInt (unit: digital value).
- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B

Return value:

- Analog: reference voltage (unit: mV)

Notes:

- Computation is using VrefInt calibration value stored in system memory for each device during production. This voltage depends on user board environment: voltage level connected to pin Vref+. On devices with small package, the pin Vref+ is not present and internally bonded to pin Vdda. On this STM32 serie, calibration data of internal voltage reference VrefInt corresponds to a resolution of 12 bits, this is the recommended ADC resolution to convert voltage of internal voltage reference VrefInt. Otherwise, this macro performs the processing to scale ADC conversion data to 12 bits.

__HAL_ADC_CALC_TEMPERATURE

Description:

- Helper macro to calculate the temperature (unit: degree Celsius) from ADC conversion data of internal temperature sensor.

Parameters:

- __VREFANALOG_VOLTAGE__: Analog reference voltage (unit: mV)
- __TEMPSENSOR_ADC_DATA__: ADC conversion data of internal temperature sensor (unit: digital value).
- __ADC_RESOLUTION__: ADC resolution at which internal temperature sensor voltage has been measured. This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B

Return value:

- Temperature: (unit: degree Celsius)

Notes:

- Computation is using temperature sensor calibration values stored in system memory for each device during production. Calculation formula: Temperature = ((TS_ADC_DATA - TS_CAL1) * (TS_CAL2_TEMP - TS_CAL1_TEMP)) / (TS_CAL2 - TS_CAL1) + TS_CAL1_TEMP with TS_ADC_DATA = temperature sensor raw data measured by ADC Avg_Slope = (TS_CAL2 - TS_CAL1) / (TS_CAL2_TEMP - TS_CAL1_TEMP) TS_CAL1 = equivalent TS_ADC_DATA at temperature TEMP_DEGC_CAL1 (calibrated in factory) TS_CAL2 = equivalent TS_ADC_DATA at temperature TEMP_DEGC_CAL2 (calibrated in factory) Caution: Calculation relevancy under reserve that calibration parameters are correct (address and data). To calculate temperature using temperature sensor datasheet typical values (generic values less, therefore less accurate than calibrated values), use helper macro __LL_ADC_CALC_TEMPERATURE_TYP_PARAMS(). As calculation input, the analog reference voltage (Vref+) must be defined as it impacts the ADC LSB equivalent voltage. Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE(). On this STM32 serie, calibration data of temperature sensor corresponds to a resolution of 12 bits, this is the recommended ADC resolution to convert voltage of temperature sensor. Otherwise, this macro performs the processing to scale ADC conversion data to 12 bits.

__HAL_ADC_CALC_TEMPERATURE_TYP_PARAMS

Description:

- Helper macro to calculate the temperature (unit: degree Celsius) from ADC conversion data of internal temperature sensor.

Parameters:

- __TEMPSENSOR_TYP_AVGSLOPE__: Device datasheet data: Temperature sensor slope typical value (unit: uV/DegCelsius). On STM32L4, refer to device datasheet parameter "Avg_Slope".
- __TEMPSENSOR_TYP_CALX_V__: Device datasheet data: Temperature sensor voltage typical value (at temperature and Vref+ defined in parameters below) (unit: mV). On STM32L4, refer to device datasheet parameter "V30" (corresponding to TS_CAL1).
- __TEMPSENSOR_CALX_TEMP__: Device datasheet data: Temperature at which temperature sensor voltage (see parameter above) is corresponding (unit: mV)
- __VREFANALOG_VOLTAGE__: Analog voltage reference (Vref+) voltage (unit: mV)
- __TEMPSENSOR_ADC_DATA__: ADC conversion data of internal temperature sensor (unit: digital value).
- __ADC_RESOLUTION__: ADC resolution at which internal temperature sensor voltage has been measured. This parameter can be one of the following values:
  - ADC_RESOLUTION_12B
  - ADC_RESOLUTION_10B
  - ADC_RESOLUTION_8B
  - ADC_RESOLUTION_6B

Return value:

- Temperature: (unit: degree Celsius)

Notes:

- Computation is using temperature sensor typical values (refer to device datasheet). Calculation formula: Temperature = (TS_TYP_CALx_VOLT(uV) - TS_ADC_DATA * Conversion_uV) / Avg_Slope + CALx_TEMP with TS_ADC_DATA = temperature sensor raw data measured by ADC (unit: digital value) Avg_Slope = temperature sensor slope (unit: uV/Degree Celsius) TS_TYP_CALx_VOLT = temperature sensor digital value at temperature CALx_TEMP (unit: mV) Caution: Calculation relevancy under reserve the temperature sensor of the current device has characteristics in line with datasheet typical values. If temperature sensor calibration values are available on on this device (presence of macro __LL_ADC_CALC_TEMPERATURE()), temperature calculation will be more accurate using helper macro __LL_ADC_CALC_TEMPERATURE(). As calculation input, the analog reference voltage (Vref+) must be defined as it impacts the ADC LSB equivalent voltage. Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE(). ADC measurement data must correspond to a resolution of 12bits (full scale digital value 4095). If not the case, the data must be preliminarily rescaled to an equivalent resolution of 12 bits.

ADC group injected trigger edge (when external trigger is selected)

ADC_EXTERNALTRIGINJECCONV_EDGE_NONE

Injected conversions hardware trigger detection disabled

ADC_EXTERNALTRIGINJECCONV_EDGE_RISING

Injected conversions hardware trigger detection on the rising edge

ADC_EXTERNALTRIGINJECCONV_EDGE_FALLING

Injected conversions hardware trigger detection on the falling edge

ADC_EXTERNALTRIGINJECCONV_EDGE_RISINGFALLING

Injected conversions hardware trigger detection on both the rising and falling edges

ADC group injected trigger source

ADC_INJECTED_SOFTWARE_START

Software triggers injected group conversion start

ADC_EXTERNALTRIGINJEC_T1_TRGO

ADC group injected conversion trigger from external peripheral: TIM1 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T1_TRGO2

ADC group injected conversion trigger from external peripheral: TIM1 TRGO2. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T1_CC4

ADC group injected conversion trigger from external peripheral: TIM1 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T2_TRGO

ADC group injected conversion trigger from external peripheral: TIM2 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T2_CC1

ADC group injected conversion trigger from external peripheral: TIM2 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T3_TRGO

ADC group injected conversion trigger from external peripheral: TIM3 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T3_CC1

ADC group injected conversion trigger from external peripheral: TIM3 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T3_CC3

ADC group injected conversion trigger from external peripheral: TIM3 channel 3 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T3_CC4

ADC group injected conversion trigger from external peripheral: TIM3 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T4_TRGO

ADC group injected conversion trigger from external peripheral: TIM4 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T6_TRGO

ADC group injected conversion trigger from external peripheral: TIM6 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T8_CC4

ADC group injected conversion trigger from external peripheral: TIM8 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T8_TRGO

ADC group injected conversion trigger from external peripheral: TIM8 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T8_TRGO2

ADC group injected conversion trigger from external peripheral: TIM8 TRGO2. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_T15_TRGO

ADC group injected conversion trigger from external peripheral: TIM15 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIGINJEC_EXT_IT15

ADC group injected conversion trigger from external peripheral: external interrupt line 15. Trigger edge set to rising edge (default setting).

ADC group injected - Sequencer ranks

ADC_INJECTED_RANK_1

ADC group injected sequencer rank 1

ADC_INJECTED_RANK_2

ADC group injected sequencer rank 2

ADC_INJECTED_RANK_3

ADC group injected sequencer rank 3

ADC_INJECTED_RANK_4

ADC group injected sequencer rank 4

ADC interrupts definition

ADC_IT_RDY

ADC Ready interrupt source

ADC_IT_EOSMP

ADC End of sampling interrupt source

ADC_IT_EOC

ADC End of regular conversion interrupt source

ADC_IT_EOS

ADC End of regular sequence of conversions interrupt source

ADC_IT_OVR

ADC overrun interrupt source

ADC_IT_JEOC

ADC End of injected conversion interrupt source

ADC_IT_JEOS

ADC End of injected sequence of conversions interrupt source

ADC_IT_AWD1

ADC Analog watchdog 1 interrupt source (main analog watchdog)

ADC_IT_AWD2

ADC Analog watchdog 2 interrupt source (additional analog watchdog)

ADC_IT_AWD3

ADC Analog watchdog 3 interrupt source (additional analog watchdog)

ADC_IT_JQOVF

ADC Injected Context Queue Overflow interrupt source

ADC_IT_AWD

ADC Analog watchdog 1 interrupt source: naming for compatibility with other STM32 devices having only one analog watchdog

ADC group regular trigger edge (when external trigger is selected)

ADC_EXTERNALTRIGCONVEDGE_NONE

Regular conversions hardware trigger detection disabled

ADC_EXTERNALTRIGCONVEDGE_RISING

ADC group regular conversion trigger polarity set to rising edge

ADC_EXTERNALTRIGCONVEDGE_FALLING

ADC group regular conversion trigger polarity set to falling edge

ADC_EXTERNALTRIGCONVEDGE_RISINGFALLING

ADC group regular conversion trigger polarity set to both rising and falling edges

ADC group regular trigger source

ADC_SOFTWARE_START

ADC group regular conversion trigger internal: SW start.

ADC_EXTERNALTRIG_T1_TRGO

ADC group regular conversion trigger from external peripheral: TIM1 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T1_TRGO2

ADC group regular conversion trigger from external peripheral: TIM1 TRGO2. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T1_CC1

ADC group regular conversion trigger from external peripheral: TIM1 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T1_CC2

ADC group regular conversion trigger from external peripheral: TIM1 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T1_CC3

ADC group regular conversion trigger from external peripheral: TIM1 channel 3 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T2_TRGO

ADC group regular conversion trigger from external peripheral: TIM2 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T2_CC2

ADC group regular conversion trigger from external peripheral: TIM2 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T3_TRGO

ADC group regular conversion trigger from external peripheral: TIM3 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T3_CC4

ADC group regular conversion trigger from external peripheral: TIM3 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T4_TRGO

ADC group regular conversion trigger from external peripheral: TIM4 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T4_CC4

ADC group regular conversion trigger from external peripheral: TIM4 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T6_TRGO

ADC group regular conversion trigger from external peripheral: TIM6 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T8_TRGO

ADC group regular conversion trigger from external peripheral: TIM8 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T8_TRGO2

ADC group regular conversion trigger from external peripheral: TIM8 TRGO2. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_T15_TRGO

ADC group regular conversion trigger from external peripheral: TIM15 TRGO. Trigger edge set to rising edge (default setting).

ADC_EXTERNALTRIG_EXT_IT11

ADC group regular conversion trigger from external peripheral: external interrupt line 11. Trigger edge set to rising edge (default setting).

ADC sequencer scan mode

ADC_SCAN_DISABLE

Scan mode disabled

ADC_SCAN_ENABLE

Scan mode enabled

ADCx SMPR1 fields

ADC_SMPR1_FIELDS

ADC States

HAL_ADC_STATE_RESET

Notes:

- ADC state machine is managed by bitfields, state must be compared with bit by bit. For example: " if ((HAL_ADC_GetState(hadc1) & HAL_ADC_STATE_REG_BUSY) != 0UL) " " if ((HAL_ADC_GetState(hadc1) & HAL_ADC_STATE_AWD1) != 0UL) " ADC not yet initialized or disabled

HAL_ADC_STATE_READY

ADC peripheral ready for use

HAL_ADC_STATE_BUSY_INTERNAL

ADC is busy due to an internal process (initialization, calibration)

HAL_ADC_STATE_TIMEOUT

TimeOut occurrence

HAL_ADC_STATE_ERROR_INTERNAL

Internal error occurrence

HAL_ADC_STATE_ERROR_CONFIG

Configuration error occurrence

HAL_ADC_STATE_ERROR_DMA

DMA error occurrence

HAL_ADC_STATE_REG_BUSY

A conversion on ADC group regular is ongoing or can occur (either by continuous mode, external trigger, low power auto power-on (if feature available), multimode ADC master control (if feature available))

HAL_ADC_STATE_REG_EOC

Conversion data available on group regular

HAL_ADC_STATE_REG_OVR

Overrun occurrence

HAL_ADC_STATE_REG_EOSMP

Not available on this STM32 serie: End Of Sampling flag raised

HAL_ADC_STATE_INJ_BUSY

A conversion on ADC group injected is ongoing or can occur (either by auto-injection mode, external trigger, low power auto power-on (if feature available), multimode ADC master control (if feature available))

HAL_ADC_STATE_INJ_EOC

Conversion data available on group injected

HAL_ADC_STATE_INJ_JQOVF

Injected queue overflow occurrence

HAL_ADC_STATE_AWD1

Out-of-window occurrence of ADC analog watchdog 1

HAL_ADC_STATE_AWD2

Out-of-window occurrence of ADC analog watchdog 2

HAL_ADC_STATE_AWD3

Out-of-window occurrence of ADC analog watchdog 3

HAL_ADC_STATE_MULTIMODE_SLAVE

ADC in multimode slave state, controlled by another ADC master (when feature available)

8 HAL ADC Extension Driver

8.1 ADCEx Firmware driver registers structures

8.1.1 ADC_InjOversamplingTypeDef

ADC_InjOversamplingTypeDef is defined in the stm32l4xx_hal_adc_ex.h

Data Fields

- ***uint32_t Ratio***
- ***uint32_t RightBitShift***

Field Documentation

- ***uint32_t ADC_InjOversamplingTypeDef::Ratio***
  Configures the oversampling ratio. This parameter can be a value of ***ADC_HAL_EC_OVS_RATIO***
- ***uint32_t ADC_InjOversamplingTypeDef::RightBitShift***
  Configures the division coefficient for the Oversampler. This parameter can be a value of ***ADC_HAL_EC_OVS_SHIFT***

8.1.2 ADC_InjectionConfTypeDef

ADC_InjectionConfTypeDef is defined in the stm32l4xx_hal_adc_ex.h

Data Fields

- ***uint32_t InjectedChannel***
- ***uint32_t InjectedRank***
- ***uint32_t InjectedSamplingTime***
- ***uint32_t InjectedSingleDiff***
- ***uint32_t InjectedOffsetNumber***
- ***uint32_t InjectedOffset***
- ***uint32_t InjectedNbrOfConversion***
- ***FunctionalState InjectedDiscontinuousConvMode***
- ***FunctionalState AutoInjectedConv***
- ***FunctionalState QueueInjectedContext***
- ***uint32_t ExternalTrigInjecConv***
- ***uint32_t ExternalTrigInjecConvEdge***
- ***FunctionalState InjecOversamplingMode***
- ***ADC_InjOversamplingTypeDef InjecOversampling***

Field Documentation

- ***uint32_t ADC_InjectionConfTypeDef::InjectedChannel***
  Specifies the channel to configure into ADC group injected. This parameter can be a value of ***ADC_HAL_EC_CHANNEL*** Note: Depending on devices and ADC instances, some channels may not be available on device package pins. Refer to device datasheet for channels availability.
- ***uint32_t ADC_InjectionConfTypeDef::InjectedRank***
  Specifies the rank in the ADC group injected sequencer. This parameter must be a value of ***ADC_INJ_SEQ_RANKS***. Note: to disable a channel or change order of conversion sequencer, rank containing a previous channel setting can be overwritten by the new channel setting (or parameter number of conversions adjusted)

- ***uint32_t ADC_InjectionConfTypeDef::InjectedSamplingTime***

  Sampling time value to be set for the selected channel. Unit: ADC clock cycles. Conversion time is the addition of sampling time and processing time (12.5 ADC clock cycles at ADC resolution 12 bits, 10.5 cycles at 10 bits, 8.5 cycles at 8 bits, 6.5 cycles at 6 bits). This parameter can be a value of ***ADC_HAL_EC_CHANNEL_SAMPLINGTIME***. Caution: This parameter applies to a channel that can be used in a regular and/or injected group. It overwrites the last setting. Note: In case of usage of internal measurement channels (VrefInt/Vbat/TempSensor), sampling time constraints must be respected (sampling time can be adjusted in function of ADC clock frequency and sampling time setting) Refer to device datasheet for timings values.

- ***uint32_t ADC_InjectionConfTypeDef::InjectedSingleDiff***

  Selection of single-ended or differential input. In differential mode: Differential measurement is between the selected channel 'i' (positive input) and channel 'i+1' (negative input). Only channel 'i' has to be configured, channel 'i+1' is configured automatically. This parameter must be a value of ***ADC_HAL_EC_CHANNEL_SINGLE_DIFF_ENDING***. Caution: This parameter applies to a channel that can be used in a regular and/or injected group. It overwrites the last setting. Note: Refer to Reference Manual to ensure the selected channel is available in differential mode. Note: When configuring a channel 'i' in differential mode, the channel 'i+1' is not usable separately. Note: This parameter must be modified when ADC is disabled (before ADC start conversion or after ADC stop conversion). If ADC is enabled, this parameter setting is bypassed without error reporting (as it can be the expected behavior in case of another parameter update on the fly)

- ***uint32_t ADC_InjectionConfTypeDef::InjectedOffsetNumber***

  Selects the offset number. This parameter can be a value of ***ADC_HAL_EC_OFFSET_NB***. Caution: Only one offset is allowed per channel. This parameter overwrites the last setting.

- ***uint32_t ADC_InjectionConfTypeDef::InjectedOffset***

  Defines the offset to be subtracted from the raw converted data. Offset value must be a positive number. Depending of ADC resolution selected (12, 10, 8 or 6 bits), this parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF, 0x3FF, 0xFF or 0x3F respectively. Note: This parameter must be modified when no conversion is on going on both regular and injected groups (ADC disabled, or ADC enabled without continuous mode or external trigger that could launch a conversion).

- ***uint32_t ADC_InjectionConfTypeDef::InjectedNbrOfConversion***

  Specifies the number of ranks that will be converted within the ADC group injected sequencer. To use the injected group sequencer and convert several ranks, parameter 'ScanConvMode' must be enabled. This parameter must be a number between Min_Data = 1 and Max_Data = 4. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEx_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.

- ***FunctionalState ADC_InjectionConfTypeDef::InjectedDiscontinuousConvMode***

  Specifies whether the conversions sequence of ADC group injected is performed in Complete-sequence/ Discontinuous-sequence (main sequence subdivided in successive parts). Discontinuous mode is used only if sequencer is enabled (parameter 'ScanConvMode'). If sequencer is disabled, this parameter is discarded. Discontinuous mode can be enabled only if continuous mode is disabled. This parameter can be set to ENABLE or DISABLE. Note: This parameter must be modified when ADC is disabled (before ADC start conversion or after ADC stop conversion). Note: For injected group, discontinuous mode converts the sequence channel by channel (discontinuous length fixed to 1 rank). Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEx_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.

- ***FunctionalState ADC_InjectionConfTypeDef::AutoInjectedConv***

  Enables or disables the selected ADC group injected automatic conversion after regular one This parameter can be set to ENABLE or DISABLE. Note: To use Automatic injected conversion, discontinuous mode must be disabled ('DiscontinuousConvMode' and 'InjectedDiscontinuousConvMode' set to DISABLE) Note: To use Automatic injected conversion, injected group external triggers must be disabled ('ExternalTrigInjecConv' set to ADC_INJECTED_SOFTWARE_START) Note: In case of DMA used with regular group: if DMA configured in normal mode (single shot) JAUTO will be stopped upon DMA transfer complete. To maintain JAUTO always enabled, DMA must be configured in circular mode. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEx_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.

- ***FunctionalState ADC_InjectionConfTypeDef::QueueInjectedContext***

  Specifies whether the context queue feature is enabled. This parameter can be set to ENABLE or DISABLE. If context queue is enabled, injected sequencer&channels configurations are queued on up to 2 contexts. If a new injected context is set when queue is full, error is triggered by interruption and through function 'HAL_ADCEx_InjectedQueueOverflowCallback'. Caution: This feature request that the sequence is fully configured before injected conversion start. Therefore, configure channels with as many calls to **HAL_ADCEx_InjectedConfigChannel()** as the 'InjectedNbrOfConversion' parameter. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEx_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set. Note: This parameter must be modified when ADC is disabled (before ADC start conversion or after ADC stop conversion).
- ***uint32_t ADC_InjectionConfTypeDef::ExternalTrigInjecConv***

  Selects the external event used to trigger the conversion start of injected group. If set to ADC_INJECTED_SOFTWARE_START, external triggers are disabled and software trigger is used instead. This parameter can be a value of ***ADC_injected_external_trigger_source***. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEx_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.
- ***uint32_t ADC_InjectionConfTypeDef::ExternalTrigInjecConvEdge***

  Selects the external trigger edge of injected group. This parameter can be a value of ***ADC_injected_external_trigger_edge***. If trigger source is set to ADC_INJECTED_SOFTWARE_START, this parameter is discarded. Caution: this setting impacts the entire injected group. Therefore, call of **HAL_ADCEx_InjectedConfigChannel()** to configure a channel on injected group can impact the configuration of other channels previously set.
- ***FunctionalState ADC_InjectionConfTypeDef::InjecOversamplingMode***

  Specifies whether the oversampling feature is enabled or disabled. This parameter can be set to ENABLE or DISABLE. Note: This parameter can be modified only if there is no conversion is ongoing (both ADSTART and JADSTART cleared).
- ***ADC_InjOversamplingTypeDef ADC_InjectionConfTypeDef::InjecOversampling***

  Specifies the Oversampling parameters. Caution: this setting overwrites the previous oversampling configuration if oversampling already enabled. Note: This parameter can be modified only if there is no conversion is ongoing (both ADSTART and JADSTART cleared).

8.2 ADCEx Firmware driver API description

The following section lists the various functions of the ADCEx library.

8.2.1 IO operation functions

This section provides functions allowing to:

- Perform the ADC self-calibration for single or differential ending.
- Get calibration factors for single or differential ending.
- Set calibration factors for single or differential ending.
- Start conversion of ADC group injected.
- Stop conversion of ADC group injected.
- Poll for conversion complete on ADC group injected.
- Get result of ADC group injected channel conversion.
- Start conversion of ADC group injected and enable interruptions.
- Stop conversion of ADC group injected and disable interruptions.
- When multimode feature is available, start multimode and enable DMA transfer.
- Stop multimode and disable ADC DMA transfer.
- Get result of multimode conversion.

This section contains the following APIs:

- ***HAL_ADCEx_Calibration_Start***
- ***HAL_ADCEx_Calibration_GetValue***
- ***HAL_ADCEx_Calibration_SetValue***

- *HAL_ADCEx_InjectedStart*
- *HAL_ADCEx_InjectedStop*
- *HAL_ADCEx_InjectedPollForConversion*
- *HAL_ADCEx_InjectedStart_IT*
- *HAL_ADCEx_InjectedStop_IT*
- *HAL_ADCEx_InjectedGetValue*
- *HAL_ADCEx_InjectedConvCpltCallback*
- *HAL_ADCEx_InjectedQueueOverflowCallback*
- *HAL_ADCEx_LevelOutOfWindow2Callback*
- *HAL_ADCEx_LevelOutOfWindow3Callback*
- *HAL_ADCEx_EndOfSamplingCallback*
- *HAL_ADCEx_RegularStop*
- *HAL_ADCEx_RegularStop_IT*
- *HAL_ADCEx_RegularStop_DMA*

8.2.2 Peripheral Control functions

This section provides functions allowing to:

- Configure channels on injected group
- Configure multimode when multimode feature is available
- Enable or Disable Injected Queue
- Disable ADC voltage regulator
- Enter ADC deep-power-down mode

This section contains the following APIs:

- *HAL_ADCEx_InjectedConfigChannel*
- *HAL_ADCEx_EnableInjectedQueue*
- *HAL_ADCEx_DisableInjectedQueue*
- *HAL_ADCEx_DisableVoltageRegulator*
- *HAL_ADCEx_EnterADCDeepPowerDownMode*

8.2.3 Detailed description of functions

`HAL_ADCEx_Calibration_Start`

Function name

HAL_StatusTypeDef HAL_ADCEx_Calibration_Start (ADC_HandleTypeDef * hadc, uint32_t SingleDiff)

Function description

Perform an ADC automatic self-calibration Calibration prerequisite: ADC must be disabled (execute this function before HAL_ADC_Start() or after HAL_ADC_Stop()).

Parameters

- **hadc:** ADC handle
- **SingleDiff:** Selection of single-ended or differential input This parameter can be one of the following values:
  - ADC_SINGLE_ENDED Channel in mode input single ended
  - ADC_DIFFERENTIAL_ENDED Channel in mode input differential ended

Return values

- **HAL:** status

`HAL_ADCEx_Calibration_GetValue`

Function name

uint32_t HAL_ADCEx_Calibration_GetValue (ADC_HandleTypeDef * hadc, uint32_t SingleDiff)

Function description

Get the calibration factor.

Parameters

- **hadc:** ADC handle.
- **SingleDiff:** This parameter can be only:
  - ADC_SINGLE_ENDED Channel in mode input single ended
  - ADC_DIFFERENTIAL_ENDED Channel in mode input differential ended

Return values

- **Calibration:** value.

`HAL_ADCEx_Calibration_SetValue`

Function name

HAL_StatusTypeDef HAL_ADCEx_Calibration_SetValue (ADC_HandleTypeDef * hadc, uint32_t SingleDiff, uint32_t CalibrationFactor)

Function description

Set the calibration factor to overwrite automatic conversion result.

Parameters

- **hadc:** ADC handle
- **SingleDiff:** This parameter can be only:
  - ADC_SINGLE_ENDED Channel in mode input single ended
  - ADC_DIFFERENTIAL_ENDED Channel in mode input differential ended
- **CalibrationFactor:** Calibration factor (coded on 7 bits maximum)

Return values

- **HAL:** state

`HAL_ADCEx_InjectedStart`

Function name

HAL_StatusTypeDef HAL_ADCEx_InjectedStart (ADC_HandleTypeDef * hadc)

Function description

Enable ADC, start conversion of injected group.

Parameters

- **hadc:** ADC handle.

Return values

- **HAL:** status

Notes

- Interruptions enabled in this function: None.
- Case of multimode enabled when multimode feature is available: HAL_ADCEx_InjectedStart() API must be called for ADC slave first, then for ADC master. For ADC slave, ADC is enabled only (conversion is not started). For ADC master, ADC is enabled and multimode conversion is started.

HAL_ADCEx_InjectedStop

Function name

HAL_StatusTypeDef HAL_ADCEx_InjectedStop (ADC_HandleTypeDef * hadc)

Function description

Stop conversion of injected channels.

Parameters

- **hadc:** ADC handle.

Return values

- **HAL:** status

Notes

- If ADC must be disabled and if conversion is on going on regular group, function HAL_ADC_Stop must be used to stop both injected and regular groups, and disable the ADC.
- If injected group mode auto-injection is enabled, function HAL_ADC_Stop must be used.
- In case of multimode enabled (when multimode feature is available), HAL_ADCEx_InjectedStop() must be called for ADC master first, then for ADC slave. For ADC master, conversion is stopped and ADC is disabled. For ADC slave, ADC is disabled only (conversion stop of ADC master has already stopped conversion of ADC slave).

HAL_ADCEx_InjectedPollForConversion

Function name

HAL_StatusTypeDef HAL_ADCEx_InjectedPollForConversion (ADC_HandleTypeDef * hadc, uint32_t Timeout)

Function description

Wait for injected group conversion to be completed.

Parameters

- **hadc:** ADC handle
- **Timeout:** Timeout value in millisecond.

Return values

- **HAL:** status

Notes

- Depending on hadc->Init.EOCSelection, JEOS or JEOC is checked and cleared depending on AUTDLY bit status.

HAL_ADCEx_InjectedStart_IT

Function name

HAL_StatusTypeDef HAL_ADCEx_InjectedStart_IT (ADC_HandleTypeDef * hadc)

Function description

Enable ADC, start conversion of injected group with interruption.

Parameters

- **hadc:** ADC handle.

Return values

- **HAL:** status.

Notes

- Interruptions enabled in this function according to initialization setting : JEOC (end of conversion) or JEOS (end of sequence)
- Case of multimode enabled (when multimode feature is enabled): HAL_ADCEx_InjectedStart_IT() API must be called for ADC slave first, then for ADC master. For ADC slave, ADC is enabled only (conversion is not started). For ADC master, ADC is enabled and multimode conversion is started.

HAL_ADCEx_InjectedStop_IT

Function name

HAL_StatusTypeDef HAL_ADCEx_InjectedStop_IT (ADC_HandleTypeDef * hadc)

Function description

Stop conversion of injected channels, disable interruption of end-of-conversion.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- If ADC must be disabled and if conversion is on going on regular group, function HAL_ADC_Stop must be used to stop both injected and regular groups, and disable the ADC.
- If injected group mode auto-injection is enabled, function HAL_ADC_Stop must be used.
- Case of multimode enabled (when multimode feature is available): HAL_ADCEx_InjectedStop_IT() API must be called for ADC master first, then for ADC slave. For ADC master, conversion is stopped and ADC is disabled. For ADC slave, ADC is disabled only (conversion stop of ADC master has already stopped conversion of ADC slave).
- In case of auto-injection mode, HAL_ADC_Stop() must be used.

HAL_ADCEx_InjectedGetValue

Function name

uint32_t HAL_ADCEx_InjectedGetValue (ADC_HandleTypeDef * hadc, uint32_t InjectedRank)

Function description

Get ADC injected group conversion result.

Parameters

- **hadc:** ADC handle
- **InjectedRank:** the converted ADC injected rank. This parameter can be one of the following values:
  - ADC_INJECTED_RANK_1 ADC group injected rank 1
  - ADC_INJECTED_RANK_2 ADC group injected rank 2
  - ADC_INJECTED_RANK_3 ADC group injected rank 3
  - ADC_INJECTED_RANK_4 ADC group injected rank 4

Return values

- **ADC:** group injected conversion data

Notes

- Reading register JDRx automatically clears ADC flag JEOC (ADC group injected end of unitary conversion).
- This function does not clear ADC flag JEOS (ADC group injected end of sequence conversion) Occurrence of flag JEOS rising: If sequencer is composed of 1 rank, flag JEOS is equivalent to flag JEOC.If sequencer is composed of several ranks, during the scan sequence flag JEOC only is raised, at the end of the scan sequence both flags JEOC and EOS are raised. Flag JEOS must not be cleared by this function because it would not be compliant with low power features (feature low power auto-wait, not available on all STM32 families). To clear this flag, either use function: in programming model IT: HAL_ADC_IRQHandler(), in programming model polling: HAL_ADCEx_InjectedPollForConversion() or __HAL_ADC_CLEAR_FLAG(&hadc, ADC_FLAG_JEOS).

`HAL_ADCEx_InjectedConvCpltCallback`

Function name

void HAL_ADCEx_InjectedConvCpltCallback (ADC_HandleTypeDef * hadc)

Function description

Injected conversion complete callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

`HAL_ADCEx_InjectedQueueOverflowCallback`

Function name

void HAL_ADCEx_InjectedQueueOverflowCallback (ADC_HandleTypeDef * hadc)

Function description

Injected context queue overflow callback.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

Notes

- This callback is called if injected context queue is enabled (parameter "QueueInjectedContext" in injected channel configuration) and if a new injected context is set when queue is full (maximum 2 contexts).

`HAL_ADCEx_LevelOutOfWindow2Callback`

Function name

void HAL_ADCEx_LevelOutOfWindow2Callback (ADC_HandleTypeDef * hadc)

Function description

Analog watchdog 2 callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADCEx_LevelOutOfWindow3Callback

Function name

void HAL_ADCEx_LevelOutOfWindow3Callback (ADC_HandleTypeDef * hadc)

Function description

Analog watchdog 3 callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADCEx_EndOfSamplingCallback

Function name

void HAL_ADCEx_EndOfSamplingCallback (ADC_HandleTypeDef * hadc)

Function description

End Of Sampling callback in non-blocking mode.

Parameters

- **hadc:** ADC handle

Return values

- **None:**

HAL_ADCEx_RegularStop

Function name

HAL_StatusTypeDef HAL_ADCEx_RegularStop (ADC_HandleTypeDef * hadc)

Function description

Stop ADC conversion of regular group (and injected channels in case of auto_injection mode), disable ADC peripheral if no conversion is on going on injected group.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

HAL_ADCEx_RegularStop_IT

Function name

HAL_StatusTypeDef HAL_ADCEx_RegularStop_IT (ADC_HandleTypeDef * hadc)

Function description

Stop ADC conversion of ADC groups regular and injected, disable interrution of end-of-conversion, disable ADC peripheral if no conversion is on going on injected group.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

HAL_ADCEx_RegularStop_DMA

Function name

HAL_StatusTypeDef HAL_ADCEx_RegularStop_DMA (ADC_HandleTypeDef * hadc)

Function description

Stop ADC conversion of regular group (and injected group in case of auto_injection mode), disable ADC DMA transfer, disable ADC peripheral if no conversion is on going on injected group.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status.

Notes

- HAL_ADCEx_RegularStop_DMA() function is dedicated to single-ADC mode only. For multimode (when multimode feature is available), HAL_ADCEx_RegularMultiModeStop_DMA() API must be used.

HAL_ADCEx_InjectedConfigChannel

Function name

HAL_StatusTypeDef HAL_ADCEx_InjectedConfigChannel (ADC_HandleTypeDef * hadc, ADC_InjectionConfTypeDef * sConfigInjected)

Function description

Configure a channel to be assigned to ADC group injected.

Parameters

- **hadc:** ADC handle
- **sConfigInjected:** Structure of ADC injected group and ADC channel for injected group.

Return values

- **HAL:** status

Notes

- Possibility to update parameters on the fly: This function initializes injected group, following calls to this function can be used to reconfigure some parameters of structure "ADC_InjectionConfTypeDef" on the fly, without resetting the ADC. The setting of these parameters is conditioned to ADC state: Refer to comments of structure "ADC_InjectionConfTypeDef".
- In case of usage of internal measurement channels: Vbat/VrefInt/TempSensor. These internal paths can be disabled using function HAL_ADC_DeInit().
- Caution: For Injected Context Queue use, a context must be fully defined before start of injected conversion. All channels are configured consecutively for the same ADC instance. Therefore, the number of calls to HAL_ADCEx_InjectedConfigChannel() must be equal to the value of parameter InjectedNbrOfConversion for each context. Example 1: If 1 context is intended to be used (or if there is no use of the Injected Queue Context feature) and if the context contains 3 injected ranks (InjectedNbrOfConversion = 3), HAL_ADCEx_InjectedConfigChannel() must be called once for each channel (i.e. 3 times) before starting a conversion. This function must not be called to configure a 4th injected channel: it would start a new context into context queue.Example 2: If 2 contexts are intended to be used and each of them contains 3 injected ranks (InjectedNbrOfConversion = 3), HAL_ADCEx_InjectedConfigChannel() must be called once for each channel and for each context (3 channels x 2 contexts = 6 calls). Conversion can start once the 1st context is set, that is after the first three HAL_ADCEx_InjectedConfigChannel() calls. The 2nd context can be set on the fly.

HAL_ADCEx_EnableInjectedQueue

Function name

HAL_StatusTypeDef HAL_ADCEx_EnableInjectedQueue (ADC_HandleTypeDef * hadc)

Function description

Enable Injected Queue.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- This function resets CFGR register JQDIS bit in order to enable the Injected Queue. JQDIS can be written only when ADSTART and JDSTART are both equal to 0 to ensure that no regular nor injected conversion is ongoing.

HAL_ADCEx_DisableInjectedQueue

Function name

HAL_StatusTypeDef HAL_ADCEx_DisableInjectedQueue (ADC_HandleTypeDef * hadc)

Function description

Disable Injected Queue.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- This function sets CFGR register JQDIS bit in order to disable the Injected Queue. JQDIS can be written only when ADSTART and JDSTART are both equal to 0 to ensure that no regular nor injected conversion is ongoing.

HAL_ADCEx_DisableVoltageRegulator

Function name

HAL_StatusTypeDef HAL_ADCEx_DisableVoltageRegulator (ADC_HandleTypeDef * hadc)

Function description

Disable ADC voltage regulator.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- Disabling voltage regulator allows to save power. This operation can be carried out only when ADC is disabled.
- To enable again the voltage regulator, the user is expected to resort to HAL_ADC_Init() API.

`HAL_ADCEx_EnterADCDeepPowerDownMode`

Function name

HAL_StatusTypeDef HAL_ADCEx_EnterADCDeepPowerDownMode (ADC_HandleTypeDef * hadc)

Function description

Enter ADC deep-power-down mode.

Parameters

- **hadc:** ADC handle

Return values

- **HAL:** status

Notes

- This mode is achieved in setting DEEPPWD bit and allows to save power in reducing leakage currents. It is particularly interesting before entering stop modes.
- Setting DEEPPWD automatically clears ADVREGEN bit and disables the ADC voltage regulator. This means that this API encompasses HAL_ADCEx_DisableVoltageRegulator(). Additionally, the internal calibration is lost.
- To exit the ADC deep-power-down mode, the user is expected to resort to HAL_ADC_Init() API as well as to relaunch a calibration with HAL_ADCEx_Calibration_Start() API or to re-apply a previously saved calibration factor.

8.3 ADCEx Firmware driver defines

The following section lists the various define and macros of the module.

8.3.1 ADCEx

ADCEx

9 HAL CAN Generic Driver

9.1 CAN Firmware driver registers structures

9.1.1 CAN_InitTypeDef

CAN_InitTypeDef is defined in the stm32l4xx_hal_can.h

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t Mode***
- ***uint32_t SyncJumpWidth***
- ***uint32_t TimeSeg1***
- ***uint32_t TimeSeg2***
- ***FunctionalState TimeTriggeredMode***
- ***FunctionalState AutoBusOff***
- ***FunctionalState AutoWakeUp***
- ***FunctionalState AutoRetransmission***
- ***FunctionalState ReceiveFifoLocked***
- ***FunctionalState TransmitFifoPriority***

Field Documentation

- ***uint32_t CAN_InitTypeDef::Prescaler***

  Specifies the length of a time quantum. This parameter must be a number between Min_Data = 1 and Max_Data = 1024.
- ***uint32_t CAN_InitTypeDef::Mode***

  Specifies the CAN operating mode. This parameter can be a value of ***CAN_operating_mode***
- ***uint32_t CAN_InitTypeDef::SyncJumpWidth***

  Specifies the maximum number of time quanta the CAN hardware is allowed to lengthen or shorten a bit to perform resynchronization. This parameter can be a value of ***CAN_synchronisation_jump_width***
- ***uint32_t CAN_InitTypeDef::TimeSeg1***

  Specifies the number of time quanta in Bit Segment 1. This parameter can be a value of ***CAN_time_quantum_in_bit_segment_1***
- ***uint32_t CAN_InitTypeDef::TimeSeg2***

  Specifies the number of time quanta in Bit Segment 2. This parameter can be a value of ***CAN_time_quantum_in_bit_segment_2***
- ***FunctionalState CAN_InitTypeDef::TimeTriggeredMode***

  Enable or disable the time triggered communication mode. This parameter can be set to ENABLE or DISABLE.
- ***FunctionalState CAN_InitTypeDef::AutoBusOff***

  Enable or disable the automatic bus-off management. This parameter can be set to ENABLE or DISABLE.
- ***FunctionalState CAN_InitTypeDef::AutoWakeUp***

  Enable or disable the automatic wake-up mode. This parameter can be set to ENABLE or DISABLE.
- ***FunctionalState CAN_InitTypeDef::AutoRetransmission***

  Enable or disable the non-automatic retransmission mode. This parameter can be set to ENABLE or DISABLE.
- ***FunctionalState CAN_InitTypeDef::ReceiveFifoLocked***

  Enable or disable the Receive FIFO Locked mode. This parameter can be set to ENABLE or DISABLE.
- ***FunctionalState CAN_InitTypeDef::TransmitFifoPriority***

  Enable or disable the transmit FIFO priority. This parameter can be set to ENABLE or DISABLE.

9.1.2 CAN_FilterTypeDef

CAN_FilterTypeDef is defined in the stm32l4xx_hal_can.h

Data Fields

- ***uint32_t FilterIdHigh***
- ***uint32_t FilterIdLow***
- ***uint32_t FilterMaskIdHigh***
- ***uint32_t FilterMaskIdLow***
- ***uint32_t FilterFIFOAssignment***
- ***uint32_t FilterBank***
- ***uint32_t FilterMode***
- ***uint32_t FilterScale***
- ***uint32_t FilterActivation***
- ***uint32_t SlaveStartFilterBank***

Field Documentation

- ***uint32_t CAN_FilterTypeDef::FilterIdHigh***

  Specifies the filter identification number (MSBs for a 32-bit configuration, first one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- ***uint32_t CAN_FilterTypeDef::FilterIdLow***

  Specifies the filter identification number (LSBs for a 32-bit configuration, second one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- ***uint32_t CAN_FilterTypeDef::FilterMaskIdHigh***

  Specifies the filter mask number or identification number, according to the mode (MSBs for a 32-bit configuration, first one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- ***uint32_t CAN_FilterTypeDef::FilterMaskIdLow***

  Specifies the filter mask number or identification number, according to the mode (LSBs for a 32-bit configuration, second one for a 16-bit configuration). This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- ***uint32_t CAN_FilterTypeDef::FilterFIFOAssignment***

  Specifies the FIFO (0 or 1U) which will be assigned to the filter. This parameter can be a value of ***CAN_filter_FIFO***
- ***uint32_t CAN_FilterTypeDef::FilterBank***

  Specifies the filter bank which will be initialized. For single CAN instance(14 dedicated filter banks), this parameter must be a number between Min_Data = 0 and Max_Data = 13. For dual CAN instances(28 filter banks shared), this parameter must be a number between Min_Data = 0 and Max_Data = 27.
- ***uint32_t CAN_FilterTypeDef::FilterMode***

  Specifies the filter mode to be initialized. This parameter can be a value of ***CAN_filter_mode***
- ***uint32_t CAN_FilterTypeDef::FilterScale***

  Specifies the filter scale. This parameter can be a value of ***CAN_filter_scale***
- ***uint32_t CAN_FilterTypeDef::FilterActivation***

  Enable or disable the filter. This parameter can be a value of ***CAN_filter_activation***
- ***uint32_t CAN_FilterTypeDef::SlaveStartFilterBank***

  Select the start filter bank for the slave CAN instance. For single CAN instances, this parameter is meaningless. For dual CAN instances, all filter banks with lower index are assigned to master CAN instance, whereas all filter banks with greater index are assigned to slave CAN instance. This parameter must be a number between Min_Data = 0 and Max_Data = 27.

9.1.3 CAN_TxHeaderTypeDef

CAN_TxHeaderTypeDef is defined in the stm32l4xx_hal_can.h

Data Fields

- ***uint32_t StdId***
- ***uint32_t ExtId***

- ***uint32_t IDE***
- ***uint32_t RTR***
- ***uint32_t DLC***
- ***FunctionalState TransmitGlobalTime***

Field Documentation

- ***uint32_t CAN_TxHeaderTypeDef::StdId***

  Specifies the standard identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x7FF.
- ***uint32_t CAN_TxHeaderTypeDef::ExtId***

  Specifies the extended identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x1FFFFFFF.
- ***uint32_t CAN_TxHeaderTypeDef::IDE***

  Specifies the type of identifier for the message that will be transmitted. This parameter can be a value of ***CAN_identifier_type***
- ***uint32_t CAN_TxHeaderTypeDef::RTR***

  Specifies the type of frame for the message that will be transmitted. This parameter can be a value of ***CAN_remote_transmission_request***
- ***uint32_t CAN_TxHeaderTypeDef::DLC***

  Specifies the length of the frame that will be transmitted. This parameter must be a number between Min_Data = 0 and Max_Data = 8.
- ***FunctionalState CAN_TxHeaderTypeDef::TransmitGlobalTime***

  Specifies whether the timestamp counter value captured on start of frame transmission, is sent in DATA6 and DATA7 replacing pData[6] and pData[7].

  Note:

  – : Time Triggered Communication Mode must be enabled.

  – : DLC must be programmed as 8 bytes, in order these 2 bytes are sent. This parameter can be set to ENABLE or DISABLE.

9.1.4 CAN_RxHeaderTypeDef

CAN_RxHeaderTypeDef is defined in the stm32l4xx_hal_can.h

Data Fields

- ***uint32_t StdId***
- ***uint32_t ExtId***
- ***uint32_t IDE***
- ***uint32_t RTR***
- ***uint32_t DLC***
- ***uint32_t Timestamp***
- ***uint32_t FilterMatchIndex***

Field Documentation

- ***uint32_t CAN_RxHeaderTypeDef::StdId***

  Specifies the standard identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x7FF.
- ***uint32_t CAN_RxHeaderTypeDef::ExtId***

  Specifies the extended identifier. This parameter must be a number between Min_Data = 0 and Max_Data = 0x1FFFFFFF.
- ***uint32_t CAN_RxHeaderTypeDef::IDE***

  Specifies the type of identifier for the message that will be transmitted. This parameter can be a value of ***CAN_identifier_type***
- ***uint32_t CAN_RxHeaderTypeDef::RTR***

  Specifies the type of frame for the message that will be transmitted. This parameter can be a value of ***CAN_remote_transmission_request***

- ***uint32_t CAN_RxHeaderTypeDef::DLC***

  Specifies the length of the frame that will be transmitted. This parameter must be a number between Min_Data = 0 and Max_Data = 8.
- ***uint32_t CAN_RxHeaderTypeDef::Timestamp***

  Specifies the timestamp counter value captured on start of frame reception.

  Note:

  – : Time Triggered Communication Mode must be enabled. This parameter must be a number between Min_Data = 0 and Max_Data = 0xFFFF.
- ***uint32_t CAN_RxHeaderTypeDef::FilterMatchIndex***

  Specifies the index of matching acceptance filter element. This parameter must be a number between Min_Data = 0 and Max_Data = 0xFF.

9.1.5 __CAN_HandleTypeDef

__CAN_HandleTypeDef is defined in the stm32l4xx_hal_can.h

Data Fields

- ***CAN_TypeDef * Instance***
- ***CAN_InitTypeDef Init***
- ***__IO HAL_CAN_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***CAN_TypeDef* __CAN_HandleTypeDef::Instance***

  Register base address
- ***CAN_InitTypeDef __CAN_HandleTypeDef::Init***

  CAN required parameters
- ***__IO HAL_CAN_StateTypeDef __CAN_HandleTypeDef::State***

  CAN communication state
- ***__IO uint32_t __CAN_HandleTypeDef::ErrorCode***

  CAN Error code. This parameter can be a value of ***CAN_Error_Code***

9.2 CAN Firmware driver API description

The following section lists the various functions of the CAN library.

9.2.1 How to use this driver

1. Initialize the CAN low level resources by implementing the HAL_CAN_MspInit():
   – Enable the CAN interface clock using __HAL_RCC_CANx_CLK_ENABLE()
   – Configure CAN pins
     ◦ Enable the clock for the CAN GPIOs
     ◦ Configure CAN pins as alternate function open-drain
   – In case of using interrupts (e.g. HAL_CAN_ActivateNotification())
     ◦ Configure the CAN interrupt priority using HAL_NVIC_SetPriority()
     ◦ Enable the CAN IRQ handler using HAL_NVIC_EnableIRQ()
     ◦ In CAN IRQ handler, call HAL_CAN_IRQHandler()
2. Initialize the CAN peripheral using HAL_CAN_Init() function. This function resorts to HAL_CAN_MspInit() for low-level initialization.
3. Configure the reception filters using the following configuration functions:
   – HAL_CAN_ConfigFilter()
4. Start the CAN module using HAL_CAN_Start() function. At this level the node is active on the bus: it receive messages, and can send messages.

5. To manage messages transmission, the following Tx control functions can be used:
   – HAL_CAN_AddTxMessage() to request transmission of a new message.
   – HAL_CAN_AbortTxRequest() to abort transmission of a pending message.
   – HAL_CAN_GetTxMailboxesFreeLevel() to get the number of free Tx mailboxes.
   – HAL_CAN_IsTxMessagePending() to check if a message is pending in a Tx mailbox.
   – HAL_CAN_GetTxTimestamp() to get the timestamp of Tx message sent, if time triggered communication mode is enabled.
6. When a message is received into the CAN Rx FIFOs, it can be retrieved using the HAL_CAN_GetRxMessage() function. The function HAL_CAN_GetRxFifoFillLevel() allows to know how many Rx message are stored in the Rx Fifo.
7. Calling the HAL_CAN_Stop() function stops the CAN module.
8. The deinitialization is achieved with HAL_CAN_DeInit() function.

Polling mode operation

1. Reception:
   – Monitor reception of message using HAL_CAN_GetRxFifoFillLevel() until at least one message is received.
   – Then get the message using HAL_CAN_GetRxMessage().
2. Transmission:
   – Monitor the Tx mailboxes availability until at least one Tx mailbox is free, using HAL_CAN_GetTxMailboxesFreeLevel().
   – Then request transmission of a message using HAL_CAN_AddTxMessage().

Interrupt mode operation

1. Notifications are activated using HAL_CAN_ActivateNotification() function. Then, the process can be controlled through the available user callbacks: HAL_CAN_xxxCallback(), using same APIs HAL_CAN_GetRxMessage() and HAL_CAN_AddTxMessage().
2. Notifications can be deactivated using HAL_CAN_DeactivateNotification() function.
3. Special care should be taken for CAN_IT_RX_FIFO0_MSG_PENDING and CAN_IT_RX_FIFO1_MSG_PENDING notifications. These notifications trig the callbacks HAL_CAN_RxFIFO0MsgPendingCallback() and HAL_CAN_RxFIFO1MsgPendingCallback(). User has two possible options here.
   – Directly get the Rx message in the callback, using HAL_CAN_GetRxMessage().
   – Or deactivate the notification in the callback without getting the Rx message. The Rx message can then be got later using HAL_CAN_GetRxMessage(). Once the Rx message have been read, the notification can be activated again.

Sleep mode

1. The CAN peripheral can be put in sleep mode (low power), using HAL_CAN_RequestSleep(). The sleep mode will be entered as soon as the current CAN activity (transmission or reception of a CAN frame) will be completed.
2. A notification can be activated to be informed when the sleep mode will be entered.
3. It can be checked if the sleep mode is entered using HAL_CAN_IsSleepActive(). Note that the CAN state (accessible from the API HAL_CAN_GetState()) is HAL_CAN_STATE_SLEEP_PENDING as soon as the sleep mode request is submitted (the sleep mode is not yet entered), and become HAL_CAN_STATE_SLEEP_ACTIVE when the sleep mode is effective.
4. The wake-up from sleep mode can be trigged by two ways:
   – Using HAL_CAN_WakeUp(). When returning from this function, the sleep mode is exited (if return status is HAL_OK).
   – When a start of Rx CAN frame is detected by the CAN peripheral, if automatic wake up mode is enabled.

Callback registration

9.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- HAL_CAN_Init : Initialize and configure the CAN.
- HAL_CAN_DeInit : De-initialize the CAN.
- HAL_CAN_MspInit : Initialize the CAN MSP.
- HAL_CAN_MspDeInit : DeInitialize the CAN MSP.

This section contains the following APIs:

- ***HAL_CAN_Init***
- ***HAL_CAN_DeInit***
- ***HAL_CAN_MspInit***
- ***HAL_CAN_MspDeInit***

9.2.3 Configuration functions

This section provides functions allowing to:

- HAL_CAN_ConfigFilter : Configure the CAN reception filters

This section contains the following APIs:

- ***HAL_CAN_ConfigFilter***

9.2.4 Control functions

This section provides functions allowing to:

- HAL_CAN_Start : Start the CAN module
- HAL_CAN_Stop : Stop the CAN module
- HAL_CAN_RequestSleep : Request sleep mode entry.
- HAL_CAN_WakeUp : Wake up from sleep mode.
- HAL_CAN_IsSleepActive : Check is sleep mode is active.
- HAL_CAN_AddTxMessage : Add a message to the Tx mailboxes and activate the corresponding transmission request
- HAL_CAN_AbortTxRequest : Abort transmission request
- HAL_CAN_GetTxMailboxesFreeLevel : Return Tx mailboxes free level
- HAL_CAN_IsTxMessagePending : Check if a transmission request is pending on the selected Tx mailbox
- HAL_CAN_GetRxMessage : Get a CAN frame from the Rx FIFO
- HAL_CAN_GetRxFifoFillLevel : Return Rx FIFO fill level

This section contains the following APIs:

- ***HAL_CAN_Start***
- ***HAL_CAN_Stop***
- ***HAL_CAN_RequestSleep***
- ***HAL_CAN_WakeUp***
- ***HAL_CAN_IsSleepActive***
- ***HAL_CAN_AddTxMessage***
- ***HAL_CAN_AbortTxRequest***
- ***HAL_CAN_GetTxMailboxesFreeLevel***
- ***HAL_CAN_IsTxMessagePending***
- ***HAL_CAN_GetTxTimestamp***
- ***HAL_CAN_GetRxMessage***
- ***HAL_CAN_GetRxFifoFillLevel***

9.2.5 Interrupts management

This section provides functions allowing to:

- HAL_CAN_ActivateNotification : Enable interrupts
- HAL_CAN_DeactivateNotification : Disable interrupts
- HAL_CAN_IRQHandler : Handles CAN interrupt request

This section contains the following APIs:

- ***HAL_CAN_ActivateNotification***
- ***HAL_CAN_DeactivateNotification***
- ***HAL_CAN_IRQHandler***

9.2.6 Peripheral State and Error functions

This subsection provides functions allowing to :

- HAL_CAN_GetState() : Return the CAN state.
- HAL_CAN_GetError() : Return the CAN error codes if any.
- HAL_CAN_ResetError(): Reset the CAN error codes if any.

This section contains the following APIs:

- ***HAL_CAN_GetState***
- ***HAL_CAN_GetError***
- ***HAL_CAN_ResetError***

9.2.7 Detailed description of functions

`HAL_CAN_Init`

Function name

HAL_StatusTypeDef HAL_CAN_Init (CAN_HandleTypeDef * hcan)

Function description

Initializes the CAN peripheral according to the specified parameters in the CAN_InitStruct.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status

`HAL_CAN_DeInit`

Function name

HAL_StatusTypeDef HAL_CAN_DeInit (CAN_HandleTypeDef * hcan)

Function description

Deinitializes the CAN peripheral registers to their default reset values.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status

`HAL_CAN_MspInit`

Function name

void HAL_CAN_MspInit (CAN_HandleTypeDef * hcan)

Function description

Initializes the CAN MSP.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

HAL_CAN_MspDeInit

Function name

void HAL_CAN_MspDeInit (CAN_HandleTypeDef * hcan)

Function description

DeInitializes the CAN MSP.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

HAL_CAN_ConfigFilter

Function name

HAL_StatusTypeDef HAL_CAN_ConfigFilter (CAN_HandleTypeDef * hcan, CAN_FilterTypeDef * sFilterConfig)

Function description

Configures the CAN reception filter according to the specified parameters in the CAN_FilterInitStruct.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **sFilterConfig:** pointer to a CAN_FilterTypeDef structure that contains the filter configuration information.

Return values

- **None:**

HAL_CAN_Start

Function name

HAL_StatusTypeDef HAL_CAN_Start (CAN_HandleTypeDef * hcan)

Function description

Start the CAN module.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status

HAL_CAN_Stop

Function name

HAL_StatusTypeDef HAL_CAN_Stop (CAN_HandleTypeDef * hcan)

Function description

Stop the CAN module and enable access to configuration registers.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status

HAL_CAN_RequestSleep

Function name

HAL_StatusTypeDef HAL_CAN_RequestSleep (CAN_HandleTypeDef * hcan)

Function description

Request the sleep mode (low power) entry.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status.

HAL_CAN_WakeUp

Function name

HAL_StatusTypeDef HAL_CAN_WakeUp (CAN_HandleTypeDef * hcan)

Function description

Wake up from sleep mode.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status.

HAL_CAN_IsSleepActive

Function name

uint32_t HAL_CAN_IsSleepActive (CAN_HandleTypeDef * hcan)

Function description

Check is sleep mode is active.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **Status:**
  - 0 : Sleep mode is not active.
  - 1 : Sleep mode is active.

HAL_CAN_AddTxMessage

Function name

HAL_StatusTypeDef HAL_CAN_AddTxMessage (CAN_HandleTypeDef * hcan, CAN_TxHeaderTypeDef * pHeader, uint8_t aData, uint32_t * pTxMailbox)

Function description

Add a message to the first free Tx mailbox and activate the corresponding transmission request.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **pHeader:** pointer to a CAN_TxHeaderTypeDef structure.
- **aData:** array containing the payload of the Tx frame.
- **pTxMailbox:** pointer to a variable where the function will return the TxMailbox used to store the Tx message. This parameter can be a value of
  - CAN_Tx_Mailboxes.

Return values

- **HAL:** status

HAL_CAN_AbortTxRequest

Function name

HAL_StatusTypeDef HAL_CAN_AbortTxRequest (CAN_HandleTypeDef * hcan, uint32_t TxMailboxes)

Function description

Abort transmission requests.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **TxMailboxes:** List of the Tx Mailboxes to abort. This parameter can be any combination of
  - CAN_Tx_Mailboxes.

Return values

- **HAL:** status

HAL_CAN_GetTxMailboxesFreeLevel

Function name

uint32_t HAL_CAN_GetTxMailboxesFreeLevel (CAN_HandleTypeDef * hcan)

Function description

Return Tx Mailboxes free level: number of free Tx Mailboxes.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **Number:** of free Tx Mailboxes.

HAL_CAN_IsTxMessagePending

Function name

uint32_t HAL_CAN_IsTxMessagePending (CAN_HandleTypeDef * hcan, uint32_t TxMailboxes)

Function description

Check if a transmission request is pending on the selected Tx Mailboxes.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **TxMailboxes:** List of Tx Mailboxes to check. This parameter can be any combination of
  - CAN_Tx_Mailboxes.

Return values

- **Status:**
  - 0 : No pending transmission request on any selected Tx Mailboxes.
  - 1 : Pending transmission request on at least one of the selected Tx Mailbox.

HAL_CAN_GetTxTimestamp

Function name

uint32_t HAL_CAN_GetTxTimestamp (CAN_HandleTypeDef * hcan, uint32_t TxMailbox)

Function description

Return timestamp of Tx message sent, if time triggered communication mode is enabled.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **TxMailbox:** Tx Mailbox where the timestamp of message sent will be read. This parameter can be one value of
  - CAN_Tx_Mailboxes.

Return values

- **Timestamp:** of message sent from Tx Mailbox.

HAL_CAN_GetRxMessage

Function name

HAL_StatusTypeDef HAL_CAN_GetRxMessage (CAN_HandleTypeDef * hcan, uint32_t RxFifo, CAN_RxHeaderTypeDef * pHeader, uint8_t aData)

Function description

Get an CAN frame from the Rx FIFO zone into the message RAM.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **RxFifo:** Fifo number of the received message to be read. This parameter can be a value of
  - CAN_receive_FIFO_number.
- **pHeader:** pointer to a CAN_RxHeaderTypeDef structure where the header of the Rx frame will be stored.
- **aData:** array where the payload of the Rx frame will be stored.

Return values

- **HAL:** status

`HAL_CAN_GetRxFifoFillLevel`

Function name

uint32_t HAL_CAN_GetRxFifoFillLevel (CAN_HandleTypeDef * hcan, uint32_t RxFifo)

Function description

Return Rx FIFO fill level.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **RxFifo:** Rx FIFO. This parameter can be a value of
  - CAN_receive_FIFO_number.

Return values

- **Number:** of messages available in Rx FIFO.

`HAL_CAN_ActivateNotification`

Function name

HAL_StatusTypeDef HAL_CAN_ActivateNotification (CAN_HandleTypeDef * hcan, uint32_t ActiveITs)

Function description

Enable interrupts.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **ActiveITs:** indicates which interrupts will be enabled. This parameter can be any combination of
  - CAN_Interrupts.

Return values

- **HAL:** status

`HAL_CAN_DeactivateNotification`

Function name

HAL_StatusTypeDef HAL_CAN_DeactivateNotification (CAN_HandleTypeDef * hcan, uint32_t InactiveITs)

Function description

Disable interrupts.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.
- **InactiveITs:** indicates which interrupts will be disabled. This parameter can be any combination of
  - CAN_Interrupts.

Return values

- **HAL:** status

HAL_CAN_IRQHandler

Function name

void HAL_CAN_IRQHandler (CAN_HandleTypeDef * hcan)

Function description

Handles CAN interrupt request.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

HAL_CAN_TxMailbox0CompleteCallback

Function name

void HAL_CAN_TxMailbox0CompleteCallback (CAN_HandleTypeDef * hcan)

Function description

Transmission Mailbox 0 complete callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

HAL_CAN_TxMailbox1CompleteCallback

Function name

void HAL_CAN_TxMailbox1CompleteCallback (CAN_HandleTypeDef * hcan)

Function description

Transmission Mailbox 1 complete callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

HAL_CAN_TxMailbox2CompleteCallback

Function name

void HAL_CAN_TxMailbox2CompleteCallback (CAN_HandleTypeDef * hcan)

Function description

Transmission Mailbox 2 complete callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_TxMailbox0AbortCallback`

Function name

void HAL_CAN_TxMailbox0AbortCallback (CAN_HandleTypeDef * hcan)

Function description

Transmission Mailbox 0 Cancellation callback.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_TxMailbox1AbortCallback`

Function name

void HAL_CAN_TxMailbox1AbortCallback (CAN_HandleTypeDef * hcan)

Function description

Transmission Mailbox 1 Cancellation callback.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_TxMailbox2AbortCallback`

Function name

void HAL_CAN_TxMailbox2AbortCallback (CAN_HandleTypeDef * hcan)

Function description

Transmission Mailbox 2 Cancellation callback.

Parameters

- **hcan:** pointer to an CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_RxFifo0MsgPendingCallback`

Function name

void HAL_CAN_RxFifo0MsgPendingCallback (CAN_HandleTypeDef * hcan)

Function description

Rx FIFO 0 message pending callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_RxFifo0FullCallback`

Function name

void HAL_CAN_RxFifo0FullCallback (CAN_HandleTypeDef * hcan)

Function description

Rx FIFO 0 full callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_RxFifo1MsgPendingCallback`

Function name

void HAL_CAN_RxFifo1MsgPendingCallback (CAN_HandleTypeDef * hcan)

Function description

Rx FIFO 1 message pending callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_RxFifo1FullCallback`

Function name

void HAL_CAN_RxFifo1FullCallback (CAN_HandleTypeDef * hcan)

Function description

Rx FIFO 1 full callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_SleepCallback`

Function name

void HAL_CAN_SleepCallback (CAN_HandleTypeDef * hcan)

Function description

Sleep callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_WakeUpFromRxMsgCallback`

Function name

void HAL_CAN_WakeUpFromRxMsgCallback (CAN_HandleTypeDef * hcan)

Function description

WakeUp from Rx message callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_ErrorCallback`

Function name

void HAL_CAN_ErrorCallback (CAN_HandleTypeDef * hcan)

Function description

Error CAN callback.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **None:**

`HAL_CAN_GetState`

Function name

HAL_CAN_StateTypeDef HAL_CAN_GetState (CAN_HandleTypeDef * hcan)

Function description

Return the CAN state.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** state

`HAL_CAN_GetError`

Function name

uint32_t HAL_CAN_GetError (CAN_HandleTypeDef * hcan)

Function description

Return the CAN error code.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **CAN:** Error Code

`HAL_CAN_ResetError`

Function name

HAL_StatusTypeDef HAL_CAN_ResetError (CAN_HandleTypeDef * hcan)

Function description

Reset the CAN error code.

Parameters

- **hcan:** pointer to a CAN_HandleTypeDef structure that contains the configuration information for the specified CAN.

Return values

- **HAL:** status

9.3 CAN Firmware driver defines

The following section lists the various define and macros of the module.

9.3.1 CAN

CAN

CAN Error Code

HAL_CAN_ERROR_NONE

No error

HAL_CAN_ERROR_EWG

Protocol Error Warning

HAL_CAN_ERROR_EPV

Error Passive

HAL_CAN_ERROR_BOF

Bus-off error

HAL_CAN_ERROR_STF

Stuff error

HAL_CAN_ERROR_FOR

Form error

HAL_CAN_ERROR_ACK

Acknowledgment error

HAL_CAN_ERROR_BR

Bit recessive error

HAL_CAN_ERROR_BD

Bit dominant error

HAL_CAN_ERROR_CRC

CRC error

HAL_CAN_ERROR_RX_FOV0

Rx FIFO0 overrun error

HAL_CAN_ERROR_RX_FOV1

Rx FIFO1 overrun error

HAL_CAN_ERROR_TX_ALST0

TxMailbox 0 transmit failure due to arbitration lost

HAL_CAN_ERROR_TX_TERR0

TxMailbox 1 transmit failure due to tranmit error

HAL_CAN_ERROR_TX_ALST1

TxMailbox 0 transmit failure due to arbitration lost

HAL_CAN_ERROR_TX_TERR1

TxMailbox 1 transmit failure due to tranmit error

HAL_CAN_ERROR_TX_ALST2

TxMailbox 0 transmit failure due to arbitration lost

HAL_CAN_ERROR_TX_TERR2

TxMailbox 1 transmit failure due to tranmit error

HAL_CAN_ERROR_TIMEOUT

Timeout error

HAL_CAN_ERROR_NOT_INITIALIZED

Peripheral not initialized

HAL_CAN_ERROR_NOT_READY

Peripheral not ready

HAL_CAN_ERROR_NOT_STARTED

Peripheral not started

HAL_CAN_ERROR_PARAM

Parameter error

HAL_CAN_ERROR_INTERNAL

Internal error

CAN Exported Macros

__HAL_CAN_RESET_HANDLE_STATE

Description:

- Reset CAN handle state.

Parameters:

- __HANDLE__: CAN handle.

Return value:

- None

__HAL_CAN_ENABLE_IT

Description:

- Enable the specified CAN interrupts.

Parameters:

- __HANDLE__: CAN handle.
- __INTERRUPT__: CAN Interrupt sources to enable. This parameter can be any combination of
  - CAN_Interrupts

Return value:

- None

__HAL_CAN_DISABLE_IT

Description:

- Disable the specified CAN interrupts.

Parameters:

- __HANDLE__: CAN handle.
- __INTERRUPT__: CAN Interrupt sources to disable. This parameter can be any combination of
  - CAN_Interrupts

Return value:

- None

__HAL_CAN_GET_IT_SOURCE

Description:

- Check if the specified CAN interrupt source is enabled or disabled.

Parameters:

- __HANDLE__: specifies the CAN Handle.
- __INTERRUPT__: specifies the CAN interrupt source to check. This parameter can be a value of
  - CAN_Interrupts

Return value:

- The: state of __IT__ (TRUE or FALSE).

__HAL_CAN_GET_FLAG

Description:

- Check whether the specified CAN flag is set or not.

Parameters:

- __HANDLE__: specifies the CAN Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of
  - CAN_flags

Return value:

- The: state of __FLAG__ (TRUE or FALSE).

__HAL_CAN_CLEAR_FLAG

Description:

- Clear the specified CAN pending flag.

Parameters:

- __HANDLE__: specifies the CAN Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - CAN_FLAG_RQCP0: Request complete MailBox 0 Flag
  - CAN_FLAG_TXOK0: Transmission OK MailBox 0 Flag
  - CAN_FLAG_ALST0: Arbitration Lost MailBox 0 Flag
  - CAN_FLAG_TERR0: Transmission error MailBox 0 Flag
  - CAN_FLAG_RQCP1: Request complete MailBox 1 Flag
  - CAN_FLAG_TXOK1: Transmission OK MailBox 1 Flag
  - CAN_FLAG_ALST1: Arbitration Lost MailBox 1 Flag
  - CAN_FLAG_TERR1: Transmission error MailBox 1 Flag
  - CAN_FLAG_RQCP2: Request complete MailBox 2 Flag
  - CAN_FLAG_TXOK2: Transmission OK MailBox 2 Flag
  - CAN_FLAG_ALST2: Arbitration Lost MailBox 2 Flag
  - CAN_FLAG_TERR2: Transmission error MailBox 2 Flag
  - CAN_FLAG_FF0: RX FIFO 0 Full Flag
  - CAN_FLAG_FOV0: RX FIFO 0 Overrun Flag
  - CAN_FLAG_FF1: RX FIFO 1 Full Flag
  - CAN_FLAG_FOV1: RX FIFO 1 Overrun Flag
  - CAN_FLAG_WKUI: Wake up Interrupt Flag
  - CAN_FLAG_SLAKI: Sleep acknowledge Interrupt Flag

Return value:

- None

CAN Filter Activation

CAN_FILTER_DISABLE

Disable filter

CAN_FILTER_ENABLE

Enable filter

CAN Filter FIFO

CAN_FILTER_FIFO0

Filter FIFO 0 assignment for filter x

CAN_FILTER_FIFO1

Filter FIFO 1 assignment for filter x

CAN Filter Mode

CAN_FILTERMODE_IDMASK

Identifier mask mode

CAN_FILTERMODE_IDLIST

Identifier list mode

CAN Filter Scale

CAN_FILTERSCALE_16BIT

Two 16-bit filters

CAN_FILTERSCALE_32BIT

One 32-bit filter

CAN Flags

CAN_FLAG_RQCP0

Request complete MailBox 0 flag

CAN_FLAG_TXOK0

Transmission OK MailBox 0 flag

CAN_FLAG_ALST0

Arbitration Lost MailBox 0 flag

CAN_FLAG_TERR0

Transmission error MailBox 0 flag

CAN_FLAG_RQCP1

Request complete MailBox1 flag

CAN_FLAG_TXOK1

Transmission OK MailBox 1 flag

CAN_FLAG_ALST1

Arbitration Lost MailBox 1 flag

CAN_FLAG_TERR1

Transmission error MailBox 1 flag

CAN_FLAG_RQCP2

Request complete MailBox2 flag

CAN_FLAG_TXOK2

Transmission OK MailBox 2 flag

CAN_FLAG_ALST2

Arbitration Lost MailBox 2 flag

CAN_FLAG_TERR2

Transmission error MailBox 2 flag

CAN_FLAG_TME0

Transmit mailbox 0 empty flag

CAN_FLAG_TME1

Transmit mailbox 1 empty flag

CAN_FLAG_TME2

Transmit mailbox 2 empty flag

CAN_FLAG_LOW0

Lowest priority mailbox 0 flag

CAN_FLAG_LOW1

Lowest priority mailbox 1 flag

CAN_FLAG_LOW2

Lowest priority mailbox 2 flag

CAN_FLAG_FF0

RX FIFO 0 Full flag

CAN_FLAG_FOV0

RX FIFO 0 Overrun flag

CAN_FLAG_FF1

RX FIFO 1 Full flag

CAN_FLAG_FOV1

RX FIFO 1 Overrun flag

CAN_FLAG_INAK

Initialization acknowledge flag

CAN_FLAG_SLAK

Sleep acknowledge flag

CAN_FLAG_ERRI

Error flag

CAN_FLAG_WKU

Wake up interrupt flag

CAN_FLAG_SLAKI

Sleep acknowledge interrupt flag

CAN_FLAG_EWG

Error warning flag

CAN_FLAG_EPV

Error passive flag

CAN_FLAG_BOF

Bus-Off flag

CAN Identifier Type

CAN_ID_STD

Standard Id

CAN_ID_EXT

Extended Id

CAN InitStatus

CAN_INITSTATUS_FAILED

CAN initialization failed

CAN_INITSTATUS_SUCCESS

CAN initialization OK

CAN Interrupts

CAN_IT_TX_MAILBOX_EMPTY

Transmit mailbox empty interrupt

CAN_IT_RX_FIFO0_MSG_PENDING

FIFO 0 message pending interrupt

CAN_IT_RX_FIFO0_FULL

FIFO 0 full interrupt

CAN_IT_RX_FIFO0_OVERRUN

FIFO 0 overrun interrupt

CAN_IT_RX_FIFO1_MSG_PENDING

FIFO 1 message pending interrupt

CAN_IT_RX_FIFO1_FULL

FIFO 1 full interrupt

CAN_IT_RX_FIFO1_OVERRUN

FIFO 1 overrun interrupt

CAN_IT_WAKEUP

Wake-up interrupt

CAN_IT_SLEEP_ACK

Sleep acknowledge interrupt

CAN_IT_ERROR_WARNING

Error warning interrupt

CAN_IT_ERROR_PASSIVE

Error passive interrupt

CAN_IT_BUSOFF

Bus-off interrupt

CAN_IT_LAST_ERROR_CODE

Last error code interrupt

CAN_IT_ERROR

Error Interrupt

CAN Operating Mode

CAN_MODE_NORMAL

Normal mode

CAN_MODE_LOOPBACK

Loopback mode

CAN_MODE_SILENT

Silent mode

CAN_MODE_SILENT_LOOPBACK

Loopback combined with silent mode

CAN Receive FIFO Number

CAN_RX_FIFO0

CAN receive FIFO 0

CAN_RX_FIFO1

CAN receive FIFO 1

CAN Remote Transmission Request

CAN_RTR_DATA

Data frame

CAN_RTR_REMOTE

Remote frame

CAN Synchronization Jump Width

CAN_SJW_1TQ

1 time quantum

CAN_SJW_2TQ

2 time quantum

CAN_SJW_3TQ

3 time quantum

CAN_SJW_4TQ

4 time quantum

CAN Time Quantum in Bit Segment 1

CAN_BS1_1TQ

1 time quantum

CAN_BS1_2TQ

2 time quantum

CAN_BS1_3TQ

3 time quantum

CAN_BS1_4TQ

4 time quantum

CAN_BS1_5TQ

5 time quantum

CAN_BS1_6TQ

6 time quantum

CAN_BS1_7TQ

7 time quantum

CAN_BS1_8TQ

8 time quantum

CAN_BS1_9TQ

9 time quantum

CAN_BS1_10TQ

10 time quantum

CAN_BS1_11TQ

11 time quantum

CAN_BS1_12TQ

12 time quantum

CAN_BS1_13TQ

13 time quantum

CAN_BS1_14TQ

14 time quantum

CAN_BS1_15TQ

15 time quantum

CAN_BS1_16TQ

16 time quantum

CAN Time Quantum in Bit Segment 2

CAN_BS2_1TQ

1 time quantum

CAN_BS2_2TQ

2 time quantum

CAN_BS2_3TQ

3 time quantum

CAN_BS2_4TQ

4 time quantum

CAN_BS2_5TQ

5 time quantum

CAN_BS2_6TQ

6 time quantum

CAN_BS2_7TQ

7 time quantum

CAN_BS2_8TQ

8 time quantum

CAN Tx Mailboxes

CAN_TX_MAILBOX0

Tx Mailbox 0

CAN_TX_MAILBOX1

Tx Mailbox 1

CAN_TX_MAILBOX2

Tx Mailbox 2

10 HAL COMP Generic Driver

10.1 COMP Firmware driver registers structures

10.1.1 COMP_InitTypeDef

COMP_InitTypeDef is defined in the stm32l4xx_hal_comp.h

Data Fields

- ***uint32_t WindowMode***
- ***uint32_t Mode***
- ***uint32_t NonInvertingInput***
- ***uint32_t InvertingInput***
- ***uint32_t Hysteresis***
- ***uint32_t OutputPol***
- ***uint32_t BlankingSrce***
- ***uint32_t TriggerMode***

Field Documentation

- ***uint32_t COMP_InitTypeDef::WindowMode***

  Set window mode of a pair of comparators instances (2 consecutive instances odd and even COMP<x> and COMP<x+1>). Note: HAL COMP driver allows to set window mode from any COMP instance of the pair of COMP instances composing window mode. This parameter can be a value of ***COMP_WindowMode***
- ***uint32_t COMP_InitTypeDef::Mode***

  Set comparator operating mode to adjust power and speed. Note: For the characteristics of comparator power modes (propagation delay and power consumption), refer to device datasheet. This parameter can be a value of ***COMP_PowerMode***
- ***uint32_t COMP_InitTypeDef::NonInvertingInput***

  Set comparator input plus (non-inverting input). This parameter can be a value of ***COMP_InputPlus***
- ***uint32_t COMP_InitTypeDef::InvertingInput***

  Set comparator input minus (inverting input). This parameter can be a value of ***COMP_InputMinus***
- ***uint32_t COMP_InitTypeDef::Hysteresis***

  Set comparator hysteresis mode of the input minus. This parameter can be a value of ***COMP_Hysteresis***
- ***uint32_t COMP_InitTypeDef::OutputPol***

  Set comparator output polarity. This parameter can be a value of ***COMP_OutputPolarity***
- ***uint32_t COMP_InitTypeDef::BlankingSrce***

  Set comparator blanking source. This parameter can be a value of ***COMP_BlankingSrce***
- ***uint32_t COMP_InitTypeDef::TriggerMode***

  Set the comparator output triggering External Interrupt Line (EXTI). This parameter can be a value of ***COMP_EXTI_TriggerMode***

10.1.2 COMP_HandleTypeDef

COMP_HandleTypeDef is defined in the stm32l4xx_hal_comp.h

Data Fields

- ***COMP_TypeDef * Instance***
- ***COMP_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_COMP_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***COMP_TypeDef* COMP_HandleTypeDef::Instance***
  Register base address
- ***COMP_InitTypeDef COMP_HandleTypeDef::Init***
  COMP required parameters
- ***HAL_LockTypeDef COMP_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_COMP_StateTypeDef COMP_HandleTypeDef::State***
  COMP communication state
- ***__IO uint32_t COMP_HandleTypeDef::ErrorCode***
  COMP error code

10.2 COMP Firmware driver API description

The following section lists the various functions of the COMP library.

10.2.1 COMP Peripheral features

The STM32L4xx device family integrates two analog comparators instances: COMP1, COMP2 except for the STM32L412xx/STM32L422xx products that embed only one: COMP1. In the rest of the file, all comments related to a pair of comparators are not applicable to STM32L412xx or STM32L422xx.

1. Comparators input minus (inverting input) and input plus (non inverting input) can be set to internal references or to GPIO pins (refer to GPIO list in reference manual).
2. Comparators output level is available using HAL_COMP_GetOutputLevel() and can be redirected to other peripherals: GPIO pins (in mode alternate functions for comparator), timers. (refer to GPIO list in reference manual).
3. The comparators have interrupt capability through the EXTI controller with wake-up from sleep and stop modes.
4. Pairs of comparators instances can be combined in window mode (2 consecutive instances odd and even COMP<x> and COMP<x+1>). From the corresponding IRQ handler, the right interrupt source can be retrieved using macro __HAL_COMP_COMPx_EXTI_GET_FLAG().

10.2.2 How to use this driver

This driver provides functions to configure and program the comparator instances of STM32L4xx devices. To use the comparator, perform the following steps:

1. Initialize the COMP low level resources by implementing the HAL_COMP_MspInit():
   – Configure the GPIO connected to comparator inputs plus and minus in analog mode using HAL_GPIO_Init().
   – If needed, configure the GPIO connected to comparator output in alternate function mode using HAL_GPIO_Init().
   – If required enable the COMP interrupt by configuring and enabling EXTI line in Interrupt mode and selecting the desired sensitivity level using HAL_GPIO_Init() function. After that enable the comparator interrupt vector using HAL_NVIC_EnableIRQ() function.
2. Configure the comparator using HAL_COMP_Init() function:
   – Select the input minus (inverting input)
   – Select the input plus (non-inverting input)
   – Select the hysteresis
   – Select the blanking source
   – Select the output polarity
   – Select the power mode
   – Select the window mode

Note: HAL_COMP_Init() calls internally __HAL_RCC_SYSCFG_CLK_ENABLE() to enable internal control clock of the comparators. However, this is a legacy strategy. In future STM32 families, COMP clock enable must be implemented by user in "HAL_COMP_MspInit()". Therefore, for compatibility anticipation, it is recommended to implement __HAL_RCC_SYSCFG_CLK_ENABLE() in "HAL_COMP_MspInit()".

3. Reconfiguration on-the-fly of comparator can be done by calling again function HAL_COMP_Init() with new input structure parameters values.
4. Enable the comparator using HAL_COMP_Start() function.
5. Use HAL_COMP_TriggerCallback() or HAL_COMP_GetOutputLevel() functions to manage comparator outputs (events and output level).
6. Disable the comparator using HAL_COMP_Stop() function.
7. De-initialize the comparator using HAL_COMP_DeInit() function.
8. For safety purpose, comparator configuration can be locked using HAL_COMP_Lock() function. The only way to unlock the comparator is a device hardware reset.

Callback registration

The compilation flag USE_HAL_COMP_REGISTER_CALLBACKS, when set to 1, allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_COMP_RegisterCallback() to register an interrupt callback.

Function @ref HAL_COMP_RegisterCallback() allows to register following callbacks:

- TriggerCallback : callback for COMP trigger.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_COMP_UnRegisterCallback to reset a callback to the default weak function.

@ref HAL_COMP_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- TriggerCallback : callback for COMP trigger.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit.

By default, after the @ref HAL_COMP_Init() and when the state is @ref HAL_COMP_STATE_RESET all callbacks are set to the corresponding weak functions: example @ref HAL_COMP_TriggerCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the @ref HAL_COMP_Init()/ @ref HAL_COMP_DeInit() only when these callbacks are null (not registered beforehand).

If MspInit or MspDeInit are not null, the @ref HAL_COMP_Init()/ @ref HAL_COMP_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state.

Callbacks can be registered/unregistered in @ref HAL_COMP_STATE_READY state only. Exception done MspInit/MspDeInit functions that can be registered/unregistered in @ref HAL_COMP_STATE_READY or @ref HAL_COMP_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/ DeInit.

Then, the user first registers the MspInit/MspDeInit user callbacks using @ref HAL_COMP_RegisterCallback() before calling @ref HAL_COMP_DeInit() or @ref HAL_COMP_Init() function.

When the compilation flag USE_HAL_COMP_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

10.2.3 Initialization and de-initialization functions

This section provides functions to initialize and de-initialize comparators

This section contains the following APIs:

- ***HAL_COMP_Init***
- ***HAL_COMP_DeInit***
- ***HAL_COMP_MspInit***
- ***HAL_COMP_MspDeInit***

10.2.4 IO operation functions

This section provides functions allowing to:

- Start a comparator instance.
- Stop a comparator instance.

This section contains the following APIs:

- *HAL_COMP_Start*
- *HAL_COMP_Stop*
- *HAL_COMP_IRQHandler*

10.2.5 Peripheral Control functions

This subsection provides a set of functions allowing to control the comparators.

This section contains the following APIs:

- *HAL_COMP_Lock*
- *HAL_COMP_GetOutputLevel*
- *HAL_COMP_TriggerCallback*

10.2.6 Peripheral State functions

This subsection permit to get in run-time the status of the peripheral.

This section contains the following APIs:

- *HAL_COMP_GetState*
- *HAL_COMP_GetError*

10.2.7 Detailed description of functions

`HAL_COMP_Init`

Function name

HAL_StatusTypeDef HAL_COMP_Init (COMP_HandleTypeDef * hcomp)

Function description

Initialize the COMP according to the specified parameters in the COMP_InitTypeDef and initialize the associated handle.

Parameters

- **hcomp:** COMP handle

Return values

- **HAL:** status

Notes

- If the selected comparator is locked, initialization can't be performed. To unlock the configuration, perform a system reset.

`HAL_COMP_DeInit`

Function name

HAL_StatusTypeDef HAL_COMP_DeInit (COMP_HandleTypeDef * hcomp)

Function description

DeInitialize the COMP peripheral.

Parameters

- **hcomp:** COMP handle

Return values

- **HAL:** status

Notes

- Deinitialization cannot be performed if the COMP configuration is locked. To unlock the configuration, perform a system reset.

`HAL_COMP_MspInit`

Function name

void HAL_COMP_MspInit (COMP_HandleTypeDef * hcomp)

Function description

Initialize the COMP MSP.

Parameters

- **hcomp:** COMP handle

Return values

- **None:**

`HAL_COMP_MspDeInit`

Function name

void HAL_COMP_MspDeInit (COMP_HandleTypeDef * hcomp)

Function description

DeInitialize the COMP MSP.

Parameters

- **hcomp:** COMP handle

Return values

- **None:**

`HAL_COMP_Start`

Function name

HAL_StatusTypeDef HAL_COMP_Start (COMP_HandleTypeDef * hcomp)

Function description

Start the comparator.

Parameters

- **hcomp:** COMP handle

Return values

- **HAL:** status

`HAL_COMP_Stop`

Function name

HAL_StatusTypeDef HAL_COMP_Stop (COMP_HandleTypeDef * hcomp)

Function description

Stop the comparator.

Parameters

- **hcomp:** COMP handle

Return values

- **HAL:** status

`HAL_COMP_IRQHandler`

Function name

void HAL_COMP_IRQHandler (COMP_HandleTypeDef * hcomp)

Function description

Comparator IRQ handler.

Parameters

- **hcomp:** COMP handle

Return values

- **None:**

`HAL_COMP_Lock`

Function name

HAL_StatusTypeDef HAL_COMP_Lock (COMP_HandleTypeDef * hcomp)

Function description

Lock the selected comparator configuration.

Parameters

- **hcomp:** COMP handle

Return values

- **HAL:** status

Notes

- A system reset is required to unlock the comparator configuration.
- Locking the comparator from reset state is possible if __HAL_RCC_SYSCFG_CLK_ENABLE() is being called before.

`HAL_COMP_GetOutputLevel`

Function name

uint32_t HAL_COMP_GetOutputLevel (COMP_HandleTypeDef * hcomp)

Function description

Return the output level (high or low) of the selected comparator.

`HAL_COMP_TriggerCallback`

Function name

void HAL_COMP_TriggerCallback (COMP_HandleTypeDef * hcomp)

Function description

Comparator trigger callback.

Parameters

- **hcomp:** COMP handle

Return values

- **None:**

`HAL_COMP_GetState`

Function name

HAL_COMP_StateTypeDef HAL_COMP_GetState (COMP_HandleTypeDef * hcomp)

Function description

Return the COMP handle state.

Parameters

- **hcomp:** COMP handle

Return values

- **HAL:** state

`HAL_COMP_GetError`

Function name

uint32_t HAL_COMP_GetError (COMP_HandleTypeDef * hcomp)

Function description

Return the COMP error code.

Parameters

- **hcomp:** COMP handle

Return values

- **COMP:** error code

10.3 COMP Firmware driver defines

The following section lists the various define and macros of the module.

10.3.1 COMP

COMP

COMP blanking source

COMP_BLANKINGSRC_NONE

Comparator output without blanking

COMP_BLANKINGSRC_TIM1_OC5_COMP1

Comparator output blanking source TIM1 OC5 (specific to COMP instance: COMP1)

COMP_BLANKINGSRC_TIM2_OC3_COMP1

Comparator output blanking source TIM2 OC3 (specific to COMP instance: COMP1)

COMP_BLANKINGSRC_TIM3_OC3_COMP1

Comparator output blanking source TIM3 OC3 (specific to COMP instance: COMP1)

COMP_BLANKINGSRC_TIM3_OC4_COMP2

Comparator output blanking source TIM3 OC4 (specific to COMP instance: COMP2)

COMP_BLANKINGSRC_TIM8_OC5_COMP2

Comparator output blanking source TIM8 OC5 (specific to COMP instance: COMP2)

COMP_BLANKINGSRC_TIM15_OC1_COMP2

Comparator output blanking source TIM15 OC1 (specific to COMP instance: COMP2)

COMP Error Code

HAL_COMP_ERROR_NONE

No error

COMP Exported Types

COMP_STATE_BITFIELD_LOCK

COMP EXTI Lines

COMP_EXTI_LINE_COMP1

EXTI line 21 connected to COMP1 output

COMP_EXTI_LINE_COMP2

EXTI line 22 connected to COMP2 output

COMP_EXTI_IT

EXTI line event with interruption

COMP_EXTI_EVENT

EXTI line event only (without interruption)

COMP_EXTI_RISING

EXTI line event on rising edge

COMP_EXTI_FALLING

EXTI line event on falling edge

COMP external interrupt line management

__HAL_COMP_COMP1_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the COMP1 EXTI line rising edge trigger.

Return value:

- None

__HAL_COMP_COMP1_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the COMP1 EXTI line rising edge trigger.

Return value:

- None

__HAL_COMP_COMP1_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the COMP1 EXTI line falling edge trigger.

Return value:

- None

__HAL_COMP_COMP1_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the COMP1 EXTI line falling edge trigger.

Return value:

- None

__HAL_COMP_COMP1_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable the COMP1 EXTI line rising & falling edge trigger.

Return value:

- None

__HAL_COMP_COMP1_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the COMP1 EXTI line rising & falling edge trigger.

Return value:

- None

__HAL_COMP_COMP1_EXTI_ENABLE_IT

Description:

- Enable the COMP1 EXTI line in interrupt mode.

Return value:

- None

__HAL_COMP_COMP1_EXTI_DISABLE_IT

Description:

- Disable the COMP1 EXTI line in interrupt mode.

Return value:

- None

__HAL_COMP_COMP1_EXTI_GENERATE_SWIT

Description:

- Generate a software interrupt on the COMP1 EXTI line.

Return value:

- None

__HAL_COMP_COMP1_EXTI_ENABLE_EVENT

Description:

- Enable the COMP1 EXTI line in event mode.

Return value:

- None

__HAL_COMP_COMP1_EXTI_DISABLE_EVENT

Description:

- Disable the COMP1 EXTI line in event mode.

Return value:

- None

__HAL_COMP_COMP1_EXTI_GET_FLAG

Description:

- Check whether the COMP1 EXTI line flag is set.

Return value:

- RESET: or SET

__HAL_COMP_COMP1_EXTI_CLEAR_FLAG

Description:

- Clear the COMP1 EXTI flag.

Return value:

- None

__HAL_COMP_COMP2_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the COMP2 EXTI line rising edge trigger.

Return value:

- None

__HAL_COMP_COMP2_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the COMP2 EXTI line rising edge trigger.

Return value:

- None

__HAL_COMP_COMP2_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the COMP2 EXTI line falling edge trigger.

Return value:

- None

__HAL_COMP_COMP2_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the COMP2 EXTI line falling edge trigger.

Return value:

- None

__HAL_COMP_COMP2_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable the COMP2 EXTI line rising & falling edge trigger.

Return value:

- None

__HAL_COMP_COMP2_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the COMP2 EXTI line rising & falling edge trigger.

Return value:

- None

__HAL_COMP_COMP2_EXTI_ENABLE_IT

Description:

- Enable the COMP2 EXTI line in interrupt mode.

Return value:

- None

__HAL_COMP_COMP2_EXTI_DISABLE_IT

Description:

- Disable the COMP2 EXTI line in interrupt mode.

Return value:

- None

__HAL_COMP_COMP2_EXTI_GENERATE_SWIT

Description:

- Generate a software interrupt on the COMP2 EXTI line.

Return value:

- None

__HAL_COMP_COMP2_EXTI_ENABLE_EVENT

Description:

- Enable the COMP2 EXTI line in event mode.

Return value:

- None

__HAL_COMP_COMP2_EXTI_DISABLE_EVENT

Description:

- Disable the COMP2 EXTI line in event mode.

Return value:

- None

__HAL_COMP_COMP2_EXTI_GET_FLAG

Description:

- Check whether the COMP2 EXTI line flag is set.

Return value:

- RESET: or SET

__HAL_COMP_COMP2_EXTI_CLEAR_FLAG

Description:

- Clear the COMP2 EXTI flag.

Return value:

- None

COMP output to EXTI

COMP_TRIGGERMODE_NONE

Comparator output triggering no External Interrupt Line

COMP_TRIGGERMODE_IT_RISING

Comparator output triggering External Interrupt Line event with interruption, on rising edge

COMP_TRIGGERMODE_IT_FALLING

Comparator output triggering External Interrupt Line event with interruption, on falling edge

COMP_TRIGGERMODE_IT_RISING_FALLING

Comparator output triggering External Interrupt Line event with interruption, on both rising and falling edges

COMP_TRIGGERMODE_EVENT_RISING

Comparator output triggering External Interrupt Line event only (without interruption), on rising edge

COMP_TRIGGERMODE_EVENT_FALLING

Comparator output triggering External Interrupt Line event only (without interruption), on falling edge

COMP_TRIGGERMODE_EVENT_RISING_FALLING

Comparator output triggering External Interrupt Line event only (without interruption), on both rising and falling edges

COMP private macros to get EXTI line associated with comparators

COMP_GET_EXTI_LINE

Description:

- Get the specified EXTI line for a comparator instance.

Parameters:

- __INSTANCE__: specifies the COMP instance.

Return value:

- value: of

COMP Handle Management

__HAL_COMP_RESET_HANDLE_STATE

Description:

- Reset COMP handle state.

Parameters:

- __HANDLE__: COMP handle

Return value:

- None

COMP_CLEAR_ERRORCODE

Description:

- Clear COMP error code (set it to no error code "HAL_COMP_ERROR_NONE").

Parameters:

- __HANDLE__: COMP handle

Return value:

- None

__HAL_COMP_ENABLE

Description:

- Enable the specified comparator.

Parameters:

- __HANDLE__: COMP handle

Return value:

- None

__HAL_COMP_DISABLE

Description:

- Disable the specified comparator.

Parameters:

- __HANDLE__: COMP handle

Return value:

- None

__HAL_COMP_LOCK

Description:

- Lock the specified comparator configuration.

Parameters:

- __HANDLE__: COMP handle

Return value:

- None

Notes:

- Using this macro induce HAL COMP handle state machine being no more in line with COMP instance state. To keep HAL COMP handle state machine updated, it is recommended to use function "HAL_COMP_Lock')".

__HAL_COMP_IS_LOCKED

Description:

- Check whether the specified comparator is locked.

Parameters:

- __HANDLE__: COMP handle

Return value:

- Value: 0 if COMP instance is not locked, value 1 if COMP instance is locked

COMP hysteresis

COMP_HYSTERESIS_NONE

No hysteresis

COMP_HYSTERESIS_LOW

Hysteresis level low

COMP_HYSTERESIS_MEDIUM

Hysteresis level medium

COMP_HYSTERESIS_HIGH

Hysteresis level high

COMP input minus (inverting input)

COMP_INPUT_MINUS_1_4VREFINT

Comparator input minus connected to 1/4 VrefInt

COMP_INPUT_MINUS_1_2VREFINT

Comparator input minus connected to 1/2 VrefInt

COMP_INPUT_MINUS_3_4VREFINT

Comparator input minus connected to 3/4 VrefInt

COMP_INPUT_MINUS_VREFINT

Comparator input minus connected to VrefInt

COMP_INPUT_MINUS_DAC1_CH1

Comparator input minus connected to DAC1 channel 1 (DAC_OUT1)

COMP_INPUT_MINUS_DAC1_CH2

Comparator input minus connected to DAC1 channel 2 (DAC_OUT2)

COMP_INPUT_MINUS_IO1

Comparator input minus connected to IO1 (pin PB1 for COMP1, pin PB3 for COMP2)

COMP_INPUT_MINUS_IO2

Comparator input minus connected to IO2 (pin PC4 for COMP1, pin PB7 for COMP2)

COMP input plus (non-inverting input)

COMP_INPUT_PLUS_IO1

Comparator input plus connected to IO1 (pin PC5 for COMP1, pin PB4 for COMP2)

COMP_INPUT_PLUS_IO2

Comparator input plus connected to IO2 (pin PB2 for COMP1, pin PB6 for COMP2)

COMP private macros to check input parameters

IS_COMP_WINDOWMODE

IS_COMP_POWERMODE

IS_COMP_INPUT_PLUS

IS_COMP_INPUT_MINUS

IS_COMP_HYSTERESIS

IS_COMP_OUTPUTPOL

IS_COMP_BLANKINGSRCE

IS_COMP_BLANKINGSRC_INSTANCE

IS_COMP_TRIGGERMODE

IS_COMP_OUTPUT_LEVEL

COMP Output Level

COMP_OUTPUT_LEVEL_LOW

COMP_OUTPUT_LEVEL_HIGH

COMP output Polarity

COMP_OUTPUTPOL_NONINVERTED

COMP output level is not inverted (comparator output is high when the input plus is at a higher voltage than the input minus)

COMP_OUTPUTPOL_INVERTED

COMP output level is inverted (comparator output is low when the input plus is at a higher voltage than the input minus)

COMP power mode

COMP_POWERMODE_HIGHSPEED

High Speed

COMP_POWERMODE_MEDIUMSPEED

Medium Speed

COMP_POWERMODE_ULTRALOWPOWER

Ultra-low power mode

COMP Window Mode

COMP_WINDOWMODE_DISABLE

Window mode disable: Comparators instances pair COMP1 and COMP2 are independent

COMP_WINDOWMODE_COMP1_INPUT_PLUS_COMMON

Window mode enable: Comparators instances pair COMP1 and COMP2 have their input plus connected together. The common input is COMP1 input plus (COMP2 input plus is no more accessible).

11 HAL CORTEX Generic Driver

11.1 CORTEX Firmware driver registers structures

11.1.1 MPU_Region_InitTypeDef

MPU_Region_InitTypeDef is defined in the stm32l4xx_hal_cortex.h

Data Fields

- ***uint8_t Enable***
- ***uint8_t Number***
- ***uint32_t BaseAddress***
- ***uint8_t Size***
- ***uint8_t SubRegionDisable***
- ***uint8_t TypeExtField***
- ***uint8_t AccessPermission***
- ***uint8_t DisableExec***
- ***uint8_t IsShareable***
- ***uint8_t IsCacheable***
- ***uint8_t IsBufferable***

Field Documentation

- ***uint8_t MPU_Region_InitTypeDef::Enable***
  Specifies the status of the region. This parameter can be a value of ***CORTEX_MPU_Region_Enable***
- ***uint8_t MPU_Region_InitTypeDef::Number***
  Specifies the number of the region to protect. This parameter can be a value of ***CORTEX_MPU_Region_Number***
- ***uint32_t MPU_Region_InitTypeDef::BaseAddress***
  Specifies the base address of the region to protect.
- ***uint8_t MPU_Region_InitTypeDef::Size***
  Specifies the size of the region to protect. This parameter can be a value of ***CORTEX_MPU_Region_Size***
- ***uint8_t MPU_Region_InitTypeDef::SubRegionDisable***
  Specifies the number of the subregion protection to disable. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF
- ***uint8_t MPU_Region_InitTypeDef::TypeExtField***
  Specifies the TEX field level. This parameter can be a value of ***CORTEX_MPU_TEX_Levels***
- ***uint8_t MPU_Region_InitTypeDef::AccessPermission***
  Specifies the region access permission type. This parameter can be a value of ***CORTEX_MPU_Region_Permission_Attributes***
- ***uint8_t MPU_Region_InitTypeDef::DisableExec***
  Specifies the instruction access status. This parameter can be a value of ***CORTEX_MPU_Instruction_Access***
- ***uint8_t MPU_Region_InitTypeDef::IsShareable***
  Specifies the shareability status of the protected region. This parameter can be a value of ***CORTEX_MPU_Access_Shareable***
- ***uint8_t MPU_Region_InitTypeDef::IsCacheable***
  Specifies the cacheable status of the region protected. This parameter can be a value of ***CORTEX_MPU_Access_Cacheable***
- ***uint8_t MPU_Region_InitTypeDef::IsBufferable***
  Specifies the bufferable status of the protected region. This parameter can be a value of ***CORTEX_MPU_Access_Bufferable***

11.2 CORTEX Firmware driver API description

The following section lists the various functions of the CORTEX library.

11.2.1 How to use this driver

How to configure Interrupts using CORTEX HAL driver

This section provides functions allowing to configure the NVIC interrupts (IRQ). The Cortex-M4 exceptions are managed by CMSIS functions.

1. Configure the NVIC Priority Grouping using HAL_NVIC_SetPriorityGrouping() function.
2. Configure the priority of the selected IRQ Channels using HAL_NVIC_SetPriority().
3. Enable the selected IRQ Channels using HAL_NVIC_EnableIRQ().

Note: When the NVIC_PRIORITYGROUP_0 is selected, IRQ pre-emption is no more possible. The pending IRQ priority will be managed only by the sub priority.

Note: IRQ priority order (sorted by highest to lowest priority):

- *Lowest pre-emption priority*
- *Lowest sub priority*
- *Lowest hardware priority (IRQ number)*

How to configure SysTick using CORTEX HAL driver

Setup SysTick Timer for time base.

- The HAL_SYSTICK_Config() function calls the SysTick_Config() function which is a CMSIS function that:
  - Configures the SysTick Reload register with value passed as function parameter.
  - Configures the SysTick IRQ priority to the lowest value (0x0F).
  - Resets the SysTick Counter register.
  - Configures the SysTick Counter clock source to be Core Clock Source (HCLK).
  - Enables the SysTick Interrupt.
  - Starts the SysTick Counter.
- You can change the SysTick Clock source to be HCLK_Div8 by calling the macro __HAL_CORTEX_SYSTICKCLK_CONFIG(SYSTICK_CLKSOURCE_HCLK_DIV8) just after the HAL_SYSTICK_Config() function call. The __HAL_CORTEX_SYSTICKCLK_CONFIG() macro is defined inside the stm32l4xx_hal_cortex.h file.
- You can change the SysTick IRQ priority by calling the HAL_NVIC_SetPriority(SysTick_IRQn,...) function just after the HAL_SYSTICK_Config() function call. The HAL_NVIC_SetPriority() call the NVIC_SetPriority() function which is a CMSIS function.
- To adjust the SysTick time base, use the following formula: Reload Value = SysTick Counter Clock (Hz) x Desired Time base (s)
  - Reload Value is the parameter to be passed for HAL_SYSTICK_Config() function
  - Reload Value should not exceed 0xFFFFFF

11.2.2 Initialization and Configuration functions

This section provides the CORTEX HAL driver functions allowing to configure Interrupts SysTick functionalities

This section contains the following APIs:

- ***HAL_NVIC_SetPriorityGrouping***
- ***HAL_NVIC_SetPriority***
- ***HAL_NVIC_EnableIRQ***
- ***HAL_NVIC_DisableIRQ***
- ***HAL_NVIC_SystemReset***
- ***HAL_SYSTICK_Config***

11.2.3 Peripheral Control functions

This subsection provides a set of functions allowing to control the CORTEX (NVIC, SYSTICK, MPU) functionalities.

This section contains the following APIs:

- ***HAL_NVIC_GetPriorityGrouping***
- ***HAL_NVIC_GetPriority***
- ***HAL_NVIC_SetPendingIRQ***
- ***HAL_NVIC_GetPendingIRQ***
- ***HAL_NVIC_ClearPendingIRQ***
- ***HAL_NVIC_GetActive***
- ***HAL_SYSTICK_CLKSourceConfig***
- ***HAL_SYSTICK_IRQHandler***
- ***HAL_SYSTICK_Callback***
- ***HAL_MPU_Enable***
- ***HAL_MPU_Disable***
- ***HAL_MPU_ConfigRegion***

11.2.4 Detailed description of functions

`HAL_NVIC_SetPriorityGrouping`

Function name

void HAL_NVIC_SetPriorityGrouping (uint32_t PriorityGroup)

Function description

Set the priority grouping field (pre-emption priority and subpriority) using the required unlock sequence.

Parameters

- **PriorityGroup:** The priority grouping bits length. This parameter can be one of the following values:
  - NVIC_PRIORITYGROUP_0: 0 bit for pre-emption priority, 4 bits for subpriority
  - NVIC_PRIORITYGROUP_1: 1 bit for pre-emption priority, 3 bits for subpriority
  - NVIC_PRIORITYGROUP_2: 2 bits for pre-emption priority, 2 bits for subpriority
  - NVIC_PRIORITYGROUP_3: 3 bits for pre-emption priority, 1 bit for subpriority
  - NVIC_PRIORITYGROUP_4: 4 bits for pre-emption priority, 0 bit for subpriority

Return values

- **None:**

Notes

- When the NVIC_PriorityGroup_0 is selected, IRQ pre-emption is no more possible. The pending IRQ priority will be managed only by the subpriority.

`HAL_NVIC_SetPriority`

Function name

void HAL_NVIC_SetPriority (IRQn_Type IRQn, uint32_t PreemptPriority, uint32_t SubPriority)

Function description

Set the priority of an interrupt.

Parameters

- **IRQn:** External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))
- **PreemptPriority:** The pre-emption priority for the IRQn channel. This parameter can be a value between 0 and 15 A lower priority value indicates a higher priority
- **SubPriority:** the subpriority level for the IRQ channel. This parameter can be a value between 0 and 15 A lower priority value indicates a higher priority.

Return values

- **None:**

`HAL_NVIC_EnableIRQ`

Function name

void HAL_NVIC_EnableIRQ (IRQn_Type IRQn)

Function description

Enable a device specific interrupt in the NVIC interrupt controller.

Parameters

- **IRQn:** External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))

Return values

- **None:**

Notes

- To configure interrupts priority correctly, the NVIC_PriorityGroupConfig() function should be called before.

`HAL_NVIC_DisableIRQ`

Function name

void HAL_NVIC_DisableIRQ (IRQn_Type IRQn)

Function description

Disable a device specific interrupt in the NVIC interrupt controller.

Parameters

- **IRQn:** External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))

Return values

- **None:**

`HAL_NVIC_SystemReset`

Function name

void HAL_NVIC_SystemReset (void)

Function description

Initiate a system reset request to reset the MCU.

Return values

- **None:**

HAL_SYSTICK_Config

Function name

uint32_t HAL_SYSTICK_Config (uint32_t TicksNumb)

Function description

Initialize the System Timer with interrupt enabled and start the System Tick Timer (SysTick): Counter is in free running mode to generate periodic interrupts.

Parameters

- **TicksNumb:** Specifies the ticks Number of ticks between two interrupts.

Return values

- **status:** - 0 Function succeeded.
  - 1 Function failed.

HAL_NVIC_GetPriorityGrouping

Function name

uint32_t HAL_NVIC_GetPriorityGrouping (void)

Function description

Get the priority grouping field from the NVIC Interrupt Controller.

Return values

- **Priority:** grouping field (SCB->AIRCR [10:8] PRIGROUP field)

HAL_NVIC_GetPriority

Function name

void HAL_NVIC_GetPriority (IRQn_Type IRQn, uint32_t PriorityGroup, uint32_t * pPreemptPriority, uint32_t * pSubPriority)

Function description

Get the priority of an interrupt.

Parameters

- **IRQn:** External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))
- **PriorityGroup:** the priority grouping bits length. This parameter can be one of the following values:
  - NVIC_PRIORITYGROUP_0: 0 bit for pre-emption priority, 4 bits for subpriority
  - NVIC_PRIORITYGROUP_1: 1 bit for pre-emption priority, 3 bits for subpriority
  - NVIC_PRIORITYGROUP_2: 2 bits for pre-emption priority, 2 bits for subpriority
  - NVIC_PRIORITYGROUP_3: 3 bits for pre-emption priority, 1 bit for subpriority
  - NVIC_PRIORITYGROUP_4: 4 bits for pre-emption priority, 0 bit for subpriority
- **pPreemptPriority:** Pointer on the Preemptive priority value (starting from 0).
- **pSubPriority:** Pointer on the Subpriority value (starting from 0).

Return values

- **None:**

HAL_NVIC_GetPendingIRQ

Function name

uint32_t HAL_NVIC_GetPendingIRQ (IRQn_Type IRQn)

Function description

Get Pending Interrupt (read the pending register in the NVIC and return the pending bit for the specified interrupt).

Parameters

- **IRQn:** External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))

Return values

- **status:** - 0 Interrupt status is not pending.
  - 1 Interrupt status is pending.

HAL_NVIC_SetPendingIRQ

Function name

void HAL_NVIC_SetPendingIRQ (IRQn_Type IRQn)

Function description

Set Pending bit of an external interrupt.

Parameters

- **IRQn:** External interrupt number This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))

Return values

- **None:**

HAL_NVIC_ClearPendingIRQ

Function name

void HAL_NVIC_ClearPendingIRQ (IRQn_Type IRQn)

Function description

Clear the pending bit of an external interrupt.

Parameters

- **IRQn:** External interrupt number. This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))

Return values

- **None:**

HAL_NVIC_GetActive

Function name

uint32_t HAL_NVIC_GetActive (IRQn_Type IRQn)

Function description

Get active interrupt (read the active register in NVIC and return the active bit).

Parameters

- **IRQn:** External interrupt number This parameter can be an enumerator of IRQn_Type enumeration (For the complete STM32 Devices IRQ Channels list, please refer to the appropriate CMSIS device file (stm32l4xxxx.h))

Return values

- **status:** - 0 Interrupt status is not pending.
  - 1 Interrupt status is pending.

`HAL_SYSTICK_CLKSourceConfig`

Function name

void HAL_SYSTICK_CLKSourceConfig (uint32_t CLKSource)

Function description

Configure the SysTick clock source.

Parameters

- **CLKSource:** specifies the SysTick clock source. This parameter can be one of the following values:
  - SYSTICK_CLKSOURCE_HCLK_DIV8: AHB clock divided by 8 selected as SysTick clock source.
  - SYSTICK_CLKSOURCE_HCLK: AHB clock selected as SysTick clock source.

Return values

- **None:**

`HAL_SYSTICK_IRQHandler`

Function name

void HAL_SYSTICK_IRQHandler (void)

Function description

Handle SYSTICK interrupt request.

Return values

- **None:**

`HAL_SYSTICK_Callback`

Function name

void HAL_SYSTICK_Callback (void)

Function description

SYSTICK callback.

Return values

- **None:**

`HAL_MPU_Enable`

Function name

void HAL_MPU_Enable (uint32_t MPU_Control)

Function description

Enable the MPU.

Parameters

- **MPU_Control:** Specifies the control mode of the MPU during hard fault, NMI, FAULTMASK and privileged accessto the default memory This parameter can be one of the following values:
  - MPU_HFNMI_PRIVDEF_NONE
  - MPU_HARDFAULT_NMI
  - MPU_PRIVILEGED_DEFAULT
  - MPU_HFNMI_PRIVDEF

Return values

- **None:**

`HAL_MPU_Disable`

Function name

void HAL_MPU_Disable (void)

Function description

Disable the MPU.

Return values

- **None:**

`HAL_MPU_ConfigRegion`

Function name

void HAL_MPU_ConfigRegion (MPU_Region_InitTypeDef * MPU_Init)

Function description

Initialize and configure the Region and the memory to be protected.

Parameters

- **MPU_Init:** Pointer to a MPU_Region_InitTypeDef structure that contains the initialization and configuration information.

Return values

- **None:**

11.3 CORTEX Firmware driver defines

The following section lists the various define and macros of the module.

11.3.1 CORTEX

CORTEX

CORTEX MPU Instruction Access Bufferable

MPU_ACCESS_BUFFERABLE

MPU_ACCESS_NOT_BUFFERABLE

CORTEX MPU Instruction Access Cacheable

MPU_ACCESS_CACHEABLE

MPU_ACCESS_NOT_CACHEABLE

CORTEX MPU Instruction Access Shareable

MPU_ACCESS_SHAREABLE

MPU_ACCESS_NOT_SHAREABLE

CORTEX MPU HFNMI and PRIVILEGED Access control

MPU_HFNMI_PRIVDEF_NONE

MPU_HARDFAULT_NMI

MPU_PRIVILEGED_DEFAULT

MPU_HFNMI_PRIVDEF

CORTEX MPU Instruction Access

MPU_INSTRUCTION_ACCESS_ENABLE

MPU_INSTRUCTION_ACCESS_DISABLE

CORTEX MPU Region Enable

MPU_REGION_ENABLE

MPU_REGION_DISABLE

CORTEX MPU Region Number

MPU_REGION_NUMBER0

MPU_REGION_NUMBER1

MPU_REGION_NUMBER2

MPU_REGION_NUMBER3

MPU_REGION_NUMBER4

MPU_REGION_NUMBER5

MPU_REGION_NUMBER6

MPU_REGION_NUMBER7

CORTEX MPU Region Permission Attributes

MPU_REGION_NO_ACCESS

MPU_REGION_PRIV_RW

MPU_REGION_PRIV_RW_URO

MPU_REGION_FULL_ACCESS

MPU_REGION_PRIV_RO

MPU_REGION_PRIV_RO_URO

CORTEX MPU Region Size

MPU_REGION_SIZE_32B

MPU_REGION_SIZE_64B

MPU_REGION_SIZE_128B

MPU_REGION_SIZE_256B

MPU_REGION_SIZE_512B

MPU_REGION_SIZE_1KB

MPU_REGION_SIZE_2KB

MPU_REGION_SIZE_4KB

MPU_REGION_SIZE_8KB

MPU_REGION_SIZE_16KB

MPU_REGION_SIZE_32KB

MPU_REGION_SIZE_64KB

MPU_REGION_SIZE_128KB

MPU_REGION_SIZE_256KB

MPU_REGION_SIZE_512KB

MPU_REGION_SIZE_1MB

MPU_REGION_SIZE_2MB

MPU_REGION_SIZE_4MB

MPU_REGION_SIZE_8MB

MPU_REGION_SIZE_16MB

MPU_REGION_SIZE_32MB

MPU_REGION_SIZE_64MB

MPU_REGION_SIZE_128MB

MPU_REGION_SIZE_256MB

MPU_REGION_SIZE_512MB

MPU_REGION_SIZE_1GB

MPU_REGION_SIZE_2GB

MPU_REGION_SIZE_4GB

CORTEX MPU TEX Levels

MPU_TEX_LEVEL0

MPU_TEX_LEVEL1

MPU_TEX_LEVEL2

MPU_TEX_LEVEL4

CORTEX Preemption Priority Group

NVIC_PRIORITYGROUP_0

0 bit for pre-emption priority, 4 bits for subpriority

NVIC_PRIORITYGROUP_1

1 bit for pre-emption priority, 3 bits for subpriority

NVIC_PRIORITYGROUP_2

2 bits for pre-emption priority, 2 bits for subpriority

NVIC_PRIORITYGROUP_3

3 bits for pre-emption priority, 1 bit for subpriority

NVIC_PRIORITYGROUP_4

4 bits for pre-emption priority, 0 bit for subpriority

CORTEX SysTick clock source

SYSTICK_CLKSOURCE_HCLK_DIV8

SYSTICK_CLKSOURCE_HCLK

12 HAL CRC Generic Driver

12.1 CRC Firmware driver registers structures

12.1.1 CRC_InitTypeDef

CRC_InitTypeDef is defined in the stm32l4xx_hal_crc.h

Data Fields

- ***uint8_t DefaultPolynomialUse***
- ***uint8_t DefaultInitValueUse***
- ***uint32_t GeneratingPolynomial***
- ***uint32_t CRCLength***
- ***uint32_t InitValue***
- ***uint32_t InputDataInversionMode***
- ***uint32_t OutputDataInversionMode***

Field Documentation

- ***uint8_t CRC_InitTypeDef::DefaultPolynomialUse***

  This parameter is a value of ***CRC_Default_Polynomial*** and indicates if default polynomial is used. If set to DEFAULT_POLYNOMIAL_ENABLE, resort to default X^32 + X^26 + X^23 + X^22 + X^16 + X^12 + X^11 + X^10 +X^8 + X^7 + X^5 + X^4 + X^2+ X +1. In that case, there is no need to set GeneratingPolynomial field. If otherwise set to DEFAULT_POLYNOMIAL_DISABLE, GeneratingPolynomial and CRCLength fields must be set.

- ***uint8_t CRC_InitTypeDef::DefaultInitValueUse***

  This parameter is a value of ***CRC_Default_InitValue_Use*** and indicates if default init value is used. If set to DEFAULT_INIT_VALUE_ENABLE, resort to default 0xFFFFFFFF value. In that case, there is no need to set InitValue field. If otherwise set to DEFAULT_INIT_VALUE_DISABLE, InitValue field must be set.

- ***uint32_t CRC_InitTypeDef::GeneratingPolynomial***

  Set CRC generating polynomial as a 7, 8, 16 or 32-bit long value for a polynomial degree respectively equal to 7, 8, 16 or 32. This field is written in normal representation, e.g., for a polynomial of degree 7, X^7 + X^6 + X^5 + X^2 + 1 is written 0x65. No need to specify it if DefaultPolynomialUse is set to DEFAULT_POLYNOMIAL_ENABLE.

- ***uint32_t CRC_InitTypeDef::CRCLength***

  This parameter is a value of ***CRC_Polynomial_Sizes*** and indicates CRC length. Value can be either one of
  - **CRC_POLYLENGTH_32B** (32-bit CRC),
  - **CRC_POLYLENGTH_16B** (16-bit CRC),
  - **CRC_POLYLENGTH_8B** (8-bit CRC),
  - **CRC_POLYLENGTH_7B** (7-bit CRC).

- ***uint32_t CRC_InitTypeDef::InitValue***

  Init value to initiate CRC computation. No need to specify it if DefaultInitValueUse is set to DEFAULT_INIT_VALUE_ENABLE.

- ***uint32_t CRC_InitTypeDef::InputDataInversionMode***

  This parameter is a value of ***CRCEx_Input_Data_Inversion*** and specifies input data inversion mode. Can be either one of the following values
  - **CRC_INPUTDATA_INVERSION_NONE** no input data inversion
  - **CRC_INPUTDATA_INVERSION_BYTE** byte-wise inversion, 0x1A2B3C4D becomes 0x58D43CB2
  - **CRC_INPUTDATA_INVERSION_HALFWORD** halfword-wise inversion, 0x1A2B3C4D becomes 0xD458B23C
  - **CRC_INPUTDATA_INVERSION_WORD** word-wise inversion, 0x1A2B3C4D becomes 0xB23CD458

- ***uint32_t CRC_InitTypeDef::OutputDataInversionMode***
  This parameter is a value of ***CRCEx_Output_Data_Inversion*** and specifies output data (i.e. CRC) inversion mode. Can be either
  - **CRC_OUTPUTDATA_INVERSION_DISABLE** no CRC inversion,
  - **CRC_OUTPUTDATA_INVERSION_ENABLE** CRC 0x11223344 is converted into 0x22CC4488

12.1.2 CRC_HandleTypeDef

CRC_HandleTypeDef is defined in the stm32l4xx_hal_crc.h

Data Fields

- ***CRC_TypeDef * Instance***
- ***CRC_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_CRC_StateTypeDef State***
- ***uint32_t InputDataFormat***

Field Documentation

- ***CRC_TypeDef* CRC_HandleTypeDef::Instance***
  Register base address
- ***CRC_InitTypeDef CRC_HandleTypeDef::Init***
  CRC configuration parameters
- ***HAL_LockTypeDef CRC_HandleTypeDef::Lock***
  CRC Locking object
- ***__IO HAL_CRC_StateTypeDef CRC_HandleTypeDef::State***
  CRC communication state
- ***uint32_t CRC_HandleTypeDef::InputDataFormat***
  This parameter is a value of ***CRC_Input_Buffer_Format*** and specifies input data format. Can be either
  - **CRC_INPUTDATA_FORMAT_BYTES** input data is a stream of bytes (8-bit data)
  - **CRC_INPUTDATA_FORMAT_HALFWORDS** input data is a stream of half-words (16-bit data)
  - **CRC_INPUTDATA_FORMAT_WORDS** input data is a stream of words (32-bit data)

  Note that constant CRC_INPUT_FORMAT_UNDEFINED is defined but an initialization error must occur if InputBufferFormat is not one of the three values listed above

12.2 CRC Firmware driver API description

The following section lists the various functions of the CRC library.

12.2.1 How to use this driver

- Enable CRC AHB clock using __HAL_RCC_CRC_CLK_ENABLE();
- Initialize CRC calculator
  - specify generating polynomial (peripheral default or non-default one)
  - specify initialization value (peripheral default or non-default one)
  - specify input data format
  - specify input or output data inversion mode if any
- Use HAL_CRC_Accumulate() function to compute the CRC value of the input data buffer starting with the previously computed CRC as initialization value
- Use HAL_CRC_Calculate() function to compute the CRC value of the input data buffer starting with the defined initialization value (default or non-default) to initiate CRC calculation

12.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the CRC according to the specified parameters in the CRC_InitTypeDef and create the associated handle

- DeInitialize the CRC peripheral
- Initialize the CRC MSP (MCU Specific Package)
- DeInitialize the CRC MSP

This section contains the following APIs:

- ***HAL_CRC_Init***
- ***HAL_CRC_DeInit***
- ***HAL_CRC_MspInit***
- ***HAL_CRC_MspDeInit***

12.2.3 Peripheral Control functions

This section provides functions allowing to:

- compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer using combination of the previous CRC value and the new one.

or

- compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer independently of the previous CRC value.

This section contains the following APIs:

- ***HAL_CRC_Accumulate***
- ***HAL_CRC_Calculate***

12.2.4 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- ***HAL_CRC_GetState***

12.2.5 Detailed description of functions

`HAL_CRC_Init`

Function name

HAL_StatusTypeDef HAL_CRC_Init (CRC_HandleTypeDef * hcrc)

Function description

Initialize the CRC according to the specified parameters in the CRC_InitTypeDef and create the associated handle.

Parameters

- **hcrc:** CRC handle

Return values

- **HAL:** status

`HAL_CRC_DeInit`

Function name

HAL_StatusTypeDef HAL_CRC_DeInit (CRC_HandleTypeDef * hcrc)

Function description

DeInitialize the CRC peripheral.

Parameters

- **hcrc:** CRC handle

Return values

- **HAL:** status

`HAL_CRC_MspInit`

Function name

void HAL_CRC_MspInit (CRC_HandleTypeDef * hcrc)

Function description

Initializes the CRC MSP.

Parameters

- **hcrc:** CRC handle

Return values

- **None:**

`HAL_CRC_MspDeInit`

Function name

void HAL_CRC_MspDeInit (CRC_HandleTypeDef * hcrc)

Function description

DeInitialize the CRC MSP.

Parameters

- **hcrc:** CRC handle

Return values

- **None:**

`HAL_CRC_Accumulate`

Function name

uint32_t HAL_CRC_Accumulate (CRC_HandleTypeDef * hcrc, uint32_t pBuffer, uint32_t BufferLength)

Function description

Compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer starting with the previously computed CRC as initialization value.

Parameters

- **hcrc:** CRC handle
- **pBuffer:** pointer to the input data buffer, exact input data format is provided by hcrc->InputDataFormat.
- **BufferLength:** input data buffer length (number of bytes if pBuffer type is * uint8_t, number of half-words if pBuffer type is * uint16_t, number of words if pBuffer type is * uint32_t).

Return values

- **uint32_t:** CRC (returned value LSBs for CRC shorter than 32 bits)

Notes

- By default, the API expects a uint32_t pointer as input buffer parameter. Input buffer pointers with other types simply need to be cast in uint32_t and the API will internally adjust its input data processing based on the handle field hcrc->InputDataFormat.

`HAL_CRC_Calculate`

Function name

uint32_t HAL_CRC_Calculate (CRC_HandleTypeDef * hcrc, uint32_t pBuffer, uint32_t BufferLength)

Function description

Compute the 7, 8, 16 or 32-bit CRC value of an 8, 16 or 32-bit data buffer starting with hcrc->Instance->INIT as initialization value.

Parameters

- **hcrc:** CRC handle
- **pBuffer:** pointer to the input data buffer, exact input data format is provided by hcrc->InputDataFormat.
- **BufferLength:** input data buffer length (number of bytes if pBuffer type is * uint8_t, number of half-words if pBuffer type is * uint16_t, number of words if pBuffer type is * uint32_t).

Return values

- **uint32_t:** CRC (returned value LSBs for CRC shorter than 32 bits)

Notes

- By default, the API expects a uint32_t pointer as input buffer parameter. Input buffer pointers with other types simply need to be cast in uint32_t and the API will internally adjust its input data processing based on the handle field hcrc->InputDataFormat.

`HAL_CRC_GetState`

Function name

HAL_CRC_StateTypeDef HAL_CRC_GetState (CRC_HandleTypeDef * hcrc)

Function description

Return the CRC handle state.

Parameters

- **hcrc:** CRC handle

Return values

- **HAL:** state

12.3 CRC Firmware driver defines

The following section lists the various define and macros of the module.

12.3.1 CRC

CRC

CRC API aliases

HAL_CRC_Input_Data_Reverse

Aliased to HAL_CRCEx_Input_Data_Reverse for inter STM32 series compatibility

HAL_CRC_Output_Data_Reverse

Aliased to HAL_CRCEx_Output_Data_Reverse for inter STM32 series compatibility

Default CRC computation initialization value

DEFAULT_CRC_INITVALUE

Initial CRC default value

Indicates whether or not default init value is used

DEFAULT_INIT_VALUE_ENABLE

Enable initial CRC default value

DEFAULT_INIT_VALUE_DISABLE

Disable initial CRC default value

Indicates whether or not default polynomial is used

DEFAULT_POLYNOMIAL_ENABLE

Enable default generating polynomial 0x04C11DB7

DEFAULT_POLYNOMIAL_DISABLE

Disable default generating polynomial 0x04C11DB7

Default CRC generating polynomial

DEFAULT_CRC32_POLY

X^32 + X^26 + X^23 + X^22 + X^16 + X^12 + X^11 + X^10 +X^8 + X^7 + X^5 + X^4 + X^2+ X +1

CRC Exported Macros

__HAL_CRC_RESET_HANDLE_STATE

Description:

- Reset CRC handle state.

Parameters:

- __HANDLE__: CRC handle.

Return value:

- None

__HAL_CRC_DR_RESET

Description:

- Reset CRC Data Register.

Parameters:

- __HANDLE__: CRC handle

Return value:

- None

__HAL_CRC_INITIALCRCVALUE_CONFIG

Description:

- Set CRC INIT non-default value.

Parameters:

- __HANDLE__: CRC handle
- __INIT__: 32-bit initial value

Return value:

- None

__HAL_CRC_SET_IDR

Description:

- Store data in the Independent Data (ID) register.

Parameters:

- __HANDLE__: CRC handle
- __VALUE__: Value to be stored in the ID register

Return value:

- None

Notes:

- Refer to the Reference Manual to get the authorized __VALUE__ length in bits

__HAL_CRC_GET_IDR

Description:

- Return the data stored in the Independent Data (ID) register.

Parameters:

- __HANDLE__: CRC handle

Return value:

- Value: of the ID register

Notes:

- Refer to the Reference Manual to get the authorized __VALUE__ length in bits

Input Buffer Format

CRC_INPUTDATA_FORMAT_UNDEFINED

Undefined input data format

CRC_INPUTDATA_FORMAT_BYTES

Input data in byte format

CRC_INPUTDATA_FORMAT_HALFWORDS

Input data in half-word format

CRC_INPUTDATA_FORMAT_WORDS

Input data in word format

Polynomial sizes to configure the peripheral

CRC_POLYLENGTH_32B

Resort to a 32-bit long generating polynomial

CRC_POLYLENGTH_16B

Resort to a 16-bit long generating polynomial

CRC_POLYLENGTH_8B

Resort to a 8-bit long generating polynomial

CRC_POLYLENGTH_7B

Resort to a 7-bit long generating polynomial

CRC polynomial possible sizes actual definitions

HAL_CRC_LENGTH_32B

32-bit long CRC

HAL_CRC_LENGTH_16B

16-bit long CRC

HAL_CRC_LENGTH_8B

8-bit long CRC

HAL_CRC_LENGTH_7B

7-bit long CRC

13 HAL CRC Extension Driver

13.1 CRCEx Firmware driver API description

The following section lists the various functions of the CRCEx library.

13.1.1 How to use this driver

- Set user-defined generating polynomial thru HAL_CRCEx_Polynomial_Set()
- Configure Input or Output data inversion

13.1.2 Extended configuration functions

This section provides functions allowing to:

- Configure the generating polynomial
- Configure the input data inversion
- Configure the output data inversion

This section contains the following APIs:

- ***HAL_CRCEx_Polynomial_Set***
- ***HAL_CRCEx_Input_Data_Reverse***
- ***HAL_CRCEx_Output_Data_Reverse***

13.1.3 Detailed description of functions

`HAL_CRCEx_Polynomial_Set`

Function name

HAL_StatusTypeDef HAL_CRCEx_Polynomial_Set (CRC_HandleTypeDef * hcrc, uint32_t Pol, uint32_t PolyLength)

Function description

Initialize the CRC polynomial if different from default one.

Parameters

- **hcrc:** CRC handle
- **Pol:** CRC generating polynomial (7, 8, 16 or 32-bit long). This parameter is written in normal representation, e.g.
  - for a polynomial of degree 7, X^7 + X^6 + X^5 + X^2 + 1 is written 0x65
  - for a polynomial of degree 16, X^16 + X^12 + X^5 + 1 is written 0x1021
- **PolyLength:** CRC polynomial length. This parameter can be one of the following values:
  - CRC_POLYLENGTH_7B 7-bit long CRC (generating polynomial of degree 7)
  - CRC_POLYLENGTH_8B 8-bit long CRC (generating polynomial of degree 8)
  - CRC_POLYLENGTH_16B 16-bit long CRC (generating polynomial of degree 16)
  - CRC_POLYLENGTH_32B 32-bit long CRC (generating polynomial of degree 32)

Return values

- **HAL:** status

`HAL_CRCEx_Input_Data_Reverse`

Function name

HAL_StatusTypeDef HAL_CRCEx_Input_Data_Reverse (CRC_HandleTypeDef * hcrc, uint32_t InputReverseMode)

Function description

Set the Reverse Input data mode.

Parameters

- **hcrc:** CRC handle
- **InputReverseMode:** Input Data inversion mode. This parameter can be one of the following values:
  - CRC_INPUTDATA_INVERSION_NONE no change in bit order (default value)
  - CRC_INPUTDATA_INVERSION_BYTE Byte-wise bit reversal
  - CRC_INPUTDATA_INVERSION_HALFWORD HalfWord-wise bit reversal
  - CRC_INPUTDATA_INVERSION_WORD Word-wise bit reversal

Return values

- **HAL:** status

`HAL_CRCEx_Output_Data_Reverse`

Function name

HAL_StatusTypeDef HAL_CRCEx_Output_Data_Reverse (CRC_HandleTypeDef * hcrc, uint32_t OutputReverseMode)

Function description

Set the Reverse Output data mode.

Parameters

- **hcrc:** CRC handle
- **OutputReverseMode:** Output Data inversion mode. This parameter can be one of the following values:
  - CRC_OUTPUTDATA_INVERSION_DISABLE no CRC inversion (default value)
  - CRC_OUTPUTDATA_INVERSION_ENABLE bit-level inversion (e.g. for a 8-bit CRC: 0xB5 becomes 0xAD)

Return values

- **HAL:** status

13.2 CRCEx Firmware driver defines

The following section lists the various define and macros of the module.

13.2.1 CRCEx

CRCEx

CRC Extended Exported Macros

__HAL_CRC_OUTPUTREVERSAL_ENABLE

Description:

- Set CRC output reversal.

Parameters:

- __HANDLE__: CRC handle

Return value:

- None

__HAL_CRC_OUTPUTREVERSAL_DISABLE

Description:

- Unset CRC output reversal.

Parameters:

- __HANDLE__: CRC handle

Return value:

- None

__HAL_CRC_POLYNOMIAL_CONFIG

Description:

- Set CRC non-default polynomial.

Parameters:

- __HANDLE__: CRC handle
- __POLYNOMIAL__: 7, 8, 16 or 32-bit polynomial

Return value:

- None

Input Data Inversion Modes

CRC_INPUTDATA_INVERSION_NONE

No input data inversion

CRC_INPUTDATA_INVERSION_BYTE

Byte-wise input data inversion

CRC_INPUTDATA_INVERSION_HALFWORD

HalfWord-wise input data inversion

CRC_INPUTDATA_INVERSION_WORD

Word-wise input data inversion

Output Data Inversion Modes

CRC_OUTPUTDATA_INVERSION_DISABLE

No output data inversion

CRC_OUTPUTDATA_INVERSION_ENABLE

Bit-wise output data inversion

14 HAL CRYP Generic Driver

14.1 CRYP Firmware driver registers structures

14.1.1 CRYP_InitTypeDef

CRYP_InitTypeDef is defined in the stm32l4xx_hal_cryp.h

Data Fields

- ***uint32_t DataType***
- ***uint32_t KeySize***
- ***uint32_t OperatingMode***
- ***uint32_t ChainingMode***
- ***uint32_t KeyWriteFlag***
- ***uint32_t GCMCMACPhase***
- ***uint8_t * pKey***
- ***uint8_t * pInitVect***
- ***uint8_t * Header***
- ***uint64_t HeaderSize***

Field Documentation

- ***uint32_t CRYP_InitTypeDef::DataType***
  32-bit data, 16-bit data, 8-bit data or 1-bit string. This parameter can be a value of ***CRYP_Data_Type***
- ***uint32_t CRYP_InitTypeDef::KeySize***
  128 or 256-bit key length. This parameter can be a value of ***CRYP_Key_Size***
- ***uint32_t CRYP_InitTypeDef::OperatingMode***
  AES operating mode. This parameter can be a value of ***CRYP_AES_OperatingMode***
- ***uint32_t CRYP_InitTypeDef::ChainingMode***
  AES chaining mode. This parameter can be a value of ***CRYP_AES_ChainingMode***
- ***uint32_t CRYP_InitTypeDef::KeyWriteFlag***
  Allows to bypass or not key write-up before decryption. This parameter can be a value of ***CRYP_Key_Write***
- ***uint32_t CRYP_InitTypeDef::GCMCMACPhase***
  Indicates the processing phase of the Galois Counter Mode (GCM), Galois Message Authentication Code (GMAC), Cipher Message Authentication Code (CMAC) (when applicable) or Counter with Cipher Mode (CCM) (when applicable). This parameter can be a value of ***CRYP_GCM_CMAC_Phase***
- ***uint8_t* CRYP_InitTypeDef::pKey***
  Encryption/Decryption Key
- ***uint8_t* CRYP_InitTypeDef::pInitVect***
  Initialization Vector used for CTR, CBC, GCM/GMAC, CMAC (when applicable) and CCM (when applicable) modes
- ***uint8_t* CRYP_InitTypeDef::Header***
  Header used in GCM/GMAC, CMAC (when applicable) and CCM (when applicable) modes
- ***uint64_t CRYP_InitTypeDef::HeaderSize***
  Header size in bytes

14.1.2 __CRYP_HandleTypeDef

__CRYP_HandleTypeDef is defined in the stm32l4xx_hal_cryp.h

Data Fields

- ***AES_TypeDef * Instance***
- ***CRYP_InitTypeDef Init***
- ***uint8_t * pCrypInBuffPtr***

- ***uint8_t * pCrypOutBuffPtr***
- ***uint32_t CrypInCount***
- ***uint32_t CrypOutCount***
- ***HAL_PhaseTypeDef Phase***
- ***DMA_HandleTypeDef * hdmain***
- ***DMA_HandleTypeDef * hdmaout***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_CRYP_STATETypeDef State***
- ***__IO uint32_t ErrorCode***
- ***HAL_SuspendTypeDef SuspendRequest***

Field Documentation

- ***AES_TypeDef* __CRYP_HandleTypeDef::Instance***
  Register base address
- ***CRYP_InitTypeDef __CRYP_HandleTypeDef::Init***
  CRYP initialization parameters
- ***uint8_t* __CRYP_HandleTypeDef::pCrypInBuffPtr***
  Pointer to CRYP processing (encryption, decryption,...) input buffer
- ***uint8_t* __CRYP_HandleTypeDef::pCrypOutBuffPtr***
  Pointer to CRYP processing (encryption, decryption,...) output buffer
- ***uint32_t __CRYP_HandleTypeDef::CrypInCount***
  Input data size in bytes or, after suspension, the remaining number of bytes to process
- ***uint32_t __CRYP_HandleTypeDef::CrypOutCount***
  Output data size in bytes
- ***HAL_PhaseTypeDef __CRYP_HandleTypeDef::Phase***
  CRYP peripheral processing phase for GCM, GMAC, CMAC (when applicable) or CCM (when applicable) modes. Indicates the last phase carried out to ease phase transitions
- ***DMA_HandleTypeDef* __CRYP_HandleTypeDef::hdmain***
  CRYP peripheral Input DMA handle parameters
- ***DMA_HandleTypeDef* __CRYP_HandleTypeDef::hdmaout***
  CRYP peripheral Output DMA handle parameters
- ***HAL_LockTypeDef __CRYP_HandleTypeDef::Lock***
  CRYP locking object
- ***__IO HAL_CRYP_STATETypeDef __CRYP_HandleTypeDef::State***
  CRYP peripheral state
- ***__IO uint32_t __CRYP_HandleTypeDef::ErrorCode***
  CRYP peripheral error code
- ***HAL_SuspendTypeDef __CRYP_HandleTypeDef::SuspendRequest***
  CRYP peripheral suspension request flag

14.2 CRYP Firmware driver API description

The following section lists the various functions of the CRYP library.

14.2.1 Initialization and deinitialization functions

This section provides functions allowing to:

- Initialize the CRYP according to the specified parameters in the CRYP_InitTypeDef and creates the associated handle
- DeInitialize the CRYP peripheral
- Initialize the CRYP MSP (MCU Specific Package)
- De-Initialize the CRYP MSP

Note: Specific care must be taken to format the key and the Initialization Vector IV!

If the key is defined as a 128-bit long array key[127..0] = {b127 ... b0} where b127 is the MSB and b0 the LSB, the key must be stored in MCU memory

- as a sequence of words where the MSB word comes first (occupies the lowest memory address)
- where each word is byte-swapped:
  - address n+0 : 0b b103 .. b96 b111 .. b104 b119 .. b112 b127 .. b120
  - address n+4 : 0b b71 .. b64 b79 .. b72 b87 .. b80 b95 .. b88
  - address n+8 : 0b b39 .. b32 b47 .. b40 b55 .. b48 b63 .. b56
  - address n+C : 0b b7 .. b0 b15 .. b8 b23 .. b16 b31 .. b24

Hereafter, another illustration when considering a 128-bit long key made of 16 bytes {B15..B0}. The 4 32-bit words that make the key must be stored as follows in MCU memory:

- address n+0 : 0x B12 B13 B14 B15
- address n+4 : 0x B8 B9 B10 B11
- address n+8 : 0x B4 B5 B6 B7
- address n+C : 0x B0 B1 B2 B3

which leads to the expected setting

- AES_KEYR3 = 0x B15 B14 B13 B12
- AES_KEYR2 = 0x B11 B10 B9 B8
- AES_KEYR1 = 0x B7 B6 B5 B4
- AES_KEYR0 = 0x B3 B2 B1 B0

Same format must be applied for a 256-bit long key made of 32 bytes {B31..B0}. The 8 32-bit words that make the key must be stored as follows in MCU memory:

- address n+00 : 0x B28 B29 B30 B31
- address n+04 : 0x B24 B25 B26 B27
- address n+08 : 0x B20 B21 B22 B23
- address n+0C : 0x B16 B17 B18 B19
- address n+10 : 0x B12 B13 B14 B15
- address n+14 : 0x B8 B9 B10 B11
- address n+18 : 0x B4 B5 B6 B7
- address n+1C : 0x B0 B1 B2 B3

which leads to the expected setting

- AES_KEYR7 = 0x B31 B30 B29 B28
- AES_KEYR6 = 0x B27 B26 B25 B24
- AES_KEYR5 = 0x B23 B22 B21 B20
- AES_KEYR4 = 0x B19 B18 B17 B16
- AES_KEYR3 = 0x B15 B14 B13 B12
- AES_KEYR2 = 0x B11 B10 B9 B8
- AES_KEYR1 = 0x B7 B6 B5 B4
- AES_KEYR0 = 0x B3 B2 B1 B0

Initialization Vector IV (4 32-bit words) format must follow the same as that of a 128-bit long key.

This section contains the following APIs:

- ***HAL_CRYP_Init***
- ***HAL_CRYP_DeInit***
- ***HAL_CRYP_MspInit***
- ***HAL_CRYP_MspDeInit***

14.2.2 AES processing functions

This section provides functions allowing to:

- Encrypt plaintext using AES algorithm in different chaining modes
- Decrypt cyphertext using AES algorithm in different chaining modes

Three processing functions are available:

- Polling mode
- Interrupt mode
- DMA mode

This section contains the following APIs:

- ***HAL_CRYP_AESECB_Encrypt***
- ***HAL_CRYP_AESCBC_Encrypt***
- ***HAL_CRYP_AESCTR_Encrypt***
- ***HAL_CRYP_AESECB_Decrypt***
- ***HAL_CRYP_AESCBC_Decrypt***
- ***HAL_CRYP_AESCTR_Decrypt***
- ***HAL_CRYP_AESECB_Encrypt_IT***
- ***HAL_CRYP_AESCBC_Encrypt_IT***
- ***HAL_CRYP_AESCTR_Encrypt_IT***
- ***HAL_CRYP_AESECB_Decrypt_IT***
- ***HAL_CRYP_AESCBC_Decrypt_IT***
- ***HAL_CRYP_AESCTR_Decrypt_IT***
- ***HAL_CRYP_AESECB_Encrypt_DMA***
- ***HAL_CRYP_AESCBC_Encrypt_DMA***
- ***HAL_CRYP_AESCTR_Encrypt_DMA***
- ***HAL_CRYP_AESECB_Decrypt_DMA***
- ***HAL_CRYP_AESCBC_Decrypt_DMA***
- ***HAL_CRYP_AESCTR_Decrypt_DMA***

14.2.3 Callback functions

This section provides Interruption and DMA callback functions:

- DMA Input data transfer complete
- DMA Output data transfer complete
- DMA or Interrupt error

This section contains the following APIs:

- ***HAL_CRYP_ErrorCallback***
- ***HAL_CRYP_InCpltCallback***
- ***HAL_CRYP_OutCpltCallback***

14.2.4 AES IRQ handler management

This section provides AES IRQ handler function.

This section contains the following APIs:

- ***HAL_CRYP_IRQHandler***

14.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- ***HAL_CRYP_GetState***
- ***HAL_CRYP_GetError***

14.2.6 Detailed description of functions

`HAL_CRYP_Init`

Function name

HAL_StatusTypeDef HAL_CRYP_Init (CRYP_HandleTypeDef * hcryp)

Function description

Initialize the CRYP according to the specified parameters in the CRYP_InitTypeDef and initialize the associated handle.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **HAL:** status

Notes

- Specific care must be taken to format the key and the Initialization Vector IV stored in the MCU memory before calling HAL_CRYP_Init(). Refer to explanations hereabove.

`HAL_CRYP_DeInit`

Function name

HAL_StatusTypeDef HAL_CRYP_DeInit (CRYP_HandleTypeDef * hcryp)

Function description

DeInitialize the CRYP peripheral.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **HAL:** status

`HAL_CRYP_MspInit`

Function name

void HAL_CRYP_MspInit (CRYP_HandleTypeDef * hcryp)

Function description

Initialize the CRYP MSP.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYP_MspDeInit`

Function name

void HAL_CRYP_MspDeInit (CRYP_HandleTypeDef * hcryp)

Function description

DeInitialize CRYP MSP.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYP_AESECB_Encrypt`

Function name

HAL_StatusTypeDef HAL_CRYP_AESECB_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)

Function description

Encrypt pPlainData in AES ECB encryption mode.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES() API instead (usage recommended).

`HAL_CRYP_AESECB_Decrypt`

Function name

HAL_StatusTypeDef HAL_CRYP_AESECB_Decrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)

Function description

Decrypt pCypherData in AES ECB decryption mode with key derivation, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES() API instead (usage recommended).

HAL_CRYP_AESCBC_Encrypt

Function name

HAL_StatusTypeDef HAL_CRYP_AESCBC_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)

Function description

Encrypt pPlainData in AES CBC encryption mode with key derivation.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES() API instead (usage recommended).

HAL_CRYP_AESCBC_Decrypt

Function name

HAL_StatusTypeDef HAL_CRYP_AESCBC_Decrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)

Function description

Decrypt pCypherData in AES ECB decryption mode with key derivation, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES() API instead (usage recommended).

HAL_CRYP_AESCTR_Encrypt

Function name

HAL_StatusTypeDef HAL_CRYP_AESCTR_Encrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData, uint32_t Timeout)

Function description

Encrypt pPlainData in AES CTR encryption mode.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES() API instead (usage recommended).

HAL_CRYP_AESCTR_Decrypt

Function name

HAL_StatusTypeDef HAL_CRYP_AESCTR_Decrypt (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData, uint32_t Timeout)

Function description

Decrypt pCypherData in AES CTR decryption mode, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES() API instead (usage recommended).

HAL_CRYP_AESECB_Encrypt_IT

Function name

HAL_StatusTypeDef HAL_CRYP_AESECB_Encrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description

Encrypt pPlainData in AES ECB encryption mode using Interrupt, the cypher data are available in pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_IT() API instead (usage recommended).

HAL_CRYP_AESCBC_Encrypt_IT

Function name

HAL_StatusTypeDef HAL_CRYP_AESCBC_Encrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description

Encrypt pPlainData in AES CBC encryption mode using Interrupt, the cypher data are available in pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_IT() API instead (usage recommended).

HAL_CRYP_AESCTR_Encrypt_IT

Function name

HAL_StatusTypeDef HAL_CRYP_AESCTR_Encrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description

Encrypt pPlainData in AES CTR encryption mode using Interrupt, the cypher data are available in pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_IT() API instead (usage recommended).

HAL_CRYP_AESECB_Decrypt_IT

Function name

HAL_StatusTypeDef HAL_CRYP_AESECB_Decrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description

Decrypt pCypherData in AES ECB decryption mode using Interrupt, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer.

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_IT() API instead (usage recommended).

HAL_CRYP_AESCTR_Decrypt_IT

Function name

HAL_StatusTypeDef HAL_CRYP_AESCTR_Decrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description

Decrypt pCypherData in AES CTR decryption mode using Interrupt, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_IT() API instead (usage recommended).

HAL_CRYP_AESCBC_Decrypt_IT

Function name

HAL_StatusTypeDef HAL_CRYP_AESCBC_Decrypt_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description

Decrypt pCypherData in AES CBC decryption mode using Interrupt, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_IT() API instead (usage recommended).

HAL_CRYP_AESECB_Encrypt_DMA

Function name

HAL_StatusTypeDef HAL_CRYP_AESECB_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description

Encrypt pPlainData in AES ECB encryption mode using DMA, the cypher data are available in pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_DMA() API instead (usage recommended).
- pPlainData and pCypherData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

HAL_CRYP_AESECB_Decrypt_DMA

Function name

HAL_StatusTypeDef HAL_CRYP_AESECB_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description

Decrypt pCypherData in AES ECB decryption mode using DMA, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_DMA() API instead (usage recommended).
- pPlainData and pCypherData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

HAL_CRYP_AESCBC_Encrypt_DMA

Function name

HAL_StatusTypeDef HAL_CRYP_AESCBC_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description

Encrypt pPlainData in AES CBC encryption mode using DMA, the cypher data are available in pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_DMA() API instead (usage recommended).
- pPlainData and pCypherData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

HAL_CRYP_AESCBC_Decrypt_DMA

Function name

HAL_StatusTypeDef HAL_CRYP_AESCBC_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description

Decrypt pCypherData in AES CBC decryption mode using DMA, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_DMA() API instead (usage recommended).
- pPlainData and pCypherData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

`HAL_CRYP_AESCTR_Encrypt_DMA`

Function name

HAL_StatusTypeDef HAL_CRYP_AESCTR_Encrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pPlainData, uint16_t Size, uint8_t * pCypherData)

Function description

Encrypt pPlainData in AES CTR encryption mode using DMA, the cypher data are available in pCypherData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer.

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_DMA() API instead (usage recommended).
- pPlainData and pCypherData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

`HAL_CRYP_AESCTR_Decrypt_DMA`

Function name

HAL_StatusTypeDef HAL_CRYP_AESCTR_Decrypt_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pCypherData, uint16_t Size, uint8_t * pPlainData)

Function description

Decrypt pCypherData in AES CTR decryption mode using DMA, the decyphered data are available in pPlainData.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer
- **Size:** Length of the plaintext buffer in bytes, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer

Return values

- **HAL:** status

Notes

- This API is provided only to maintain compatibility with legacy software. Users should directly resort to generic HAL_CRYPEx_AES_DMA() API instead (usage recommended).
- pPlainData and pCypherData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

`HAL_CRYP_InCpltCallback`

Function name

void HAL_CRYP_InCpltCallback (CRYP_HandleTypeDef * hcryp)

Function description

Input DMA transfer complete callback.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYP_OutCpltCallback`

Function name

void HAL_CRYP_OutCpltCallback (CRYP_HandleTypeDef * hcryp)

Function description

Output DMA transfer complete callback.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYP_ErrorCallback`

Function name

void HAL_CRYP_ErrorCallback (CRYP_HandleTypeDef * hcryp)

Function description

CRYP error callback.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYP_IRQHandler`

Function name

void HAL_CRYP_IRQHandler (CRYP_HandleTypeDef * hcryp)

Function description

Handle AES interrupt request.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYP_GetState`

Function name

HAL_CRYP_STATETypeDef HAL_CRYP_GetState (CRYP_HandleTypeDef * hcryp)

Function description

Return the CRYP handle state.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **HAL:** state

`HAL_CRYP_GetError`

Function name

uint32_t HAL_CRYP_GetError (CRYP_HandleTypeDef * hcryp)

Function description

Return the CRYP peripheral error.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **Error:** bit-map

Notes

- The returned error is a bit-map combination of possible errors

14.3 CRYP Firmware driver defines

The following section lists the various define and macros of the module.

14.3.1 CRYP

CRYP

AES chaining mode

CRYP_CHAINMODE_AES_ECB

Electronic codebook chaining algorithm

CRYP_CHAINMODE_AES_CBC

Cipher block chaining algorithm

CRYP_CHAINMODE_AES_CTR

Counter mode chaining algorithm

CRYP_CHAINMODE_AES_GCM_GMAC

Galois counter mode - Galois message authentication code

CRYP_CHAINMODE_AES_CCM

Counter with Cipher Mode

AES operating mode

CRYP_ALGOMODE_ENCRYPT

Encryption mode

CRYP_ALGOMODE_KEYDERIVATION

Key derivation mode

CRYP_ALGOMODE_DECRYPT

Decryption

CRYP_ALGOMODE_KEYDERIVATION_DECRYPT

Key derivation and decryption

CRYP_ALGOMODE_TAG_GENERATION

GMAC or CMAC (when applicable) authentication tag generation

AES Enable state

CRYP_AES_DISABLE

Disable AES

CRYP_AES_ENABLE

Enable AES

AES clearing flags

CRYP_CCF_CLEAR

Computation Complete Flag Clear

CRYP_ERR_CLEAR

Error Flag Clear

AES Data Type selection

CRYP_DATATYPE_32B

32-bit data type (no swapping)

CRYP_DATATYPE_16B

16-bit data type (half-word swapping)

CRYP_DATATYPE_8B

8-bit data type (byte swapping)

CRYP_DATATYPE_1B

1-bit data type (bit swapping)

DMA Input phase management enable state

CRYP_DMAIN_DISABLE

Disable DMA Input phase management

CRYP_DMAIN_ENABLE

Enable DMA Input phase management

DMA Output phase management enable state

CRYP_DMAOUT_DISABLE

Disable DMA Output phase management

CRYP_DMAOUT_ENABLE

Enable DMA Output phase management

CRYP Exported Macros

__HAL_CRYP_RESET_HANDLE_STATE

Description:

- Reset CRYP handle state.

Parameters:

- __HANDLE__: specifies the CRYP handle.

Return value:

- None

__HAL_CRYP_ENABLE

Description:

- Enable the CRYP AES peripheral.

Parameters:

- __HANDLE__: specifies the CRYP handle.

Return value:

- None

__HAL_CRYP_DISABLE

Description:

- Disable the CRYP AES peripheral.

Parameters:

- __HANDLE__: specifies the CRYP handle.

Return value:

- None

__HAL_CRYP_SET_OPERATINGMODE

Description:

- Set the algorithm operating mode.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __OPERATING_MODE__: specifies the operating mode This parameter can be one of the following values:
  - CRYP_ALGOMODE_ENCRYPT encryption
  - CRYP_ALGOMODE_KEYDERIVATION key derivation
  - CRYP_ALGOMODE_DECRYPT decryption
  - CRYP_ALGOMODE_KEYDERIVATION_DECRYPT key derivation and decryption

Return value:

- None

__HAL_CRYP_SET_CHAININGMODE

Description:

- Set the algorithm chaining mode.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __CHAINING_MODE__: specifies the chaining mode This parameter can be one of the following values:
  - CRYP_CHAINMODE_AES_ECB Electronic CodeBook
  - CRYP_CHAINMODE_AES_CBC Cipher Block Chaining
  - CRYP_CHAINMODE_AES_CTR CounTeR mode
  - CRYP_CHAINMODE_AES_GCM_GMAC Galois Counter Mode or Galois Message Authentication Code
  - CRYP_CHAINMODE_AES_CMAC Cipher Message Authentication Code (or Counter with Cipher Mode when applicable)

Return value:

- None

__HAL_CRYP_GET_FLAG

Description:

- Check whether the specified CRYP status flag is set or not.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - CRYP_FLAG_BUSY GCM process suspension forbidden
  - CRYP_IT_WRERR Write Error
  - CRYP_IT_RDERR Read Error
  - CRYP_IT_CCF Computation Complete

Return value:

- The: state of __FLAG__ (TRUE or FALSE).

__HAL_CRYP_CLEAR_FLAG

Description:

- Clear the CRYP pending status flag.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - CRYP_ERR_CLEAR Read (RDERR) or Write Error (WRERR) Flag Clear
  - CRYP_CCF_CLEAR Computation Complete Flag (CCF) Clear

Return value:

- None

__HAL_CRYP_GET_IT_SOURCE

Description:

- Check whether the specified CRYP interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP interrupt source to check This parameter can be one of the following values:
  - CRYP_IT_ERRIE Error interrupt (used for RDERR and WRERR)
  - CRYP_IT_CCFIE Computation Complete interrupt

Return value:

- State: of interruption (TRUE or FALSE).

__HAL_CRYP_GET_IT

Description:

- Check whether the specified CRYP interrupt is set or not.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: specifies the interrupt to check. This parameter can be one of the following values:
  - CRYP_IT_WRERR Write Error
  - CRYP_IT_RDERR Read Error
  - CRYP_IT_CCF Computation Complete

Return value:

- The: state of __INTERRUPT__ (TRUE or FALSE).

__HAL_CRYP_CLEAR_IT

Description:

- Clear the CRYP pending interrupt.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: specifies the IT to clear. This parameter can be one of the following values:
  - CRYP_ERR_CLEAR Read (RDERR) or Write Error (WRERR) Flag Clear
  - CRYP_CCF_CLEAR Computation Complete Flag (CCF) Clear

Return value:

- None

__HAL_CRYP_ENABLE_IT

Description:

- Enable the CRYP interrupt.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP Interrupt. This parameter can be one of the following values:
  - CRYP_IT_ERRIE Error interrupt (used for RDERR and WRERR)
  - CRYP_IT_CCFIE Computation Complete interrupt

Return value:

- None

__HAL_CRYP_DISABLE_IT

Description:

- Disable the CRYP interrupt.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP Interrupt. This parameter can be one of the following values:
  - CRYP_IT_ERRIE Error interrupt (used for RDERR and WRERR)
  - CRYP_IT_CCFIE Computation Complete interrupt

Return value:

- None

CRYP Exported Types

HAL_CRYP_ERROR_NONE

No error

HAL_CRYP_WRITE_ERROR

Write error

HAL_CRYP_READ_ERROR

Read error

HAL_CRYP_DMA_ERROR

DMA error

HAL_CRYP_BUSY_ERROR

Busy flag error

AES status flags

CRYP_FLAG_BUSY

GCM process suspension forbidden

CRYP_FLAG_WRERR

Write Error

CRYP_FLAG_RDERR

Read error

CRYP_FLAG_CCF

Computation completed

GCM/GMAC and CCM/CMAC (when applicable) processing phase selection

CRYP_GCM_INIT_PHASE

GCM/GMAC (or CCM) init phase

CRYP_GCMCMAC_HEADER_PHASE

GCM/GMAC/CCM/CMAC header phase

CRYP_GCM_PAYLOAD_PHASE

GCM/CCM payload phase

CRYP_GCMCMAC_FINAL_PHASE

GCM/GMAC/CCM/CMAC final phase

CRYP_INIT_PHASE

Init phase

CRYP_HEADER_PHASE

Header phase

CRYP_PAYLOAD_PHASE

Payload phase

CRYP_FINAL_PHASE

Final phase

AES Interrupts flags

CRYP_IT_WRERR

Write Error

CRYP_IT_RDERR

Read Error

CRYP_IT_CCF

Computation completed

Key size selection

CRYP_KEYSIZE_128B

128-bit long key

CRYP_KEYSIZE_256B

256-bit long key

AES decryption key write-up flag

CRYP_KEY_WRITE_ENABLE

Enable decryption key writing

CRYP_KEY_WRITE_DISABLE

Disable decryption key writing

15 HAL CRYP Extension Driver

15.1 CRYPEx Firmware driver API description

The following section lists the various functions of the CRYPEx library.

15.1.1 Extended callback functions

This section provides callback function:

- Computation completed.

This section contains the following APIs:

- ***HAL_CRYPEx_ComputationCpltCallback***

15.1.2 AES extended processing functions

This section provides functions allowing to:

- Encrypt plaintext or decrypt cipher text using AES algorithm in different chaining modes. Functions are generic (handles ECB, CBC and CTR and all modes) and are only differentiated based on the processing type. Three processing types are available:
  - Polling mode
  - Interrupt mode
  - DMA mode
- Generate and authentication tag in addition to encrypt/decrypt a plain/cipher text using AES algorithm in different chaining modes. Functions are generic (handles GCM, GMAC, CMAC and CCM when applicable) and process only one phase so that steps can be skipped if so required. Functions are only differentiated based on the processing type. Three processing types are available:
  - Polling mode
  - Interrupt mode
  - DMA mode

This section contains the following APIs:

- ***HAL_CRYPEx_AES***
- ***HAL_CRYPEx_AES_IT***
- ***HAL_CRYPEx_AES_DMA***
- ***HAL_CRYPEx_AES_Auth***
- ***HAL_CRYPEx_AES_Auth_IT***
- ***HAL_CRYPEx_AES_Auth_DMA***

15.1.3 AES extended suspension and resumption functions

This section provides functions allowing to:

- save in memory the Initialization Vector, the Key registers, the Control register or the Suspend registers when a process is suspended by a higher priority message
- write back in CRYP hardware block the saved values listed above when the suspended lower priority message processing is resumed.

This section contains the following APIs:

- ***HAL_CRYPEx_Read_IVRegisters***
- ***HAL_CRYPEx_Write_IVRegisters***
- ***HAL_CRYPEx_Read_SuspendRegisters***
- ***HAL_CRYPEx_Write_SuspendRegisters***
- ***HAL_CRYPEx_Read_KeyRegisters***
- ***HAL_CRYPEx_Write_KeyRegisters***

- *HAL_CRYPEx_Read_ControlRegister*
- *HAL_CRYPEx_Write_ControlRegister*
- *HAL_CRYPEx_ProcessSuspend*

15.1.4 Detailed description of functions

`HAL_CRYPEx_ComputationCpltCallback`

Function name

void HAL_CRYPEx_ComputationCpltCallback (CRYP_HandleTypeDef * hcryp)

Function description

Computation completed callbacks.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **None:**

`HAL_CRYPEx_AES`

Function name

HAL_StatusTypeDef HAL_CRYPEx_AES (CRYP_HandleTypeDef * hcryp, uint8_t * pInputData, uint16_t Size, uint8_t * pOutputData, uint32_t Timeout)

Function description

Carry out in polling mode the ciphering or deciphering operation according to hcryp->Init structure fields, all operating modes (encryption, key derivation and/or decryption) and chaining modes ECB, CBC and CTR are managed by this function in polling mode.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pInputData:** Pointer to the plain text in case of encryption or cipher text in case of decryption or key derivation+decryption. Parameter is meaningless in case of key derivation.
- **Size:** Length of the input data buffer in bytes, must be a multiple of 16. Parameter is meaningless in case of key derivation.
- **pOutputData:** Pointer to the cipher text in case of encryption or plain text in case of decryption/key derivation+decryption, or pointer to the derivative keys in case of key derivation only.
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

`HAL_CRYPEx_AES_IT`

Function name

HAL_StatusTypeDef HAL_CRYPEx_AES_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pInputData, uint16_t Size, uint8_t * pOutputData)

Function description

Carry out in interrupt mode the ciphering or deciphering operation according to hcryp->Init structure fields, all operating modes (encryption, key derivation and/or decryption) and chaining modes ECB, CBC and CTR are managed by this function in interrupt mode.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pInputData:** Pointer to the plain text in case of encryption or cipher text in case of decryption or key derivation+decryption. Parameter is meaningless in case of key derivation.
- **Size:** Length of the input data buffer in bytes, must be a multiple of 16. Parameter is meaningless in case of key derivation.
- **pOutputData:** Pointer to the cipher text in case of encryption or plain text in case of decryption/key derivation+decryption, or pointer to the derivative keys in case of key derivation only.

Return values

- **HAL:** status

HAL_CRYPEx_AES_DMA

Function name

HAL_StatusTypeDef HAL_CRYPEx_AES_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pInputData, uint16_t Size, uint8_t * pOutputData)

Function description

Carry out in DMA mode the ciphering or deciphering operation according to hcryp->Init structure fields.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pInputData:** Pointer to the plain text in case of encryption or cipher text in case of decryption or key derivation+decryption.
- **Size:** Length of the input data buffer in bytes, must be a multiple of 16.
- **pOutputData:** Pointer to the cipher text in case of encryption or plain text in case of decryption/key derivation+decryption.

Return values

- **HAL:** status

Notes

- Chaining modes ECB, CBC and CTR are managed by this function in DMA mode.
- Supported operating modes are encryption, decryption and key derivation with decryption.
- No DMA channel is provided for key derivation only and therefore, access to AES_KEYRx registers must be done by software.
- This API is not applicable to key derivation only; for such a mode, access to AES_KEYRx registers must be done by software thru HAL_CRYPEx_AES() or HAL_CRYPEx_AES_IT() APIs.
- pInputData and pOutputData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

HAL_CRYPEx_AES_Auth

Function name

HAL_StatusTypeDef HAL_CRYPEx_AES_Auth (CRYP_HandleTypeDef * hcryp, uint8_t * pInputData, uint64_t Size, uint8_t * pOutputData, uint32_t Timeout)

Function description

Carry out in polling mode the authentication tag generation as well as the ciphering or deciphering operation according to hcryp->Init structure fields.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pInputData:**
  - pointer to payload data in GCM or CCM payload phase,
  - pointer to B0 block in CMAC header phase,
  - pointer to C block in CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init, header and final phases.
- **Size:**
  - length of the input payload data buffer in bytes in GCM or CCM payload phase,
  - length of B0 block (in bytes) in CMAC header phase,
  - length of C block (in bytes) in CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init and header phases.
  - Parameter is meaningless in case of CCM final phase.
  - Parameter is message length in bytes in case of GCM final phase.
  - Parameter must be set to zero in case of GMAC final phase.
- **pOutputData:**
  - pointer to plain or cipher text in GCM/CCM payload phase,
  - pointer to authentication tag in GCM/GMAC/CCM/CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init and header phases.
  - Parameter is meaningless in case of CMAC header phase.
- **Timeout:** Specify Timeout value

Return values

- **HAL:** status

Notes

- Supported operating modes are encryption and decryption, supported chaining modes are GCM, GMAC, CMAC and CCM when the latter is applicable.
- Phases are singly processed according to hcryp->Init.GCMCMACPhase so that steps in these specific chaining modes can be skipped by the user if so required.

`HAL_CRYPEx_AES_Auth_IT`

Function name

HAL_StatusTypeDef HAL_CRYPEx_AES_Auth_IT (CRYP_HandleTypeDef * hcryp, uint8_t * pInputData, uint64_t Size, uint8_t * pOutputData)

Function description

Carry out in interrupt mode the authentication tag generation as well as the ciphering or deciphering operation according to hcryp->Init structure fields.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pInputData:**
  - pointer to payload data in GCM or CCM payload phase,
  - pointer to B0 block in CMAC header phase,
  - pointer to C block in CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init, header and final phases.
- **Size:**
  - length of the input payload data buffer in bytes in GCM or CCM payload phase,
  - length of B0 block (in bytes) in CMAC header phase,
  - length of C block (in bytes) in CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init and header phases.
  - Parameter is meaningless in case of CCM final phase.
  - Parameter is message length in bytes in case of GCM final phase.
  - Parameter must be set to zero in case of GMAC final phase.
- **pOutputData:**
  - pointer to plain or cipher text in GCM/CCM payload phase,
  - pointer to authentication tag in GCM/GMAC/CCM/CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init and header phases.
  - Parameter is meaningless in case of CMAC header phase.

Return values

- **HAL:** status

Notes

- Supported operating modes are encryption and decryption, supported chaining modes are GCM, GMAC and CMAC.
- Phases are singly processed according to hcryp->Init.GCMCMACPhase so that steps in these specific chaining modes can be skipped by the user if so required.

`HAL_CRYPEx_AES_Auth_DMA`

Function name

HAL_StatusTypeDef HAL_CRYPEx_AES_Auth_DMA (CRYP_HandleTypeDef * hcryp, uint8_t * pInputData, uint64_t Size, uint8_t * pOutputData)

Function description

Carry out in DMA mode the authentication tag generation as well as the ciphering or deciphering operation according to hcryp->Init structure fields.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pInputData:**
  - pointer to payload data in GCM or CCM payload phase,
  - pointer to B0 block in CMAC header phase,
  - pointer to C block in CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init, header and final phases.
- **Size:**
  - length of the input payload data buffer in bytes in GCM or CCM payload phase,
  - length of B0 block (in bytes) in CMAC header phase,
  - length of C block (in bytes) in CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init and header phases.
  - Parameter is meaningless in case of CCM final phase.
  - Parameter is message length in bytes in case of GCM final phase.
  - Parameter must be set to zero in case of GMAC final phase.
- **pOutputData:**
  - pointer to plain or cipher text in GCM/CCM payload phase,
  - pointer to authentication tag in GCM/GMAC/CCM/CMAC final phase.
  - Parameter is meaningless in case of GCM/GMAC/CCM init and header phases.
  - Parameter is meaningless in case of CMAC header phase.

Return values

- **HAL:** status

Notes

- Supported operating modes are encryption and decryption, supported chaining modes are GCM, GMAC and CMAC.
- Phases are singly processed according to hcryp->Init.GCMCMACPhase so that steps in these specific chaining modes can be skipped by the user if so required.
- pInputData and pOutputData buffers must be 32-bit aligned to ensure a correct DMA transfer to and from the IP.

`HAL_CRYPEx_Read_IVRegisters`

Function name

void HAL_CRYPEx_Read_IVRegisters (CRYP_HandleTypeDef * hcryp, uint8_t * Output)

Function description

In case of message processing suspension, read the Initialization Vector.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Output:** Pointer to the buffer containing the saved Initialization Vector.

Return values

- **None:**

Notes

- This value has to be stored for reuse by writing the AES_IVRx registers as soon as the interrupted processing has to be resumed. Applicable to all chaining modes.
- AES must be disabled when reading or resetting the IV values.

HAL_CRYPEx_Write_IVRegisters

Function name

void HAL_CRYPEx_Write_IVRegisters (CRYP_HandleTypeDef * hcryp, uint8_t * Input)

Function description

In case of message processing resumption, rewrite the Initialization Vector in the AES_IVRx registers.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Input:** Pointer to the buffer containing the saved Initialization Vector to write back in the CRYP hardware block.

Return values

- **None:**

Notes

- Applicable to all chaining modes.
- AES must be disabled when reading or resetting the IV values.

HAL_CRYPEx_Read_SuspendRegisters

Function name

void HAL_CRYPEx_Read_SuspendRegisters (CRYP_HandleTypeDef * hcryp, uint8_t * Output)

Function description

In case of message GCM/GMAC (CCM/CMAC when applicable) processing suspension, read the Suspend Registers.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Output:** Pointer to the buffer containing the saved Suspend Registers.

Return values

- **None:**

Notes

- These values have to be stored for reuse by writing back the AES_SUSPxR registers as soon as the interrupted processing has to be resumed.

HAL_CRYPEx_Write_SuspendRegisters

Function name

void HAL_CRYPEx_Write_SuspendRegisters (CRYP_HandleTypeDef * hcryp, uint8_t * Input)

Function description

In case of message GCM/GMAC (CCM/CMAC when applicable) processing resumption, rewrite the Suspend Registers in the AES_SUSPxR registers.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Input:** Pointer to the buffer containing the saved suspend registers to write back in the CRYP hardware block.

Return values

- **None:**

HAL_CRYPEx_Read_KeyRegisters

Function name

void HAL_CRYPEx_Read_KeyRegisters (CRYP_HandleTypeDef * hcryp, uint8_t * Output, uint32_t KeySize)

Function description

In case of message GCM/GMAC (CCM/CMAC when applicable) processing suspension, read the Key Registers.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Output:** Pointer to the buffer containing the saved Key Registers.
- **KeySize:** Indicates the key size (128 or 256 bits).

Return values

- **None:**

Notes

- These values have to be stored for reuse by writing back the AES_KEYRx registers as soon as the interrupted processing has to be resumed.

HAL_CRYPEx_Write_KeyRegisters

Function name

void HAL_CRYPEx_Write_KeyRegisters (CRYP_HandleTypeDef * hcryp, uint8_t * Input, uint32_t KeySize)

Function description

In case of message GCM/GMAC (CCM/CMAC when applicable) processing resumption, rewrite the Key Registers in the AES_KEYRx registers.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Input:** Pointer to the buffer containing the saved key registers to write back in the CRYP hardware block.
- **KeySize:** Indicates the key size (128 or 256 bits)

Return values

- **None:**

HAL_CRYPEx_Read_ControlRegister

Function name

void HAL_CRYPEx_Read_ControlRegister (CRYP_HandleTypeDef * hcryp, uint8_t * Output)

Function description

In case of message GCM/GMAC (CCM/CMAC when applicable) processing suspension, read the Control Register.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Output:** Pointer to the buffer containing the saved Control Register.

Return values

- **None:**

Notes

- This values has to be stored for reuse by writing back the AES_CR register as soon as the interrupted processing has to be resumed.

`HAL_CRYPEx_Write_ControlRegister`

Function name

void HAL_CRYPEx_Write_ControlRegister (CRYP_HandleTypeDef * hcryp, uint8_t * Input)

Function description

In case of message GCM/GMAC (CCM/CMAC when applicable) processing resumption, rewrite the Control Registers in the AES_CR register.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.
- **Input:** Pointer to the buffer containing the saved Control Register to write back in the CRYP hardware block.

Return values

- **None:**

`HAL_CRYPEx_ProcessSuspend`

Function name

void HAL_CRYPEx_ProcessSuspend (CRYP_HandleTypeDef * hcryp)

Function description

Request CRYP processing suspension when in polling or interruption mode.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module.

Return values

- **None:**

Notes

- Set the handle field SuspendRequest to the appropriate value so that the on-going CRYP processing is suspended as soon as the required conditions are met.
- It is advised not to suspend the CRYP processing when the DMA controller is managing the data transfer

`CRYP_AES_Auth_IT`

Function name

HAL_StatusTypeDef CRYP_AES_Auth_IT (CRYP_HandleTypeDef * hcryp)

Function description

Handle CRYP block input/output data handling under interruption for GCM, GMAC, CCM or CMAC chaining modes.

Parameters

- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values

- **HAL:** status

Notes

- The function is called under interruption only, once interruptions have been enabled by HAL_CRYPEx_AES_Auth_IT().

16 HAL DAC Generic Driver

16.1 DAC Firmware driver registers structures

16.1.1 DAC_HandleTypeDef

DAC_HandleTypeDef is defined in the stm32l4xx_hal_dac.h

Data Fields

- ***DAC_TypeDef * Instance***
- ***__IO HAL_DAC_StateTypeDef State***
- ***HAL_LockTypeDef Lock***
- ***DMA_HandleTypeDef * DMA_Handle1***
- ***DMA_HandleTypeDef * DMA_Handle2***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***DAC_TypeDef* DAC_HandleTypeDef::Instance***
  Register base address
- ***__IO HAL_DAC_StateTypeDef DAC_HandleTypeDef::State***
  DAC communication state
- ***HAL_LockTypeDef DAC_HandleTypeDef::Lock***
  DAC locking object
- ***DMA_HandleTypeDef* DAC_HandleTypeDef::DMA_Handle1***
  Pointer DMA handler for channel 1
- ***DMA_HandleTypeDef* DAC_HandleTypeDef::DMA_Handle2***
  Pointer DMA handler for channel 2
- ***__IO uint32_t DAC_HandleTypeDef::ErrorCode***
  DAC Error code

16.1.2 DAC_SampleAndHoldConfTypeDef

DAC_SampleAndHoldConfTypeDef is defined in the stm32l4xx_hal_dac.h

Data Fields

- ***uint32_t DAC_SampleTime***
- ***uint32_t DAC_HoldTime***
- ***uint32_t DAC_RefreshTime***

Field Documentation

- ***uint32_t DAC_SampleAndHoldConfTypeDef::DAC_SampleTime***
  Specifies the Sample time for the selected channel. This parameter applies when DAC_SampleAndHold is DAC_SAMPLEANDHOLD_ENABLE. This parameter must be a number between Min_Data = 0 and Max_Data = 1023
- ***uint32_t DAC_SampleAndHoldConfTypeDef::DAC_HoldTime***
  Specifies the hold time for the selected channel This parameter applies when DAC_SampleAndHold is DAC_SAMPLEANDHOLD_ENABLE. This parameter must be a number between Min_Data = 0 and Max_Data = 1023
- ***uint32_t DAC_SampleAndHoldConfTypeDef::DAC_RefreshTime***
  Specifies the refresh time for the selected channel This parameter applies when DAC_SampleAndHold is DAC_SAMPLEANDHOLD_ENABLE. This parameter must be a number between Min_Data = 0 and Max_Data = 255

16.1.3 DAC_ChannelConfTypeDef

DAC_ChannelConfTypeDef is defined in the stm32l4xx_hal_dac.h

Data Fields

- ***uint32_t DAC_HighFrequency***
- ***uint32_t DAC_SampleAndHold***
- ***uint32_t DAC_Trigger***
- ***uint32_t DAC_OutputBuffer***
- ***uint32_t DAC_ConnectOnChipPeripheral***
- ***uint32_t DAC_UserTrimming***
- ***uint32_t DAC_TrimmingValue***
- ***DAC_SampleAndHoldConfTypeDef DAC_SampleAndHoldConfig***

Field Documentation

- ***uint32_t DAC_ChannelConfTypeDef::DAC_HighFrequency***
  Specifies the frequency interface mode This parameter can be a value of ***DAC_HighFrequency***
- ***uint32_t DAC_ChannelConfTypeDef::DAC_SampleAndHold***
  Specifies whether the DAC mode. This parameter can be a value of ***DAC_SampleAndHold***
- ***uint32_t DAC_ChannelConfTypeDef::DAC_Trigger***
  Specifies the external trigger for the selected DAC channel. This parameter can be a value of ***DAC_trigger_selection***
- ***uint32_t DAC_ChannelConfTypeDef::DAC_OutputBuffer***
  Specifies whether the DAC channel output buffer is enabled or disabled. This parameter can be a value of ***DAC_output_buffer***
- ***uint32_t DAC_ChannelConfTypeDef::DAC_ConnectOnChipPeripheral***
  Specifies whether the DAC output is connected or not to on chip peripheral . This parameter can be a value of ***DAC_ConnectOnChipPeripheral***
- ***uint32_t DAC_ChannelConfTypeDef::DAC_UserTrimming***
  Specifies the trimming mode This parameter must be a value of ***DAC_UserTrimming*** DAC_UserTrimming is either factory or user trimming
- ***uint32_t DAC_ChannelConfTypeDef::DAC_TrimmingValue***
  Specifies the offset trimming value i.e. when DAC_SampleAndHold is DAC_TRIMMING_USER. This parameter must be a number between Min_Data = 1 and Max_Data = 31
- ***DAC_SampleAndHoldConfTypeDef DAC_ChannelConfTypeDef::DAC_SampleAndHoldConfig***
  Sample and Hold settings

16.2 DAC Firmware driver API description

The following section lists the various functions of the DAC library.

16.2.1 DAC Peripheral features

DAC Channels

STM32L4 devices integrate one or two 12-bit Digital Analog Converters (i.e. one or 2 channel(s)) 1 channel : STM32L451xx STM32L452xx STM32L462xx 2 channels: STM32L431xx STM32L432xx STM32L433xx STM32L442xx STM32L443xx STM32L471xx STM32L475xx STM32L476xx STM32L485xx STM32L486xx STM32L496xx STM32L4A6xx STM32L4P5xx STM32L4Q5xx STM32L4R5xx STM32L4R7xx STM32L4R9xx STM32L4S5xx STM32L4S7xx STM32L4S9xx When 2 channels are available, the 2 converters (i.e. channel1 & channel2) can be used independently or simultaneously (dual mode):

1. DAC channel1 with DAC_OUT1 (PA4) as output or connected to on-chip peripherals.
2. Whenever present, DAC channel2 with DAC_OUT2 (PA5) as output or connected to on-chip peripherals.

DAC Triggers

Digital to Analog conversion can be non-triggered using DAC_TRIGGER_NONE and DAC_OUT1/DAC_OUT2 is available once writing to DHRx register.

Digital to Analog conversion can be triggered by:

1. External event: EXTI Line 9 (any GPIOx_PIN_9) using DAC_TRIGGER_EXT_IT9. The used pin (GPIOx_PIN_9) must be configured in input mode.
2. Timers TRGO: TIM2, TIM3, TIM4, TIM5, TIM6 and TIM7 (DAC_TRIGGER_T2_TRGO, DAC_TRIGGER_T3_TRGO...)
3. Software using DAC_TRIGGER_SOFTWARE

DAC Buffer mode feature

Each DAC channel integrates an output buffer that can be used to reduce the output impedance, and to drive external loads directly without having to add an external operational amplifier. To enable, the output buffer use sConfig.DAC_OutputBuffer = DAC_OUTPUTBUFFER_ENABLE;

Note: Refer to the device datasheet for more details about output impedance value with and without output buffer.

DAC connect feature

Each DAC channel can be connected internally. To connect, use sConfig.DAC_ConnectOnChipPeripheral = DAC_CHIPCONNECT_ENABLE;

GPIO configurations guidelines

When a DAC channel is used (ex channel1 on PA4) and the other is not (ex channel2 on PA5 is configured in Analog and disabled). Channel1 may disturb channel2 as coupling effect. Note that there is no coupling on channel2 as soon as channel2 is turned on. Coupling on adjacent channel could be avoided as follows: when unused PA5 is configured as INPUT PULL-UP or DOWN. PA5 is configured in ANALOG just before it is turned on.

DAC Sample and Hold feature

For each converter, 2 modes are supported: normal mode and "sample and hold" mode (i.e. low power mode). In the sample and hold mode, the DAC core converts data, then holds the converted voltage on a capacitor. When not converting, the DAC cores and buffer are completely turned off between samples and the DAC output is tri-stated, therefore reducing the overall power consumption. A new stabilization period is needed before each new conversion. The sample and hold allow setting internal or external voltage @ low power consumption cost (output value can be at any given rate either by CPU or DMA). The Sample and hold block and registers uses either LSI & run in several power modes: run mode, sleep mode, low power run, low power sleep mode & stop1 mode. Low power stop1 mode allows only static conversion. To enable Sample and Hold mode Enable LSI using HAL_RCC_OscConfig with RCC_OSCILLATORTYPE_LSI & RCC_LSI_ON parameters. Use DAC_InitStructure.DAC_SampleAndHold = DAC_SAMPLEANDHOLD_ENABLE; & DAC_ChannelConfTypeDef.DAC_SampleAndHoldConfig.DAC_SampleTime, DAC_HoldTime & DAC_RefreshTime;

DAC calibration feature

1. The 2 converters (channel1 & channel2) provide calibration capabilities.
   - Calibration aims at correcting some offset of output buffer.
   - The DAC uses either factory calibration settings OR user defined calibration (trimming) settings (i.e. trimming mode).
   - The user defined settings can be figured out using self calibration handled by HAL_DACEx_SelfCalibrate.
   - HAL_DACEx_SelfCalibrate:
     - Runs automatically the calibration.
     - Enables the user trimming mode
     - Updates a structure with trimming values with fresh calibration results. The user may store the calibration results for larger (ex monitoring the trimming as a function of temperature for instance)

DAC wave generation feature

Both DAC channels can be used to generate

1. Noise wave
2. Triangle wave

DAC data format

The DAC data format can be:

1. 8-bit right alignment using DAC_ALIGN_8B_R
2. 12-bit left alignment using DAC_ALIGN_12B_L
3. 12-bit right alignment using DAC_ALIGN_12B_R

DAC data value to voltage correspondence

The analog output voltage on each DAC channel pin is determined by the following equation:

DAC_OUTx = VREF+ * DOR / 4095

- with DOR is the Data Output Register

VEF+ is the input voltage reference (refer to the device datasheet)

e.g. To set DAC_OUT1 to 0.7V, use

- Assuming that VREF+ = 3.3V, DAC_OUT1 = (3.3 * 868) / 4095 = 0.7V

DMA requests

A DMA1 request can be generated when an external trigger (but not a software trigger) occurs if DMA1 requests are enabled using HAL_DAC_Start_DMA(). DMA requests are mapped as following:

1. When DMAMUX is NOT present: DMA1 requests are mapped as following: (+) DAC channel1 mapped on DMA1 request 6 / channel3 (+) DAC channel2 mapped on DMA1 request 5 / channel4 DMA2 requests are mapped as following: (+) DAC channel1 mapped on DMA2 request 3 / channel4 (+) DAC channel2 mapped on DMA2 request 3 / channel5
2. When DMAMUX is present: (+) DAC channel1 mapped on DMA1/DMA2 request 6 (can be any DMA channel) (+) DAC channel2 mapped on DMA1/DMA2 request 7 (can be any DMA channel)

A DMA1 request can be generated when an external trigger (but not a software trigger) occurs if DMA1 requests are enabled using HAL_DAC_Start_DMA(). DMA requests are mapped as following: (#) When DMAMUX is NOT present: DMA1 requests are mapped as following:

- DAC channel1 mapped on DMA1 request 6 / channel3
- DAC channel2 mapped on DMA1 request 5 / channel4 DMA2 requests are mapped as following:
- DAC channel1 mapped on DMA2 request 3 / channel4
- DAC channel2 mapped on DMA2 request 3 / channel5 (#) When DMAMUX is present:
- DAC channel1 mapped on DMA1/DMA2 request 6 (can be any DMA channel)
- DAC channel2 mapped on DMA1/DMA2 request 7 (can be any DMA channel)

High frequency interface mode

The high frequency interface informs DAC instance about the bus frequency in use. It is mandatory information for DAC (as internal timing of DAC is bus frequency dependent) provided thanks to parameter DAC_HighFrequency handled in HAL_DAC_ConfigChannel () function. Use of DAC_HIGH_FREQUENCY_INTERFACE_MODE_AUTOMATIC value of DAC_HighFrequency is recommended function figured out the correct setting. The high frequency mode is same for all converters of a same DAC instance. Either same parameter DAC_HighFrequency is used for all DAC converters or again self DAC_HIGH_FREQUENCY_INTERFACE_MODE_AUTOMATIC detection parameter.

Note: For Dual mode and specific signal (Triangle and noise) generation please refer to Extended Features Driver description

16.2.2 How to use this driver

- DAC APB clock must be enabled to get write access to DAC registers using HAL_DAC_Init()
- Configure DAC_OUTx (DAC_OUT1: PA4, DAC_OUT2: PA5) in analog mode.
- Configure the DAC channel using HAL_DAC_ConfigChannel() function.
- Enable the DAC channel using HAL_DAC_Start() or HAL_DAC_Start_DMA() functions.

Calibration mode IO operation

- Retrieve the factory trimming (calibration settings) using HAL_DACEx_GetTrimOffset()
- Run the calibration using HAL_DACEx_SelfCalibrate()
- Update the trimming while DAC running using HAL_DACEx_SetUserTrimming()

Polling mode IO operation

- Start the DAC peripheral using HAL_DAC_Start()
- To read the DAC last data output value, use the HAL_DAC_GetValue() function.
- Stop the DAC peripheral using HAL_DAC_Stop()

DMA mode IO operation

- Start the DAC peripheral using HAL_DAC_Start_DMA(), at this stage the user specify the length of data to be transferred at each end of conversion First issued trigger will start the conversion of the value previously set by HAL_DAC_SetValue().
- At the middle of data transfer HAL_DAC_ConvHalfCpltCallbackCh1() or HAL_DACEx_ConvHalfCpltCallbackCh2() function is executed and user can add his own code by customization of function pointer HAL_DAC_ConvHalfCpltCallbackCh1() or HAL_DACEx_ConvHalfCpltCallbackCh2()
- At The end of data transfer HAL_DAC_ConvCpltCallbackCh1() or HAL_DACEx_ConvHalfCpltCallbackCh2() function is executed and user can add his own code by customization of function pointer HAL_DAC_ConvCpltCallbackCh1() or HAL_DACEx_ConvHalfCpltCallbackCh2()
- In case of transfer Error, HAL_DAC_ErrorCallbackCh1() function is executed and user can add his own code by customization of function pointer HAL_DAC_ErrorCallbackCh1
- In case of DMA underrun, DAC interruption triggers and execute internal function HAL_DAC_IRQHandler. HAL_DAC_DMAUnderrunCallbackCh1() or HAL_DACEx_DMAUnderrunCallbackCh2() function is executed and user can add his own code by customization of function pointer HAL_DAC_DMAUnderrunCallbackCh1() or HAL_DACEx_DMAUnderrunCallbackCh2() and add his own code by customization of function pointer HAL_DAC_ErrorCallbackCh1()
- Stop the DAC peripheral using HAL_DAC_Stop_DMA()

Callback registration

The compilation define USE_HAL_DAC_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_DAC_RegisterCallback() to register a user callback, it allows to register following callbacks:

- ConvCpltCallbackCh1 : callback when a half transfer is completed on Ch1.
- ConvHalfCpltCallbackCh1 : callback when a transfer is completed on Ch1.
- ErrorCallbackCh1 : callback when an error occurs on Ch1.
- DMAUnderrunCallbackCh1 : callback when an underrun error occurs on Ch1.
- ConvCpltCallbackCh2 : callback when a half transfer is completed on Ch2.
- ConvHalfCpltCallbackCh2 : callback when a transfer is completed on Ch2.
- ErrorCallbackCh2 : callback when an error occurs on Ch2.
- DMAUnderrunCallbackCh2 : callback when an underrun error occurs on Ch2.
- MspInitCallback : DAC MspInit.
- MspDeInitCallback : DAC MspdeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. Use function @ref HAL_DAC_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. It allows to reset following callbacks:
- ConvCpltCallbackCh1 : callback when a half transfer is completed on Ch1.
- ConvHalfCpltCallbackCh1 : callback when a transfer is completed on Ch1.
- ErrorCallbackCh1 : callback when an error occurs on Ch1.
- DMAUnderrunCallbackCh1 : callback when an underrun error occurs on Ch1.
- ConvCpltCallbackCh2 : callback when a half transfer is completed on Ch2.

- ConvHalfCpltCallbackCh2 : callback when a transfer is completed on Ch2.
- ErrorCallbackCh2 : callback when an error occurs on Ch2.
- DMAUnderrunCallbackCh2 : callback when an underrun error occurs on Ch2.
- MspInitCallback : DAC MspInit.
- MspDeInitCallback : DAC MspdeInit.
- All Callbacks This function) takes as parameters the HAL peripheral handle and the Callback ID. By default, after the @ref HAL_DAC_Init and if the state is HAL_DAC_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions. Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_DAC_Init and @ref HAL_DAC_DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_DAC_Init and @ref HAL_DAC_DeInit keep and use the user MspInit/ MspDeInit callbacks (registered beforehand) Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_DAC_RegisterCallback before calling @ref HAL_DAC_DeInit or @ref HAL_DAC_Init function. When The compilation define USE_HAL_DAC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

DAC HAL driver macros list

Below the list of most used macros in DAC HAL driver.

- __HAL_DAC_ENABLE : Enable the DAC peripheral
- __HAL_DAC_DISABLE : Disable the DAC peripheral
- __HAL_DAC_CLEAR_FLAG: Clear the DAC's pending flags
- __HAL_DAC_GET_FLAG: Get the selected DAC's flag status

Note: You can refer to the DAC HAL driver header file for more useful macros

16.2.3 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the DAC.
- De-initialize the DAC.

This section contains the following APIs:

- ***HAL_DAC_Init***
- ***HAL_DAC_DeInit***
- ***HAL_DAC_MspInit***
- ***HAL_DAC_MspDeInit***

16.2.4 IO operation functions

This section provides functions allowing to:

- Start conversion.
- Stop conversion.
- Start conversion and enable DMA transfer.
- Stop conversion and disable DMA transfer.
- Get result of conversion.

This section contains the following APIs:

- ***HAL_DAC_Start***
- ***HAL_DAC_Stop***
- ***HAL_DAC_Start_DMA***
- ***HAL_DAC_Stop_DMA***
- ***HAL_DAC_IRQHandler***
- ***HAL_DAC_SetValue***

- *HAL_DAC_ConvCpltCallbackCh1*
- *HAL_DAC_ConvHalfCpltCallbackCh1*
- *HAL_DAC_ErrorCallbackCh1*
- *HAL_DAC_DMAUnderrunCallbackCh1*

16.2.5 Peripheral Control functions

This section provides functions allowing to:

- Configure channels.
- Set the specified data holding register value for DAC channel.

This section contains the following APIs:

- *HAL_DAC_GetValue*
- *HAL_DAC_ConfigChannel*

16.2.6 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DAC state.
- Check the DAC Errors.

This section contains the following APIs:

- *HAL_DAC_GetState*
- *HAL_DAC_GetError*

16.2.7 Detailed description of functions

`HAL_DAC_Init`

Function name

HAL_StatusTypeDef HAL_DAC_Init (DAC_HandleTypeDef * hdac)

Function description

Initialize the DAC peripheral according to the specified parameters in the DAC_InitStruct and initialize the associated handle.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **HAL:** status

`HAL_DAC_DeInit`

Function name

HAL_StatusTypeDef HAL_DAC_DeInit (DAC_HandleTypeDef * hdac)

Function description

Deinitialize the DAC peripheral registers to their default reset values.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **HAL:** status

HAL_DAC_MspInit

Function name

void HAL_DAC_MspInit (DAC_HandleTypeDef * hdac)

Function description

Initialize the DAC MSP.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_MspDeInit

Function name

void HAL_DAC_MspDeInit (DAC_HandleTypeDef * hdac)

Function description

DeInitialize the DAC MSP.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_Start

Function name

HAL_StatusTypeDef HAL_DAC_Start (DAC_HandleTypeDef * hdac, uint32_t Channel)

Function description

Enables DAC and starts conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected (when supported)

Return values

- **HAL:** status

HAL_DAC_Stop

Function name

HAL_StatusTypeDef HAL_DAC_Stop (DAC_HandleTypeDef * hdac, uint32_t Channel)

Function description

Disables DAC and stop conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **HAL:** status

`HAL_DAC_Start_DMA`

Function name

HAL_StatusTypeDef HAL_DAC_Start_DMA (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t * pData, uint32_t Length, uint32_t Alignment)

Function description

Enables DAC and starts conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected
- **pData:** The destination peripheral Buffer address.
- **Length:** The length of data to be transferred from memory to DAC peripheral
- **Alignment:** Specifies the data alignment for DAC channel. This parameter can be one of the following values:
  - DAC_ALIGN_8B_R: 8bit right data alignment selected
  - DAC_ALIGN_12B_L: 12bit left data alignment selected
  - DAC_ALIGN_12B_R: 12bit right data alignment selected

Return values

- **HAL:** status

`HAL_DAC_Stop_DMA`

Function name

HAL_StatusTypeDef HAL_DAC_Stop_DMA (DAC_HandleTypeDef * hdac, uint32_t Channel)

Function description

Disables DAC and stop conversion of channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **HAL:** status

HAL_DAC_IRQHandler

Function name

void HAL_DAC_IRQHandler (DAC_HandleTypeDef * hdac)

Function description

Handles DAC interrupt request This function uses the interruption of DMA underrun.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_SetValue

Function name

HAL_StatusTypeDef HAL_DAC_SetValue (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Alignment, uint32_t Data)

Function description

Set the specified data holding register value for DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected
- **Alignment:** Specifies the data alignment. This parameter can be one of the following values:
  - DAC_ALIGN_8B_R: 8bit right data alignment selected
  - DAC_ALIGN_12B_L: 12bit left data alignment selected
  - DAC_ALIGN_12B_R: 12bit right data alignment selected
- **Data:** Data to be loaded in the selected data holding register.

Return values

- **HAL:** status

HAL_DAC_ConvCpltCallbackCh1

Function name

void HAL_DAC_ConvCpltCallbackCh1 (DAC_HandleTypeDef * hdac)

Function description

Conversion complete callback in non-blocking mode for Channel1.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_ConvHalfCpltCallbackCh1

Function name

void HAL_DAC_ConvHalfCpltCallbackCh1 (DAC_HandleTypeDef * hdac)

Function description

Conversion half DMA transfer callback in non-blocking mode for Channel1.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_ErrorCallbackCh1

Function name

void HAL_DAC_ErrorCallbackCh1 (DAC_HandleTypeDef * hdac)

Function description

Error DAC callback for Channel1.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_DMAUnderrunCallbackCh1

Function name

void HAL_DAC_DMAUnderrunCallbackCh1 (DAC_HandleTypeDef * hdac)

Function description

DMA underrun DAC callback for channel1.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DAC_GetValue

Function name

uint32_t HAL_DAC_GetValue (DAC_HandleTypeDef * hdac, uint32_t Channel)

Function description

Returns the last data output value of the selected DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **The:** selected DAC channel data output value.

`HAL_DAC_ConfigChannel`

Function name

HAL_StatusTypeDef HAL_DAC_ConfigChannel (DAC_HandleTypeDef * hdac, DAC_ChannelConfTypeDef * sConfig, uint32_t Channel)

Function description

Configures the selected DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **sConfig:** DAC configuration structure.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected (Whenever present)

Return values

- **HAL:** status

Notes

- By calling this function, the high frequency interface mode (HFSEL bits) will be set. This parameter scope is the DAC instance. As the function is called for each channel, the DAC high frequency interface mode of sConfig must be the same at each call. (or DAC_HIGH_FREQUENCY_INTERFACE_MODE_AUTOMATIC self detect).

`HAL_DAC_GetState`

Function name

HAL_DAC_StateTypeDef HAL_DAC_GetState (DAC_HandleTypeDef * hdac)

Function description

return the DAC handle state

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **HAL:** state

`HAL_DAC_GetError`

Function name

uint32_t HAL_DAC_GetError (DAC_HandleTypeDef * hdac)

Function description

Return the DAC error code.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **DAC:** Error Code

DAC_DMAConvCpltCh1

Function name

void DAC_DMAConvCpltCh1 (DMA_HandleTypeDef * hdma)

Function description

DMA conversion complete callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values

- **None:**

DAC_DMAErrorCh1

Function name

void DAC_DMAErrorCh1 (DMA_HandleTypeDef * hdma)

Function description

DMA error callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values

- **None:**

DAC_DMAHalfConvCpltCh1

Function name

void DAC_DMAHalfConvCpltCh1 (DMA_HandleTypeDef * hdma)

Function description

DMA half transfer complete callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values

- **None:**

16.3 DAC Firmware driver defines

The following section lists the various define and macros of the module.

16.3.1 DAC

DAC

DAC Channel selection

DAC_CHANNEL_1

DAC_CHANNEL_2

DAC ConnectOnChipPeripheral

DAC_CHIPCONNECT_DISABLE

DAC_CHIPCONNECT_ENABLE

DAC data alignment

DAC_ALIGN_12B_R

DAC_ALIGN_12B_L

DAC_ALIGN_8B_R

DAC Error Code

HAL_DAC_ERROR_NONE

No error

HAL_DAC_ERROR_DMAUNDERRUNCH1

DAC channel1 DMA underrun error

HAL_DAC_ERROR_DMAUNDERRUNCH2

DAC channel2 DMA underrun error

HAL_DAC_ERROR_DMA

DMA error

HAL_DAC_ERROR_TIMEOUT

Timeout error

DAC Exported Macros

__HAL_DAC_RESET_HANDLE_STATE

Description:

- Reset DAC handle state.

Parameters:

- __HANDLE__: specifies the DAC handle.

Return value:

- None

__HAL_DAC_ENABLE

Description:

- Enable the DAC channel.

Parameters:

- __HANDLE__: specifies the DAC handle.
- __DAC_Channel__: specifies the DAC channel

Return value:

- None

__HAL_DAC_DISABLE

Description:

- Disable the DAC channel.

Parameters:

- __HANDLE__: specifies the DAC handle
- __DAC_Channel__: specifies the DAC channel.

Return value:

- None

DAC_DHR12R1_ALIGNMENT

Description:

- Set DHR12R1 alignment.

Parameters:

- __ALIGNMENT__: specifies the DAC alignment

Return value:

- None

DAC_DHR12R2_ALIGNMENT

Description:

- Set DHR12R2 alignment.

Parameters:

- __ALIGNMENT__: specifies the DAC alignment

Return value:

- None

DAC_DHR12RD_ALIGNMENT

Description:

- Set DHR12RD alignment.

Parameters:

- __ALIGNMENT__: specifies the DAC alignment

Return value:

- None

__HAL_DAC_ENABLE_IT

Description:

- Enable the DAC interrupt.

Parameters:

- __HANDLE__: specifies the DAC handle
- __INTERRUPT__: specifies the DAC interrupt. This parameter can be any combination of the following values:
  - DAC_IT_DMAUDR1: DAC channel 1 DMA underrun interrupt
  - DAC_IT_DMAUDR2: DAC channel 2 DMA underrun interrupt

Return value:

- None

__HAL_DAC_DISABLE_IT

Description:

- Disable the DAC interrupt.

Parameters:

- __HANDLE__: specifies the DAC handle
- __INTERRUPT__: specifies the DAC interrupt. This parameter can be any combination of the following values:
  - DAC_IT_DMAUDR1: DAC channel 1 DMA underrun interrupt
  - DAC_IT_DMAUDR2: DAC channel 2 DMA underrun interrupt

Return value:

- None

__HAL_DAC_GET_IT_SOURCE

Description:

- Check whether the specified DAC interrupt source is enabled or not.

Parameters:

- __HANDLE__: DAC handle
- __INTERRUPT__: DAC interrupt source to check This parameter can be any combination of the following values:
  - DAC_IT_DMAUDR1: DAC channel 1 DMA underrun interrupt
  - DAC_IT_DMAUDR2: DAC channel 2 DMA underrun interrupt

Return value:

- State: of interruption (SET or RESET)

__HAL_DAC_GET_FLAG

Description:

- Get the selected DAC's flag status.

Parameters:

- __HANDLE__: specifies the DAC handle.
- __FLAG__: specifies the DAC flag to get. This parameter can be any combination of the following values:
  - DAC_FLAG_DMAUDR1: DAC channel 1 DMA underrun flag
  - DAC_FLAG_DMAUDR2: DAC channel 2 DMA underrun flag

Return value:

- None

__HAL_DAC_CLEAR_FLAG

Description:

- Clear the DAC's flag.

Parameters:

- __HANDLE__: specifies the DAC handle.
- __FLAG__: specifies the DAC flag to clear. This parameter can be any combination of the following values:
  - DAC_FLAG_DMAUDR1: DAC channel 1 DMA underrun flag
  - DAC_FLAG_DMAUDR2: DAC channel 2 DMA underrun flag

Return value:

- None

DAC flags definition

DAC_FLAG_DMAUDR1

DAC_FLAG_DMAUDR2

DAC high frequency interface mode

DAC_HIGH_FREQUENCY_INTERFACE_MODE_DISABLE

High frequency interface mode disabled

DAC_HIGH_FREQUENCY_INTERFACE_MODE_ABOVE_80MHZ

High frequency interface mode compatible to AHB>80MHz enabled

DAC_HIGH_FREQUENCY_INTERFACE_MODE_AUTOMATIC

High frequency interface mode automatic

DAC IT definition

DAC_IT_DMAUDR1

DAC_IT_DMAUDR2

DAC output buffer

DAC_OUTPUTBUFFER_ENABLE

DAC_OUTPUTBUFFER_DISABLE

DAC power mode

DAC_SAMPLEANDHOLD_DISABLE

DAC_SAMPLEANDHOLD_ENABLE

DAC trigger selection

DAC_TRIGGER_NONE

conversion is automatic once the DAC_DHRxxxx register has been loaded, and not by external trigger

DAC_TRIGGER_SOFTWARE

conversion started by software trigger for DAC channel

DAC_TRIGGER_T1_TRGO

TIM1 TRGO selected as external conversion trigger for DAC channel.

DAC_TRIGGER_T2_TRGO

TIM2 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_T4_TRGO

TIM4 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_T5_TRGO

TIM5 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_T6_TRGO

TIM6 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_T7_TRGO

TIM7 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_T8_TRGO

TIM8 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_T15_TRGO

TIM15 TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_LPTIM1_OUT

LPTIM1 OUT TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_LPTIM2_OUT

LPTIM2 OUT TRGO selected as external conversion trigger for DAC channel

DAC_TRIGGER_EXT_IT9

EXTI Line9 event selected as external conversion trigger for DAC channel

DAC User Trimming

DAC_TRIMMING_FACTORY

Factory trimming

DAC_TRIMMING_USER

User trimming

17 HAL DAC Extension Driver

17.1 DACEx Firmware driver API description

The following section lists the various functions of the DACEx library.

17.1.1 How to use this driver

Dual mode IO operation

Signal generation operation

17.1.2 Extended features functions

This section provides functions allowing to:

- Start conversion.
- Stop conversion.
- Start conversion and enable DMA transfer.
- Stop conversion and disable DMA transfer.
- Get result of conversion.
- Get result of dual mode conversion.

This section contains the following APIs:

- ***HAL_DACEx_TriangleWaveGenerate***
- ***HAL_DACEx_NoiseWaveGenerate***
- ***HAL_DACEx_DualSetValue***
- ***HAL_DACEx_ConvCpltCallbackCh2***
- ***HAL_DACEx_ConvHalfCpltCallbackCh2***
- ***HAL_DACEx_ErrorCallbackCh2***
- ***HAL_DACEx_DMAUnderrunCallbackCh2***
- ***HAL_DACEx_SelfCalibrate***
- ***HAL_DACEx_SetUserTrimming***
- ***HAL_DACEx_GetTrimOffset***
- ***HAL_DACEx_DualGetValue***

17.1.3 Peripheral Control functions

This section provides functions allowing to:

- Set the specified data holding register value for DAC channel.

This section contains the following APIs:

- ***HAL_DACEx_DualGetValue***
- ***HAL_DACEx_SelfCalibrate***
- ***HAL_DACEx_SetUserTrimming***
- ***HAL_DACEx_GetTrimOffset***

17.1.4 Detailed description of functions

`HAL_DACEx_TriangleWaveGenerate`

Function name

HAL_StatusTypeDef HAL_DACEx_TriangleWaveGenerate (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Amplitude)

Function description

Enable or disable the selected DAC channel wave generation.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected
- **Amplitude:** Select max triangle amplitude. This parameter can be one of the following values:
  - DAC_TRIANGLEAMPLITUDE_1: Select max triangle amplitude of 1
  - DAC_TRIANGLEAMPLITUDE_3: Select max triangle amplitude of 3
  - DAC_TRIANGLEAMPLITUDE_7: Select max triangle amplitude of 7
  - DAC_TRIANGLEAMPLITUDE_15: Select max triangle amplitude of 15
  - DAC_TRIANGLEAMPLITUDE_31: Select max triangle amplitude of 31
  - DAC_TRIANGLEAMPLITUDE_63: Select max triangle amplitude of 63
  - DAC_TRIANGLEAMPLITUDE_127: Select max triangle amplitude of 127
  - DAC_TRIANGLEAMPLITUDE_255: Select max triangle amplitude of 255
  - DAC_TRIANGLEAMPLITUDE_511: Select max triangle amplitude of 511
  - DAC_TRIANGLEAMPLITUDE_1023: Select max triangle amplitude of 1023
  - DAC_TRIANGLEAMPLITUDE_2047: Select max triangle amplitude of 2047
  - DAC_TRIANGLEAMPLITUDE_4095: Select max triangle amplitude of 4095

Return values

- **HAL:** status

`HAL_DACEx_NoiseWaveGenerate`

Function name

HAL_StatusTypeDef HAL_DACEx_NoiseWaveGenerate (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Amplitude)

Function description

Enable or disable the selected DAC channel wave generation.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected
- **Amplitude:** Unmask DAC channel LFSR for noise wave generation. This parameter can be one of the following values:
  - DAC_LFSRUNMASK_BIT0: Unmask DAC channel LFSR bit0 for noise wave generation
  - DAC_LFSRUNMASK_BITS1_0: Unmask DAC channel LFSR bit[1:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS2_0: Unmask DAC channel LFSR bit[2:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS3_0: Unmask DAC channel LFSR bit[3:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS4_0: Unmask DAC channel LFSR bit[4:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS5_0: Unmask DAC channel LFSR bit[5:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS6_0: Unmask DAC channel LFSR bit[6:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS7_0: Unmask DAC channel LFSR bit[7:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS8_0: Unmask DAC channel LFSR bit[8:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS9_0: Unmask DAC channel LFSR bit[9:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS10_0: Unmask DAC channel LFSR bit[10:0] for noise wave generation
  - DAC_LFSRUNMASK_BITS11_0: Unmask DAC channel LFSR bit[11:0] for noise wave generation

Return values

- **HAL:** status

`HAL_DACEx_DualSetValue`

Function name

HAL_StatusTypeDef HAL_DACEx_DualSetValue (DAC_HandleTypeDef * hdac, uint32_t Alignment, uint32_t Data1, uint32_t Data2)

Function description

Set the specified data holding register value for dual DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **Alignment:** Specifies the data alignment for dual channel DAC. This parameter can be one of the following values: DAC_ALIGN_8B_R: 8bit right data alignment selected DAC_ALIGN_12B_L: 12bit left data alignment selected DAC_ALIGN_12B_R: 12bit right data alignment selected
- **Data1:** Data for DAC Channel1 to be loaded in the selected data holding register.
- **Data2:** Data for DAC Channel2 to be loaded in the selected data holding register.

Return values

- **HAL:** status

Notes

- In dual mode, a unique register access is required to write in both DAC channels at the same time.

`HAL_DACEx_DualGetValue`

Function name

uint32_t HAL_DACEx_DualGetValue (DAC_HandleTypeDef * hdac)

Function description

Return the last data output value of the selected DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **The:** selected DAC channel data output value.

`HAL_DACEx_ConvCpltCallbackCh2`

Function name

void HAL_DACEx_ConvCpltCallbackCh2 (DAC_HandleTypeDef * hdac)

Function description

Conversion complete callback in non-blocking mode for Channel2.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

`HAL_DACEx_ConvHalfCpltCallbackCh2`

Function name

void HAL_DACEx_ConvHalfCpltCallbackCh2 (DAC_HandleTypeDef * hdac)

Function description

Conversion half DMA transfer callback in non-blocking mode for Channel2.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

`HAL_DACEx_ErrorCallbackCh2`

Function name

void HAL_DACEx_ErrorCallbackCh2 (DAC_HandleTypeDef * hdac)

Function description

Error DAC callback for Channel2.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DACEx_DMAUnderrunCallbackCh2

Function name

void HAL_DACEx_DMAUnderrunCallbackCh2 (DAC_HandleTypeDef * hdac)

Function description

DMA underrun DAC callback for Channel2.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values

- **None:**

HAL_DACEx_SelfCalibrate

Function name

HAL_StatusTypeDef HAL_DACEx_SelfCalibrate (DAC_HandleTypeDef * hdac, DAC_ChannelConfTypeDef * sConfig, uint32_t Channel)

Function description

Run the self calibration of one DAC channel.

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **sConfig:** DAC channel configuration structure.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **Updates:** DAC_TrimmingValue. , DAC_UserTrimming set to DAC_UserTrimming
- **HAL:** status

Notes

- Calibration runs about 7 ms.

HAL_DACEx_SetUserTrimming

Function name

HAL_StatusTypeDef HAL_DACEx_SetUserTrimming (DAC_HandleTypeDef * hdac, DAC_ChannelConfTypeDef * sConfig, uint32_t Channel, uint32_t NewTrimmingValue)

Function description

Set the trimming mode and trimming value (user trimming mode applied).

Parameters

- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.
- **sConfig:** DAC configuration structure updated with new DAC trimming value.
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected
- **NewTrimmingValue:** DAC new trimming value

Return values

- **HAL:** status

`HAL_DACEx_GetTrimOffset`

Function name

uint32_t HAL_DACEx_GetTrimOffset (DAC_HandleTypeDef * hdac, uint32_t Channel)

Function description

Return the DAC trimming value.

Parameters

- **hdac:** DAC handle
- **Channel:** The selected DAC channel. This parameter can be one of the following values:
  - DAC_CHANNEL_1: DAC Channel1 selected
  - DAC_CHANNEL_2: DAC Channel2 selected

Return values

- **Trimming:** value : range: 0->31

`DAC_DMAConvCpltCh2`

Function name

void DAC_DMAConvCpltCh2 (DMA_HandleTypeDef * hdma)

Function description

DMA conversion complete callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values

- **None:**

`DAC_DMAErrorCh2`

Function name

void DAC_DMAErrorCh2 (DMA_HandleTypeDef * hdma)

Function description

DMA error callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values

- **None:**

`DAC_DMAHalfConvCpltCh2`

Function name

void DAC_DMAHalfConvCpltCh2 (DMA_HandleTypeDef * hdma)

Function description

DMA half transfer complete callback.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values

- **None:**

17.2 DACEx Firmware driver defines

The following section lists the various define and macros of the module.

17.2.1 DACEx

DACEx

DACEx lfsrunmask triangle amplitude

DAC_LFSRUNMASK_BIT0

Unmask DAC channel LFSR bit0 for noise wave generation

DAC_LFSRUNMASK_BITS1_0

Unmask DAC channel LFSR bit[1:0] for noise wave generation

DAC_LFSRUNMASK_BITS2_0

Unmask DAC channel LFSR bit[2:0] for noise wave generation

DAC_LFSRUNMASK_BITS3_0

Unmask DAC channel LFSR bit[3:0] for noise wave generation

DAC_LFSRUNMASK_BITS4_0

Unmask DAC channel LFSR bit[4:0] for noise wave generation

DAC_LFSRUNMASK_BITS5_0

Unmask DAC channel LFSR bit[5:0] for noise wave generation

DAC_LFSRUNMASK_BITS6_0

Unmask DAC channel LFSR bit[6:0] for noise wave generation

DAC_LFSRUNMASK_BITS7_0

Unmask DAC channel LFSR bit[7:0] for noise wave generation

DAC_LFSRUNMASK_BITS8_0

Unmask DAC channel LFSR bit[8:0] for noise wave generation

DAC_LFSRUNMASK_BITS9_0

Unmask DAC channel LFSR bit[9:0] for noise wave generation

DAC_LFSRUNMASK_BITS10_0

Unmask DAC channel LFSR bit[10:0] for noise wave generation

DAC_LFSRUNMASK_BITS11_0

Unmask DAC channel LFSR bit[11:0] for noise wave generation

DAC_TRIANGLEAMPLITUDE_1

Select max triangle amplitude of 1

DAC_TRIANGLEAMPLITUDE_3

Select max triangle amplitude of 3

DAC_TRIANGLEAMPLITUDE_7

Select max triangle amplitude of 7

DAC_TRIANGLEAMPLITUDE_15

Select max triangle amplitude of 15

DAC_TRIANGLEAMPLITUDE_31

Select max triangle amplitude of 31

DAC_TRIANGLEAMPLITUDE_63

Select max triangle amplitude of 63

DAC_TRIANGLEAMPLITUDE_127

Select max triangle amplitude of 127

DAC_TRIANGLEAMPLITUDE_255

Select max triangle amplitude of 255

DAC_TRIANGLEAMPLITUDE_511

Select max triangle amplitude of 511

DAC_TRIANGLEAMPLITUDE_1023

Select max triangle amplitude of 1023

DAC_TRIANGLEAMPLITUDE_2047

Select max triangle amplitude of 2047

DAC_TRIANGLEAMPLITUDE_4095

Select max triangle amplitude of 4095

18 HAL DCMI Generic Driver

18.1 DCMI Firmware driver registers structures

18.1.1 DCMI_CodesInitTypeDef

DCMI_CodesInitTypeDef is defined in the stm32l4xx_hal_dcmi.h

Data Fields

- ***uint8_t FrameStartCode***
- ***uint8_t LineStartCode***
- ***uint8_t LineEndCode***
- ***uint8_t FrameEndCode***

Field Documentation

- ***uint8_t DCMI_CodesInitTypeDef::FrameStartCode***
  Specifies the code of the frame start delimiter.
- ***uint8_t DCMI_CodesInitTypeDef::LineStartCode***
  Specifies the code of the line start delimiter.
- ***uint8_t DCMI_CodesInitTypeDef::LineEndCode***
  Specifies the code of the line end delimiter.
- ***uint8_t DCMI_CodesInitTypeDef::FrameEndCode***
  Specifies the code of the frame end delimiter.

18.1.2 DCMI_SyncUnmaskTypeDef

DCMI_SyncUnmaskTypeDef is defined in the stm32l4xx_hal_dcmi.h

Data Fields

- ***uint8_t FrameStartUnmask***
- ***uint8_t LineStartUnmask***
- ***uint8_t LineEndUnmask***
- ***uint8_t FrameEndUnmask***

Field Documentation

- ***uint8_t DCMI_SyncUnmaskTypeDef::FrameStartUnmask***
  Specifies the frame start delimiter unmask.
- ***uint8_t DCMI_SyncUnmaskTypeDef::LineStartUnmask***
  Specifies the line start delimiter unmask.
- ***uint8_t DCMI_SyncUnmaskTypeDef::LineEndUnmask***
  Specifies the line end delimiter unmask.
- ***uint8_t DCMI_SyncUnmaskTypeDef::FrameEndUnmask***
  Specifies the frame end delimiter unmask.

18.1.3 DCMI_InitTypeDef

DCMI_InitTypeDef is defined in the stm32l4xx_hal_dcmi.h

Data Fields

- ***uint32_t SynchroMode***
- ***uint32_t PCKPolarity***
- ***uint32_t VSPolarity***
- ***uint32_t HSPolarity***
- ***uint32_t CaptureRate***
- ***uint32_t ExtendedDataMode***

- ***DCMI_CodesInitTypeDef SynchroCode***
- ***uint32_t JPEGMode***
- ***uint32_t ByteSelectMode***
- ***uint32_t ByteSelectStart***
- ***uint32_t LineSelectMode***
- ***uint32_t LineSelectStart***

Field Documentation

- ***uint32_t DCMI_InitTypeDef::SynchroMode***
  Specifies the Synchronization Mode: Hardware or Embedded. This parameter can be a value of ***DCMI_Synchronization_Mode***
- ***uint32_t DCMI_InitTypeDef::PCKPolarity***
  Specifies the Pixel clock polarity: Falling or Rising. This parameter can be a value of ***DCMI_PIXCK_Polarity***
- ***uint32_t DCMI_InitTypeDef::VSPolarity***
  Specifies the Vertical synchronization polarity: High or Low. This parameter can be a value of ***DCMI_VSYNC_Polarity***
- ***uint32_t DCMI_InitTypeDef::HSPolarity***
  Specifies the Horizontal synchronization polarity: High or Low. This parameter can be a value of ***DCMI_HSYNC_Polarity***
- ***uint32_t DCMI_InitTypeDef::CaptureRate***
  Specifies the frequency of frame capture: All, 1/2 or 1/4. This parameter can be a value of ***DCMI_Capture_Rate***
- ***uint32_t DCMI_InitTypeDef::ExtendedDataMode***
  Specifies the data width: 8-bit, 10-bit, 12-bit or 14-bit. This parameter can be a value of ***DCMI_Extended_Data_Mode***
- ***DCMI_CodesInitTypeDef DCMI_InitTypeDef::SynchroCode***
  Specifies the frame start delimiter codes.
- ***uint32_t DCMI_InitTypeDef::JPEGMode***
  Enable or Disable the JPEG mode. This parameter can be a value of DCMI_MODE_JPEG
- ***uint32_t DCMI_InitTypeDef::ByteSelectMode***
  Specifies the data to be captured by the interface This parameter can be a value of ***DCMI_Byte_Select_Mode***
- ***uint32_t DCMI_InitTypeDef::ByteSelectStart***
  Specifies if the data to be captured by the interface is even or odd This parameter can be a value of ***DCMI_Byte_Select_Start***
- ***uint32_t DCMI_InitTypeDef::LineSelectMode***
  Specifies the line of data to be captured by the interface This parameter can be a value of ***DCMI_Line_Select_Mode***
- ***uint32_t DCMI_InitTypeDef::LineSelectStart***
  Specifies if the line of data to be captured by the interface is even or odd This parameter can be a value of ***DCMI_Line_Select_Start***

18.1.4 __DCMI_HandleTypeDef

__DCMI_HandleTypeDef is defined in the stm32l4xx_hal_dcmi.h

Data Fields

- ***DCMI_TypeDef * Instance***
- ***DCMI_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_DCMI_StateTypeDef State***
- ***__IO uint32_t XferCount***
- ***__IO uint32_t XferSize***
- ***uint32_t pBuffPtr***

- ***DMA_HandleTypeDef * DMA_Handle***
- ***DMA_HandleTypeDef * DMAM2M_Handle***
- ***__IO uint32_t ErrorCode***
- ***uint32_t pCircularBuffer***
- ***uint32_t HalfCopyLength***

Field Documentation

- ***DCMI_TypeDef* __DCMI_HandleTypeDef::Instance***
  DCMI Register base address
- ***DCMI_InitTypeDef __DCMI_HandleTypeDef::Init***
  DCMI init parameters
- ***HAL_LockTypeDef __DCMI_HandleTypeDef::Lock***
  DCMI locking object
- ***__IO HAL_DCMI_StateTypeDef __DCMI_HandleTypeDef::State***
  DCMI state
- ***__IO uint32_t __DCMI_HandleTypeDef::XferCount***
  DMA transfers counter
- ***__IO uint32_t __DCMI_HandleTypeDef::XferSize***
  DMA transfer size
- ***uint32_t __DCMI_HandleTypeDef::pBuffPtr***
  Pointer to DMA output buffer
- ***DMA_HandleTypeDef* __DCMI_HandleTypeDef::DMA_Handle***
  Pointer to DMA handler
- ***DMA_HandleTypeDef* __DCMI_HandleTypeDef::DMAM2M_Handle***
  Pointer to DMA handler for memory to memory copy (case picture size > maximum DMA transfer length)
- ***__IO uint32_t __DCMI_HandleTypeDef::ErrorCode***
  DCMI Error code
- ***uint32_t __DCMI_HandleTypeDef::pCircularBuffer***
  Pointer to intermediate copy buffer (case picture size > maximum DMA transfer length)
- ***uint32_t __DCMI_HandleTypeDef::HalfCopyLength***
  Intermediate copies length (case picture size > maximum DMA transfer length)

18.2 DCMI Firmware driver API description

The following section lists the various functions of the DCMI library.

18.2.1 How to use this driver

The sequence below describes how to use this driver to capture images from a camera module connected to the DCMI Interface. This sequence does not take into account the configuration of the camera module, which should be made before configuring and enabling the DCMI to capture images.

1. Program the required configuration through the following parameters: horizontal and vertical polarity, pixel clock polarity, capture rate, synchronization mode, frame delimiter codes, data width, byte and line selection using HAL_DCMI_Init() function.
2. Optionally select JPEG mode; in that case, only the polarity and the capture mode parameters need to be set.
3. Capture mode can be either snapshot or continuous mode.
4. Configure the DMA_Handle to transfer data from DCMI DR register to the destination memory buffer.

Note: In snapshot mode, the interface transfers a single frame through DMA. In continuous mode, the DMA must be set in circular mode to ensure a continuous flow of images data samples.

5. Program the transfer configuration through the following parameters: DCMI mode, destination memory buffer address and data length then enable capture using HAL_DCMI_Start_DMA() function.
6. Whether in continuous or snapshot mode, data length parameter must be equal to the frame size.

7. When the frame size is unknown beforehand (e.g. JPEG case), data length must be large enough to ensure the capture of a frame.
8. If the frame size is larger than the maximum DMA transfer length (i.e. 65535),
   – the DMA must be configured in circular mode, either for snapshot or continuous capture mode,
   – during capture, the driver copies the image data samples from DCMI DR register at the end of the final destination buffer used as a work buffer,
   – at each DMA half (respectively complete) transfer interrupt, the first (resp. second) half of the work buffer is copied to the final destination thru a second DMA channel.
   – Parameters of this second DMA channel are contained in the memory to memory DMA handle "DMAM2M_Handle", itself field of the DCMI handle structure.
   – This memory to memory transfer has length half that of the work buffer and is carried out in normal mode (not in circular mode).
9. Optionally, configure and enable the CROP feature to select a rectangular window from the received image using HAL_DCMI_ConfigCrop() and HAL_DCMI_EnableCrop() functions. Use HAL_DCMI_DisableCrop() to disable this feature.
10. The capture can be stopped with HAL_DCMI_Stop() function.
11. To control the DCMI state, use the function HAL_DCMI_GetState().
12. To read the DCMI error code, use the function HAL_DCMI_GetError().

Note: When the frame size is less than the maximum DMA transfer length (i.e. 65535) and when in snapshot mode, user must make sure the FRAME interrupt is disabled. This allows to avoid corner cases where the FRAME interrupt might be triggered before the DMA transfer completion interrupt. In this specific configuration, the driver checks the FRAME capture flag after the DMA transfer end and calls HAL_DCMI_FrameEventCallback() if the flag is set.

DCMI HAL driver macros list

Below the list of most used macros in DCMI HAL driver.

- __HAL_DCMI_ENABLE: Enable the DCMI peripheral.
- __HAL_DCMI_DISABLE: Disable the DCMI peripheral.
- __HAL_DCMI_GET_FLAG: Get the DCMI pending flags.
- __HAL_DCMI_CLEAR_FLAG: Clear the DCMI pending flags.
- __HAL_DCMI_ENABLE_IT: Enable the specified DCMI interrupts.
- __HAL_DCMI_DISABLE_IT: Disable the specified DCMI interrupts.
- __HAL_DCMI_GET_IT_SOURCE: Check whether the specified DCMI interrupt has occurred or not.

Callback registration

18.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the DCMI
- De-initialize the DCMI

This section contains the following APIs:

- ***HAL_DCMI_Init***
- ***HAL_DCMI_DeInit***
- ***HAL_DCMI_MspInit***
- ***HAL_DCMI_MspDeInit***

18.2.3 IO operation functions

This section provides functions allowing to:

- Configure destination address and data length, enable DCMI DMA request and DCMI capture.
- Stop DCMI capture.
- Handle DCMI interrupt request.

A set of callbacks is provided:

- HAL_DCMI_ErrorCallback()
- HAL_DCMI_LineEventCallback()
- HAL_DCMI_VsyncEventCallback()
- HAL_DCMI_FrameEventCallback()

This section contains the following APIs:

- ***HAL_DCMI_Start_DMA***
- ***HAL_DCMI_Stop***
- ***HAL_DCMI_Suspend***
- ***HAL_DCMI_Resume***
- ***HAL_DCMI_IRQHandler***
- ***HAL_DCMI_ErrorCallback***
- ***HAL_DCMI_LineEventCallback***
- ***HAL_DCMI_VsyncEventCallback***
- ***HAL_DCMI_FrameEventCallback***

18.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the crop feature.
- Enable/Disable the crop feature.
- Configure the synchronization delimiters unmasks.
- Enable/Disable user-specified DCMI interrupts.

This section contains the following APIs:

- ***HAL_DCMI_ConfigCrop***
- ***HAL_DCMI_DisableCrop***
- ***HAL_DCMI_EnableCrop***
- ***HAL_DCMI_ConfigSyncUnmask***

18.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DCMI state.
- Get the specific DCMI error flag.

This section contains the following APIs:

- ***HAL_DCMI_GetState***
- ***HAL_DCMI_GetError***

18.2.6 Detailed description of functions

`HAL_DCMI_Init`

Function name

HAL_StatusTypeDef HAL_DCMI_Init (DCMI_HandleTypeDef * hdcmi)

Function description

Initialize the DCMI according to the specified parameters in the DCMI_InitTypeDef and create the associated handle.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

Notes

- By default, all interruptions are enabled (line end, frame end, overrun, VSYNC and embedded synchronization error interrupts).

`HAL_DCMI_DeInit`

Function name

HAL_StatusTypeDef HAL_DCMI_DeInit (DCMI_HandleTypeDef * hdcmi)

Function description

De-initialize the DCMI peripheral, reset control registers to their default values.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

`HAL_DCMI_MspInit`

Function name

void HAL_DCMI_MspInit (DCMI_HandleTypeDef * hdcmi)

Function description

Initialize the DCMI MSP.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

`HAL_DCMI_MspDeInit`

Function name

void HAL_DCMI_MspDeInit (DCMI_HandleTypeDef * hdcmi)

Function description

De-initialize the DCMI MSP.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

`HAL_DCMI_Start_DMA`

Function name

HAL_StatusTypeDef HAL_DCMI_Start_DMA (DCMI_HandleTypeDef * hdcmi, uint32_t DCMI_Mode, uint32_t pData, uint32_t Length)

Function description

Enable DCMI capture in DMA mode.

Parameters

- **hdcmi:** Pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- **DCMI_Mode:** DCMI capture mode snapshot or continuous grab.
- **pData:** The destination memory buffer address.
- **Length:** The length of capture to be transferred (in 32-bit words).

Return values

- **HAL:** status

Notes

- In case of length larger than 65535 (0xFFFF is the DMA maximum transfer length), the API uses the end of the destination buffer as a work area: HAL_DCMI_Start_DMA() initiates a circular DMA transfer from DCMI DR to the ad-hoc work buffer and each half and complete transfer interrupt triggers a copy from the work buffer to the final destination pData thru a second DMA channel.
- Following HAL_DCMI_Init() call, all interruptions are enabled (line end, frame end, overrun, VSYNC and embedded synchronization error interrupts). User can disable unwanted interrupts thru __HAL_DCMI_DISABLE_IT() macro before invoking HAL_DCMI_Start_DMA().
- For length less than 0xFFFF (DMA maximum transfer length) and in snapshot mode, frame interrupt is disabled before DMA transfer. FRAME capture flag is checked in DCMI_DMAXferCplt callback at the end of the DMA transfer. If flag is set, HAL_DCMI_FrameEventCallback() API is called.

`HAL_DCMI_Stop`

Function name

HAL_StatusTypeDef HAL_DCMI_Stop (DCMI_HandleTypeDef * hdcmi)

Function description

Disable DCMI capture in DMA mode.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

`HAL_DCMI_Suspend`

Function name

HAL_StatusTypeDef HAL_DCMI_Suspend (DCMI_HandleTypeDef * hdcmi)

Function description

Suspend DCMI capture.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

`HAL_DCMI_Resume`

Function name

HAL_StatusTypeDef HAL_DCMI_Resume (DCMI_HandleTypeDef * hdcmi)

Function description

Resume DCMI capture.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

`HAL_DCMI_ErrorCallback`

Function name

void HAL_DCMI_ErrorCallback (DCMI_HandleTypeDef * hdcmi)

Function description

Error DCMI callback.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

`HAL_DCMI_LineEventCallback`

Function name

void HAL_DCMI_LineEventCallback (DCMI_HandleTypeDef * hdcmi)

Function description

Line Event callback.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

`HAL_DCMI_FrameEventCallback`

Function name

void HAL_DCMI_FrameEventCallback (DCMI_HandleTypeDef * hdcmi)

Function description

Frame Event callback.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

`HAL_DCMI_VsyncEventCallback`

Function name

void HAL_DCMI_VsyncEventCallback (DCMI_HandleTypeDef * hdcmi)

Function description

VSYNC Event callback.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **None:**

HAL_DCMI_IRQHandler

Function name

void HAL_DCMI_IRQHandler (DCMI_HandleTypeDef * hdcmi)

Function description

Handle DCMI interrupt request.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for the DCMI.

Return values

- **None:**

HAL_DCMI_ConfigCrop

Function name

HAL_StatusTypeDef HAL_DCMI_ConfigCrop (DCMI_HandleTypeDef * hdcmi, uint32_t X0, uint32_t Y0, uint32_t XSize, uint32_t YSize)

Function description

Configure the DCMI crop window coordinates.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- **X0:** DCMI window crop window X offset (number of pixels clocks to count before the capture).
- **Y0:** DCMI window crop window Y offset (image capture starts with this line number, previous line data are ignored).
- **XSize:** DCMI crop window horizontal size (in number of pixels per line).
- **YSize:** DCMI crop window vertical size (in lines count).

Return values

- **HAL:** status

Notes

- For all the parameters, the actual value is the input data + 1 (e.g. YSize = 0x0 means 1 line, YSize = 0x1 means 2 lines, ...)

HAL_DCMI_EnableCrop

Function name

HAL_StatusTypeDef HAL_DCMI_EnableCrop (DCMI_HandleTypeDef * hdcmi)

Function description

Enable the crop feature.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

`HAL_DCMI_DisableCrop`

Function name

HAL_StatusTypeDef HAL_DCMI_DisableCrop (DCMI_HandleTypeDef * hdcmi)

Function description

Disable the crop feature.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** status

`HAL_DCMI_ConfigSyncUnmask`

Function name

HAL_StatusTypeDef HAL_DCMI_ConfigSyncUnmask (DCMI_HandleTypeDef * hdcmi, DCMI_SyncUnmaskTypeDef * SyncUnmask)

Function description

Set embedded synchronization delimiters unmasks.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.
- **SyncUnmask:** pointer to a DCMI_SyncUnmaskTypeDef structure that contains the embedded synchronization delimiters unmasks.

Return values

- **HAL:** status

`HAL_DCMI_GetState`

Function name

HAL_DCMI_StateTypeDef HAL_DCMI_GetState (DCMI_HandleTypeDef * hdcmi)

Function description

Return the DCMI state.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **HAL:** state

`HAL_DCMI_GetError`

Function name

uint32_t HAL_DCMI_GetError (DCMI_HandleTypeDef * hdcmi)

Function description

Return the DCMI error code.

Parameters

- **hdcmi:** pointer to a DCMI_HandleTypeDef structure that contains the configuration information for DCMI.

Return values

- **DCMI:** Error Code

18.3 DCMI Firmware driver defines

The following section lists the various define and macros of the module.

18.3.1 DCMI

DCMI

DCMI Byte Select Mode

DCMI_BSM_ALL

Interface captures all received data

DCMI_BSM_OTHER

Interface captures every other byte from the received data

DCMI_BSM_ALTERNATE_4

Interface captures one byte out of four

DCMI_BSM_ALTERNATE_2

Interface captures two bytes out of four

DCMI Byte Select Start

DCMI_OEBS_ODD

Interface captures first data from the frame/line start, second one being dropped

DCMI_OEBS_EVEN

Interface captures second data from the frame/line start, first one being dropped

DCMI Capture Mode

DCMI_MODE_CONTINUOUS

The received data are transferred continuously into the destination memory through the DMA

DCMI_MODE_SNAPSHOT

Once activated, the interface waits for the start of frame and then transfers a single frame through the DMA

DCMI Capture Rate

DCMI_CR_ALL_FRAME

All frames are captured

DCMI_CR_ALTERNATE_2_FRAME

Every alternate frame captured

DCMI_CR_ALTERNATE_4_FRAME

One frame in 4 frames captured

DCMI Error Code

HAL_DCMI_ERROR_NONE

No error

HAL_DCMI_ERROR_OVR

Overrun error

HAL_DCMI_ERROR_SYNC

Synchronization error

HAL_DCMI_ERROR_TIMEOUT

Timeout error

HAL_DCMI_ERROR_DMA

DMA error

DCMI Exported Macros

__HAL_DCMI_RESET_HANDLE_STATE

Description:

- Reset DCMI handle state.

Parameters:

- __HANDLE__: specifies the DCMI handle.

Return value:

- None

__HAL_DCMI_ENABLE

Description:

- Enable the DCMI.

Parameters:

- __HANDLE__: DCMI handle

Return value:

- None

__HAL_DCMI_DISABLE

Description:

- Disable the DCMI.

Parameters:

- __HANDLE__: DCMI handle

Return value:

- None

__HAL_DCMI_GET_FLAG

Description:

- Get the DCMI pending flag.

Parameters:

- __HANDLE__: DCMI handle
- __FLAG__: Get the specified flag. This parameter can be one of the following values (no combination allowed)
  - DCMI_FLAG_HSYNC: HSYNC pin state (active line / synchronization between lines)
  - DCMI_FLAG_VSYNC: VSYNC pin state (active frame / synchronization between frames)
  - DCMI_FLAG_FNE: FIFO empty flag
  - DCMI_FLAG_FRAMERI: Frame capture complete flag
  - DCMI_FLAG_OVRRI: Overrun flag
  - DCMI_FLAG_ERRRI: Synchronization error flag
  - DCMI_FLAG_VSYNCRI: VSYNC flag
  - DCMI_FLAG_LINERI: Line flag
  - DCMI_FLAG_FRAMEMI: DCMI Capture complete masked interrupt status
  - DCMI_FLAG_OVRMI: DCMI Overrun masked interrupt status
  - DCMI_FLAG_ERRMI: DCMI Synchronization error masked interrupt status
  - DCMI_FLAG_VSYNCMI: DCMI VSYNC masked interrupt status
  - DCMI_FLAG_LINEMI: DCMI Line masked interrupt status

Return value:

- The: state of FLAG.

__HAL_DCMI_CLEAR_FLAG

Description:

- Clear the DCMI pending flag.

Parameters:

- __HANDLE__: DCMI handle
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - DCMI_FLAG_FRAMERI: Frame capture complete flag
  - DCMI_FLAG_OVRRI: Overrun flag
  - DCMI_FLAG_ERRRI: Synchronization error flag
  - DCMI_FLAG_VSYNCRI: VSYNC flag
  - DCMI_FLAG_LINERI: Line flag

Return value:

- None

__HAL_DCMI_ENABLE_IT

Description:

- Enable the specified DCMI interrupts.

Parameters:

- __HANDLE__: DCMI handle
- __INTERRUPT__: specifies the DCMI interrupt sources to be enabled. This parameter can be any combination of the following values:
  - DCMI_IT_FRAME: Frame capture complete interrupt
  - DCMI_IT_OVR: Overrun interrupt
  - DCMI_IT_ERR: Synchronization error interrupt
  - DCMI_IT_VSYNC: VSYNC interrupt
  - DCMI_IT_LINE: Line interrupt

Return value:

- None

__HAL_DCMI_DISABLE_IT

Description:

- Disable the specified DCMI interrupts.

Parameters:

- __HANDLE__: DCMI handle
- __INTERRUPT__: specifies the DCMI interrupt sources to be enabled. This parameter can be any combination of the following values:
  - DCMI_IT_FRAME: Frame capture complete interrupt
  - DCMI_IT_OVR: Overrun interrupt
  - DCMI_IT_ERR: Synchronization error interrupt
  - DCMI_IT_VSYNC: VSYNC interrupt
  - DCMI_IT_LINE: Line interrupt

Return value:

- None

__HAL_DCMI_GET_IT_SOURCE

Description:

- Check whether the specified DCMI interrupt has occurred or not.

Parameters:

- __HANDLE__: DCMI handle
- __INTERRUPT__: specifies the DCMI interrupt flag and source to check. This parameter can be one of the following values:
  - DCMI_IT_FRAME: Frame capture complete interrupt mask
  - DCMI_IT_OVR: Overrun interrupt mask
  - DCMI_IT_ERR: Synchronization error interrupt mask
  - DCMI_IT_VSYNC: VSYNC interrupt mask
  - DCMI_IT_LINE: Line interrupt mask

Return value:

- The: state of INTERRUPT.

Notes:

- A bit in MIS register is set if the corresponding enable bit in DCMI_IER is set and the corresponding bit in DCMI_RIS is set.

DCMI Extended Data Mode

DCMI_EXTEND_DATA_8B

Interface captures 8-bit data on every pixel clock

DCMI_EXTEND_DATA_10B

Interface captures 10-bit data on every pixel clock

DCMI_EXTEND_DATA_12B

Interface captures 12-bit data on every pixel clock

DCMI_EXTEND_DATA_14B

Interface captures 14-bit data on every pixel clock

DCMI Flags

DCMI_FLAG_HSYNC

HSYNC pin state (active line / synchronization between lines)

DCMI_FLAG_VSYNC

VSYNC pin state (active frame / synchronization between frames)

DCMI_FLAG_FNE

FIFO not empty flag

DCMI_FLAG_FRAMERI

Capture complete interrupt flag

DCMI_FLAG_OVRRI

Overrun interrupt flag

DCMI_FLAG_ERRRI

Synchronization error interrupt flag

DCMI_FLAG_VSYNCRI

VSYNC interrupt flag

DCMI_FLAG_LINERI

Line interrupt flag

DCMI_FLAG_FRAMEMI

DCMI Capture complete masked interrupt status

DCMI_FLAG_OVRMI

DCMI Overrun masked interrupt status

DCMI_FLAG_ERRMI

DCMI Synchronization error masked interrupt status

DCMI_FLAG_VSYNCMI

DCMI VSYNC masked interrupt status

DCMI_FLAG_LINEMI

DCMI Line masked interrupt status

DCMI HSYNC Polarity

DCMI_HSPOLARITY_LOW

Horizontal synchronization active Low

DCMI_HSPOLARITY_HIGH

Horizontal synchronization active High

DCMI Interrupt Sources

DCMI_IT_FRAME

Capture complete interrupt

DCMI_IT_OVR

Overrun interrupt

DCMI_IT_ERR

Synchronization error interrupt

DCMI_IT_VSYNC

VSYNC interrupt

DCMI_IT_LINE

Line interrupt

DCMI JPEG Mode

DCMI_JPEG_DISABLE

JPEG mode disabled

DCMI_JPEG_ENABLE

JPEG mode enabled

DCMI Line Select Mode

DCMI_LSM_ALL

Interface captures all received lines

DCMI_LSM_ALTERNATE_2

Interface captures one line out of two

DCMI Line Select Start

DCMI_OELS_ODD

Interface captures first line from the frame start, second one being dropped

DCMI_OELS_EVEN

Interface captures second line from the frame start, first one being dropped

DCMI Pixel Clock Polarity

DCMI_PCKPOLARITY_FALLING

Pixel clock active on Falling edge

DCMI_PCKPOLARITY_RISING

Pixel clock active on Rising edge

DCMI Registers Indices

DCMI_MIS_INDEX

DCMI MIS register index

DCMI_SR_INDEX

DCMI SR register index

DCMI Stop TimeOut

DCMI_TIMEOUT_STOP

1s

DCMI Synchronization Mode

DCMI_SYNCHRO_HARDWARE

Hardware synchronization data capture (frame/line start/stop) is synchronized with the HSYNC/VSYNC signals

DCMI_SYNCHRO_EMBEDDED

Embedded synchronization data capture is synchronized with synchronization codes embedded in the data flow

DCMI VSYNC Polarity

DCMI_VSPOLARITY_LOW

Vertical synchronization active Low

DCMI_VSPOLARITY_HIGH

Vertical synchronization active High

DCMI Window Coordinate

DCMI_WINDOW_COORDINATE

Window coordinate

DCMI Window Height

DCMI_WINDOW_HEIGHT

Window Height

19 HAL DFSDM Generic Driver

19.1 DFSDM Firmware driver registers structures

19.1.1 DFSDM_Channel_OutputClockTypeDef

DFSDM_Channel_OutputClockTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***FunctionalState Activation***
- ***uint32_t Selection***
- ***uint32_t Divider***

Field Documentation

- ***FunctionalState DFSDM_Channel_OutputClockTypeDef::Activation***
  Output clock enable/disable
- ***uint32_t DFSDM_Channel_OutputClockTypeDef::Selection***
  Output clock is system clock or audio clock. This parameter can be a value of ***DFSDM_Channel_OuputClock***
- ***uint32_t DFSDM_Channel_OutputClockTypeDef::Divider***
  Output clock divider. This parameter must be a number between Min_Data = 2 and Max_Data = 256

19.1.2 DFSDM_Channel_InputTypeDef

DFSDM_Channel_InputTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t Multiplexer***
- ***uint32_t DataPacking***
- ***uint32_t Pins***

Field Documentation

- ***uint32_t DFSDM_Channel_InputTypeDef::Multiplexer***
  Input is external serial inputs, internal register or ADC output. ADC output is available only on STM32L451xx, STM32L452xx, STM32L462xx, STM32L496xx, STM32L4A6xx, STM32L4R5xx, STM32L4R7xx, STM32L4R9xx, STM32L4S5xx, STM32L4S7xx, STM32L4S9xx, STM32L4P5xx and STM32L4Q5xx products. This parameter can be a value of ***DFSDM_Channel_InputMultiplexer***
- ***uint32_t DFSDM_Channel_InputTypeDef::DataPacking***
  Standard, interleaved or dual mode for internal register. This parameter can be a value of ***DFSDM_Channel_DataPacking***
- ***uint32_t DFSDM_Channel_InputTypeDef::Pins***
  Input pins are taken from same or following channel. This parameter can be a value of ***DFSDM_Channel_InputPins***

19.1.3 DFSDM_Channel_SerialInterfaceTypeDef

DFSDM_Channel_SerialInterfaceTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t Type***
- ***uint32_t SpiClock***

Field Documentation

- ***uint32_t DFSDM_Channel_SerialInterfaceTypeDef::Type***
  SPI or Manchester modes. This parameter can be a value of ***DFSDM_Channel_SerialInterfaceType***

- ***uint32_t DFSDM_Channel_SerialInterfaceTypeDef::SpiClock***
  SPI clock select (external or internal with different sampling point). This parameter can be a value of ***DFSDM_Channel_SpiClock***

19.1.4 DFSDM_Channel_AwdTypeDef

DFSDM_Channel_AwdTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t FilterOrder***
- ***uint32_t Oversampling***

Field Documentation

- ***uint32_t DFSDM_Channel_AwdTypeDef::FilterOrder***
  Analog watchdog Sinc filter order. This parameter can be a value of ***DFSDM_Channel_AwdFilterOrder***
- ***uint32_t DFSDM_Channel_AwdTypeDef::Oversampling***
  Analog watchdog filter oversampling ratio. This parameter must be a number between Min_Data = 1 and Max_Data = 32

19.1.5 DFSDM_Channel_InitTypeDef

DFSDM_Channel_InitTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***DFSDM_Channel_OutputClockTypeDef OutputClock***
- ***DFSDM_Channel_InputTypeDef Input***
- ***DFSDM_Channel_SerialInterfaceTypeDef SerialInterface***
- ***DFSDM_Channel_AwdTypeDef Awd***
- ***int32_t Offset***
- ***uint32_t RightBitShift***

Field Documentation

- ***DFSDM_Channel_OutputClockTypeDef DFSDM_Channel_InitTypeDef::OutputClock***
  DFSDM channel output clock parameters
- ***DFSDM_Channel_InputTypeDef DFSDM_Channel_InitTypeDef::Input***
  DFSDM channel input parameters
- ***DFSDM_Channel_SerialInterfaceTypeDef DFSDM_Channel_InitTypeDef::SerialInterface***
  DFSDM channel serial interface parameters
- ***DFSDM_Channel_AwdTypeDef DFSDM_Channel_InitTypeDef::Awd***
  DFSDM channel analog watchdog parameters
- ***int32_t DFSDM_Channel_InitTypeDef::Offset***
  DFSDM channel offset. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607
- ***uint32_t DFSDM_Channel_InitTypeDef::RightBitShift***
  DFSDM channel right bit shift. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F

19.1.6 DFSDM_Channel_HandleTypeDef

DFSDM_Channel_HandleTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***DFSDM_Channel_TypeDef * Instance***
- ***DFSDM_Channel_InitTypeDef Init***
- ***HAL_DFSDM_Channel_StateTypeDef State***

Field Documentation

- ***DFSDM_Channel_TypeDef* DFSDM_Channel_HandleTypeDef::Instance***
  DFSDM channel instance

- ***DFSDM_Channel_InitTypeDef DFSDM_Channel_HandleTypeDef::Init***
  DFSDM channel init parameters
- ***HAL_DFSDM_Channel_StateTypeDef DFSDM_Channel_HandleTypeDef::State***
  DFSDM channel state

19.1.7 DFSDM_Filter_RegularParamTypeDef

DFSDM_Filter_RegularParamTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t Trigger***
- ***FunctionalState FastMode***
- ***FunctionalState DmaMode***

Field Documentation

- ***uint32_t DFSDM_Filter_RegularParamTypeDef::Trigger***
  Trigger used to start regular conversion: software or synchronous. This parameter can be a value of *DFSDM_Filter_Trigger*
- ***FunctionalState DFSDM_Filter_RegularParamTypeDef::FastMode***
  Enable/disable fast mode for regular conversion
- ***FunctionalState DFSDM_Filter_RegularParamTypeDef::DmaMode***
  Enable/disable DMA for regular conversion

19.1.8 DFSDM_Filter_InjectedParamTypeDef

DFSDM_Filter_InjectedParamTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t Trigger***
- ***FunctionalState ScanMode***
- ***FunctionalState DmaMode***
- ***uint32_t ExtTrigger***
- ***uint32_t ExtTriggerEdge***

Field Documentation

- ***uint32_t DFSDM_Filter_InjectedParamTypeDef::Trigger***
  Trigger used to start injected conversion: software, external or synchronous. This parameter can be a value of *DFSDM_Filter_Trigger*
- ***FunctionalState DFSDM_Filter_InjectedParamTypeDef::ScanMode***
  Enable/disable scanning mode for injected conversion
- ***FunctionalState DFSDM_Filter_InjectedParamTypeDef::DmaMode***
  Enable/disable DMA for injected conversion
- ***uint32_t DFSDM_Filter_InjectedParamTypeDef::ExtTrigger***
  External trigger. This parameter can be a value of *DFSDM_Filter_ExtTrigger*
- ***uint32_t DFSDM_Filter_InjectedParamTypeDef::ExtTriggerEdge***
  External trigger edge: rising, falling or both. This parameter can be a value of *DFSDM_Filter_ExtTriggerEdge*

19.1.9 DFSDM_Filter_FilterParamTypeDef

DFSDM_Filter_FilterParamTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t SincOrder***
- ***uint32_t Oversampling***
- ***uint32_t IntOversampling***

Field Documentation

- ***uint32_t DFSDM_Filter_FilterParamTypeDef::SincOrder***
  Sinc filter order. This parameter can be a value of ***DFSDM_Filter_SincOrder***
- ***uint32_t DFSDM_Filter_FilterParamTypeDef::Oversampling***
  Filter oversampling ratio. This parameter must be a number between Min_Data = 1 and Max_Data = 1024
- ***uint32_t DFSDM_Filter_FilterParamTypeDef::IntOversampling***
  Integrator oversampling ratio. This parameter must be a number between Min_Data = 1 and Max_Data = 256

19.1.10 DFSDM_Filter_InitTypeDef

DFSDM_Filter_InitTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***DFSDM_Filter_RegularParamTypeDef RegularParam***
- ***DFSDM_Filter_InjectedParamTypeDef InjectedParam***
- ***DFSDM_Filter_FilterParamTypeDef FilterParam***

Field Documentation

- ***DFSDM_Filter_RegularParamTypeDef DFSDM_Filter_InitTypeDef::RegularParam***
  DFSDM regular conversion parameters
- ***DFSDM_Filter_InjectedParamTypeDef DFSDM_Filter_InitTypeDef::InjectedParam***
  DFSDM injected conversion parameters
- ***DFSDM_Filter_FilterParamTypeDef DFSDM_Filter_InitTypeDef::FilterParam***
  DFSDM filter parameters

19.1.11 DFSDM_Filter_HandleTypeDef

DFSDM_Filter_HandleTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***DFSDM_Filter_TypeDef * Instance***
- ***DFSDM_Filter_InitTypeDef Init***
- ***DMA_HandleTypeDef * hdmaReg***
- ***DMA_HandleTypeDef * hdmaInj***
- ***uint32_t RegularContMode***
- ***uint32_t RegularTrigger***
- ***uint32_t InjectedTrigger***
- ***uint32_t ExtTriggerEdge***
- ***FunctionalState InjectedScanMode***
- ***uint32_t InjectedChannelsNbr***
- ***uint32_t InjConvRemaining***
- ***HAL_DFSDM_Filter_StateTypeDef State***
- ***uint32_t ErrorCode***

Field Documentation

- ***DFSDM_Filter_TypeDef* DFSDM_Filter_HandleTypeDef::Instance***
  DFSDM filter instance
- ***DFSDM_Filter_InitTypeDef DFSDM_Filter_HandleTypeDef::Init***
  DFSDM filter init parameters
- ***DMA_HandleTypeDef* DFSDM_Filter_HandleTypeDef::hdmaReg***
  Pointer on DMA handler for regular conversions
- ***DMA_HandleTypeDef* DFSDM_Filter_HandleTypeDef::hdmaInj***
  Pointer on DMA handler for injected conversions
- ***uint32_t DFSDM_Filter_HandleTypeDef::RegularContMode***
  Regular conversion continuous mode

- ***uint32_t DFSDM_Filter_HandleTypeDef::RegularTrigger***
  Trigger used for regular conversion
- ***uint32_t DFSDM_Filter_HandleTypeDef::InjectedTrigger***
  Trigger used for injected conversion
- ***uint32_t DFSDM_Filter_HandleTypeDef::ExtTriggerEdge***
  Rising, falling or both edges selected
- ***FunctionalState DFSDM_Filter_HandleTypeDef::InjectedScanMode***
  Injected scanning mode
- ***uint32_t DFSDM_Filter_HandleTypeDef::InjectedChannelsNbr***
  Number of channels in injected sequence
- ***uint32_t DFSDM_Filter_HandleTypeDef::InjConvRemaining***
  Injected conversions remaining
- ***HAL_DFSDM_Filter_StateTypeDef DFSDM_Filter_HandleTypeDef::State***
  DFSDM filter state
- ***uint32_t DFSDM_Filter_HandleTypeDef::ErrorCode***
  DFSDM filter error code

19.1.12 DFSDM_Filter_AwdParamTypeDef

DFSDM_Filter_AwdParamTypeDef is defined in the stm32l4xx_hal_dfsdm.h

Data Fields

- ***uint32_t DataSource***
- ***uint32_t Channel***
- ***int32_t HighThreshold***
- ***int32_t LowThreshold***
- ***uint32_t HighBreakSignal***
- ***uint32_t LowBreakSignal***

Field Documentation

- ***uint32_t DFSDM_Filter_AwdParamTypeDef::DataSource***
  Values from digital filter or from channel watchdog filter. This parameter can be a value of ***DFSDM_Filter_AwdDataSource***
- ***uint32_t DFSDM_Filter_AwdParamTypeDef::Channel***
  Analog watchdog channel selection. This parameter can be a values combination of ***DFSDM_Channel_Selection***
- ***int32_t DFSDM_Filter_AwdParamTypeDef::HighThreshold***
  High threshold for the analog watchdog. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607
- ***int32_t DFSDM_Filter_AwdParamTypeDef::LowThreshold***
  Low threshold for the analog watchdog. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607
- ***uint32_t DFSDM_Filter_AwdParamTypeDef::HighBreakSignal***
  Break signal assigned to analog watchdog high threshold event. This parameter can be a values combination of ***DFSDM_BreakSignals***
- ***uint32_t DFSDM_Filter_AwdParamTypeDef::LowBreakSignal***
  Break signal assigned to analog watchdog low threshold event. This parameter can be a values combination of ***DFSDM_BreakSignals***

19.2 DFSDM Firmware driver API description

The following section lists the various functions of the DFSDM library.

19.2.1 How to use this driver

Channel initialization

1. User has first to initialize channels (before filters initialization).
2. As prerequisite, fill in the HAL_DFSDM_ChannelMspInit() :
   – Enable DFSDMz clock interface with __HAL_RCC_DFSDMz_CLK_ENABLE().
   – Enable the clocks for the DFSDMz GPIOS with __HAL_RCC_GPIOx_CLK_ENABLE().
   – Configure these DFSDMz pins in alternate mode using HAL_GPIO_Init().
   – If interrupt mode is used, enable and configure DFSDMz_FLT0 global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
3. Configure the output clock, input, serial interface, analog watchdog, offset and data right bit shift parameters for this channel using the HAL_DFSDM_ChannelInit() function.

Channel clock absence detector

1. Start clock absence detector using HAL_DFSDM_ChannelCkabStart() or HAL_DFSDM_ChannelCkabStart_IT().
2. In polling mode, use HAL_DFSDM_ChannelPollForCkab() to detect the clock absence.
3. In interrupt mode, HAL_DFSDM_ChannelCkabCallback() will be called if clock absence is detected.
4. Stop clock absence detector using HAL_DFSDM_ChannelCkabStop() or HAL_DFSDM_ChannelCkabStop_IT().
5. Please note that the same mode (polling or interrupt) has to be used for all channels because the channels are sharing the same interrupt.
6. Please note also that in interrupt mode, if clock absence detector is stopped for one channel, interrupt will be disabled for all channels.

Channel short circuit detector

1. Start short circuit detector using HAL_DFSDM_ChannelScdStart() or or HAL_DFSDM_ChannelScdStart_IT().
2. In polling mode, use HAL_DFSDM_ChannelPollForScd() to detect short circuit.
3. In interrupt mode, HAL_DFSDM_ChannelScdCallback() will be called if short circuit is detected.
4. Stop short circuit detector using HAL_DFSDM_ChannelScdStop() or or HAL_DFSDM_ChannelScdStop_IT().
5. Please note that the same mode (polling or interrupt) has to be used for all channels because the channels are sharing the same interrupt.
6. Please note also that in interrupt mode, if short circuit detector is stopped for one channel, interrupt will be disabled for all channels.

Channel analog watchdog value

1. Get analog watchdog filter value of a channel using HAL_DFSDM_ChannelGetAwdValue().

Channel offset value

1. Modify offset value of a channel using HAL_DFSDM_ChannelModifyOffset().

Filter initialization

1. After channel initialization, user has to init filters.
2. As prerequisite, fill in the HAL_DFSDM_FilterMspInit() :
   – If interrupt mode is used , enable and configure DFSDMz_FLTx global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ(). Please note that DFSDMz_FLT0 global interrupt could be already enabled if interrupt is used for channel.
   – If DMA mode is used, configure DMA with HAL_DMA_Init() and link it with DFSDMz filter handle using __HAL_LINKDMA().
3. Configure the regular conversion, injected conversion and filter parameters for this filter using the HAL_DFSDM_FilterInit() function.

Filter regular channel conversion

1. Select regular channel and enable/disable continuous mode using HAL_DFSDM_FilterConfigRegChannel().
2. Start regular conversion using HAL_DFSDM_FilterRegularStart(), HAL_DFSDM_FilterRegularStart_IT(), HAL_DFSDM_FilterRegularStart_DMA() or HAL_DFSDM_FilterRegularMsbStart_DMA().
3. In polling mode, use HAL_DFSDM_FilterPollForRegConversion() to detect the end of regular conversion.
4. In interrupt mode, HAL_DFSDM_FilterRegConvCpltCallback() will be called at the end of regular conversion.
5. Get value of regular conversion and corresponding channel using HAL_DFSDM_FilterGetRegularValue().
6. In DMA mode, HAL_DFSDM_FilterRegConvHalfCpltCallback() and HAL_DFSDM_FilterRegConvCpltCallback() will be called respectively at the half transfer and at the transfer complete. Please note that HAL_DFSDM_FilterRegConvHalfCpltCallback() will be called only in DMA circular mode.
7. Stop regular conversion using HAL_DFSDM_FilterRegularStop(), HAL_DFSDM_FilterRegularStop_IT() or HAL_DFSDM_FilterRegularStop_DMA().

Filter injected channels conversion

1. Select injected channels using HAL_DFSDM_FilterConfigInjChannel().
2. Start injected conversion using HAL_DFSDM_FilterInjectedStart(), HAL_DFSDM_FilterInjectedStart_IT(), HAL_DFSDM_FilterInjectedStart_DMA() or HAL_DFSDM_FilterInjectedMsbStart_DMA().
3. In polling mode, use HAL_DFSDM_FilterPollForInjConversion() to detect the end of injected conversion.
4. In interrupt mode, HAL_DFSDM_FilterInjConvCpltCallback() will be called at the end of injected conversion.
5. Get value of injected conversion and corresponding channel using HAL_DFSDM_FilterGetInjectedValue().
6. In DMA mode, HAL_DFSDM_FilterInjConvHalfCpltCallback() and HAL_DFSDM_FilterInjConvCpltCallback() will be called respectively at the half transfer and at the transfer complete. Please note that HAL_DFSDM_FilterInjConvCpltCallback() will be called only in DMA circular mode.
7. Stop injected conversion using HAL_DFSDM_FilterInjectedStop(), HAL_DFSDM_FilterInjectedStop_IT() or HAL_DFSDM_FilterInjectedStop_DMA().

Filter analog watchdog

1. Start filter analog watchdog using HAL_DFSDM_FilterAwdStart_IT().
2. HAL_DFSDM_FilterAwdCallback() will be called if analog watchdog occurs.
3. Stop filter analog watchdog using HAL_DFSDM_FilterAwdStop_IT().

Filter extreme detector

1. Start filter extreme detector using HAL_DFSDM_FilterExdStart().
2. Get extreme detector maximum value using HAL_DFSDM_FilterGetExdMaxValue().
3. Get extreme detector minimum value using HAL_DFSDM_FilterGetExdMinValue().
4. Start filter extreme detector using HAL_DFSDM_FilterExdStop().

Filter conversion time

1. Get conversion time value using HAL_DFSDM_FilterGetConvTimeValue().

Callback registration

The compilation define USE_HAL_DFSDM_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use functions HAL_DFSDM_Channel_RegisterCallback(), HAL_DFSDM_Filter_RegisterCallback() or HAL_DFSDM_Filter_RegisterAwdCallback() to register a user callback.

Function HAL_DFSDM_Channel_RegisterCallback() allows to register following callbacks:

- CkabCallback : DFSDM channel clock absence detection callback.
- ScdCallback : DFSDM channel short circuit detection callback.
- MspInitCallback : DFSDM channel MSP init callback.

- MspDeInitCallback : DFSDM channel MSP de-init callback.

This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Function HAL_DFSDM_Filter_RegisterCallback() allows to register following callbacks:

- RegConvCpltCallback : DFSDM filter regular conversion complete callback.
- RegConvHalfCpltCallback : DFSDM filter half regular conversion complete callback.
- InjConvCpltCallback : DFSDM filter injected conversion complete callback.
- InjConvHalfCpltCallback : DFSDM filter half injected conversion complete callback.
- ErrorCallback : DFSDM filter error callback.
- MspInitCallback : DFSDM filter MSP init callback.
- MspDeInitCallback : DFSDM filter MSP de-init callback.

This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

For specific DFSDM filter analog watchdog callback use dedicated register callback: HAL_DFSDM_Filter_RegisterAwdCallback().

Use functions HAL_DFSDM_Channel_UnRegisterCallback() or HAL_DFSDM_Filter_UnRegisterCallback() to reset a callback to the default weak function.

HAL_DFSDM_Channel_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID.

This function allows to reset following callbacks:

- CkabCallback : DFSDM channel clock absence detection callback.
- ScdCallback : DFSDM channel short circuit detection callback.
- MspInitCallback : DFSDM channel MSP init callback.
- MspDeInitCallback : DFSDM channel MSP de-init callback.

HAL_DFSDM_Filter_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID.

This function allows to reset following callbacks:

- RegConvCpltCallback : DFSDM filter regular conversion complete callback.
- RegConvHalfCpltCallback : DFSDM filter half regular conversion complete callback.
- InjConvCpltCallback : DFSDM filter injected conversion complete callback.
- InjConvHalfCpltCallback : DFSDM filter half injected conversion complete callback.
- ErrorCallback : DFSDM filter error callback.
- MspInitCallback : DFSDM filter MSP init callback.
- MspDeInitCallback : DFSDM filter MSP de-init callback.

For specific DFSDM filter analog watchdog callback use dedicated unregister callback: HAL_DFSDM_Filter_UnRegisterAwdCallback().

By default, after the call of init function and if the state is RESET all callbacks are reset to the corresponding legacy weak functions: examples HAL_DFSDM_ChannelScdCallback(), HAL_DFSDM_FilterErrorCallback(). Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak functions in the init and de-init only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the init and de-init keep and use the user MspInit/MspDeInit callbacks (registered beforehand)

Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the init/de-init. In that case first register the MspInit/MspDeInit user callbacks using HAL_DFSDM_Channel_RegisterCallback() or HAL_DFSDM_Filter_RegisterCallback() before calling init or de-init function.

When The compilation define USE_HAL_DFSDM_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak callbacks are used.

19.2.2 Channel initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the DFSDM channel.

- De-initialize the DFSDM channel.

This section contains the following APIs:

- ***HAL_DFSDM_ChannelInit***
- ***HAL_DFSDM_ChannelDeInit***
- ***HAL_DFSDM_ChannelMspInit***
- ***HAL_DFSDM_ChannelMspDeInit***

19.2.3 Channel operation functions

This section provides functions allowing to:

- Manage clock absence detector feature.
- Manage short circuit detector feature.
- Get analog watchdog value.
- Modify offset value.

This section contains the following APIs:

- ***HAL_DFSDM_ChannelCkabStart***
- ***HAL_DFSDM_ChannelPollForCkab***
- ***HAL_DFSDM_ChannelCkabStop***
- ***HAL_DFSDM_ChannelCkabStart_IT***
- ***HAL_DFSDM_ChannelCkabCallback***
- ***HAL_DFSDM_ChannelCkabStop_IT***
- ***HAL_DFSDM_ChannelScdStart***
- ***HAL_DFSDM_ChannelPollForScd***
- ***HAL_DFSDM_ChannelScdStop***
- ***HAL_DFSDM_ChannelScdStart_IT***
- ***HAL_DFSDM_ChannelScdCallback***
- ***HAL_DFSDM_ChannelScdStop_IT***
- ***HAL_DFSDM_ChannelGetAwdValue***
- ***HAL_DFSDM_ChannelModifyOffset***

19.2.4 Channel state function

This section provides function allowing to:

- Get channel handle state.

This section contains the following APIs:

- ***HAL_DFSDM_ChannelGetState***

19.2.5 Filter initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the DFSDM filter.
- De-initialize the DFSDM filter.

This section contains the following APIs:

- ***HAL_DFSDM_FilterInit***
- ***HAL_DFSDM_FilterDeInit***
- ***HAL_DFSDM_FilterMspInit***
- ***HAL_DFSDM_FilterMspDeInit***

19.2.6 Filter control functions

This section provides functions allowing to:

- Select channel and enable/disable continuous mode for regular conversion.

- Select channels for injected conversion.

This section contains the following APIs:

- ***HAL_DFSDM_FilterConfigRegChannel***
- ***HAL_DFSDM_FilterConfigInjChannel***

19.2.7 Filter operation functions

This section provides functions allowing to:

- Start conversion of regular/injected channel.
- Poll for the end of regular/injected conversion.
- Stop conversion of regular/injected channel.
- Start conversion of regular/injected channel and enable interrupt.
- Call the callback functions at the end of regular/injected conversions.
- Stop conversion of regular/injected channel and disable interrupt.
- Start conversion of regular/injected channel and enable DMA transfer.
- Stop conversion of regular/injected channel and disable DMA transfer.
- Start analog watchdog and enable interrupt.
- Call the callback function when analog watchdog occurs.
- Stop analog watchdog and disable interrupt.
- Start extreme detector.
- Stop extreme detector.
- Get result of regular channel conversion.
- Get result of injected channel conversion.
- Get extreme detector maximum and minimum values.
- Get conversion time.
- Handle DFSDM interrupt request.

This section contains the following APIs:

- ***HAL_DFSDM_FilterRegularStart***
- ***HAL_DFSDM_FilterPollForRegConversion***
- ***HAL_DFSDM_FilterRegularStop***
- ***HAL_DFSDM_FilterRegularStart_IT***
- ***HAL_DFSDM_FilterRegularStop_IT***
- ***HAL_DFSDM_FilterRegularStart_DMA***
- ***HAL_DFSDM_FilterRegularMsbStart_DMA***
- ***HAL_DFSDM_FilterRegularStop_DMA***
- ***HAL_DFSDM_FilterGetRegularValue***
- ***HAL_DFSDM_FilterInjectedStart***
- ***HAL_DFSDM_FilterPollForInjConversion***
- ***HAL_DFSDM_FilterInjectedStop***
- ***HAL_DFSDM_FilterInjectedStart_IT***
- ***HAL_DFSDM_FilterInjectedStop_IT***
- ***HAL_DFSDM_FilterInjectedStart_DMA***
- ***HAL_DFSDM_FilterInjectedMsbStart_DMA***
- ***HAL_DFSDM_FilterInjectedStop_DMA***
- ***HAL_DFSDM_FilterGetInjectedValue***
- ***HAL_DFSDM_FilterAwdStart_IT***
- ***HAL_DFSDM_FilterAwdStop_IT***
- ***HAL_DFSDM_FilterExdStart***
- ***HAL_DFSDM_FilterExdStop***

- *HAL_DFSDM_FilterGetExdMaxValue*
- *HAL_DFSDM_FilterGetExdMinValue*
- *HAL_DFSDM_FilterGetConvTimeValue*
- *HAL_DFSDM_IRQHandler*
- *HAL_DFSDM_FilterRegConvCpltCallback*
- *HAL_DFSDM_FilterRegConvHalfCpltCallback*
- *HAL_DFSDM_FilterInjConvCpltCallback*
- *HAL_DFSDM_FilterInjConvHalfCpltCallback*
- *HAL_DFSDM_FilterAwdCallback*
- *HAL_DFSDM_FilterErrorCallback*

19.2.8 Filter state functions

This section provides functions allowing to:

- Get the DFSDM filter state.
- Get the DFSDM filter error.

This section contains the following APIs:

- *HAL_DFSDM_FilterGetState*
- *HAL_DFSDM_FilterGetError*

19.2.9 Detailed description of functions

`HAL_DFSDM_ChannelInit`

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

Initialize the DFSDM channel according to the specified parameters in the DFSDM_ChannelInitTypeDef structure and initialize the associated handle.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status.

`HAL_DFSDM_ChannelDeInit`

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelDeInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

De-initialize the DFSDM channel.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status.

`HAL_DFSDM_ChannelMspInit`

Function name

void HAL_DFSDM_ChannelMspInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

Initialize the DFSDM channel MSP.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **None:**

HAL_DFSDM_ChannelMspDeInit

Function name

void HAL_DFSDM_ChannelMspDeInit (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

De-initialize the DFSDM channel MSP.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **None:**

HAL_DFSDM_ChannelCkabStart

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStart (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to start clock absence detection in polling mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status

Notes

- Same mode has to be used for all channels.
- If clock is not available on this channel during 5 seconds, clock absence detection will not be activated and function will return HAL_TIMEOUT error.

HAL_DFSDM_ChannelCkabStart_IT

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStart_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to start clock absence detection in interrupt mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status

Notes

- Same mode has to be used for all channels.
- If clock is not available on this channel during 5 seconds, clock absence detection will not be activated and function will return HAL_TIMEOUT error.

`HAL_DFSDM_ChannelCkabStop`

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStop (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to stop clock absence detection in polling mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status

`HAL_DFSDM_ChannelCkabStop_IT`

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelCkabStop_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to stop clock absence detection in interrupt mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status

Notes

- Interrupt will be disabled for all channels

`HAL_DFSDM_ChannelScdStart`

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelScdStart (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Threshold, uint32_t BreakSignal)

Function description

This function allows to start short circuit detection in polling mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **Threshold:** Short circuit detector threshold. This parameter must be a number between Min_Data = 0 and Max_Data = 255.
- **BreakSignal:** Break signals assigned to short circuit event. This parameter can be a values combination of DFSDM break signals.

Return values

- **HAL:** status

Notes

- Same mode has to be used for all channels

HAL_DFSDM_ChannelScdStart_IT

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelScdStart_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Threshold, uint32_t BreakSignal)

Function description

This function allows to start short circuit detection in interrupt mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **Threshold:** Short circuit detector threshold. This parameter must be a number between Min_Data = 0 and Max_Data = 255.
- **BreakSignal:** Break signals assigned to short circuit event. This parameter can be a values combination of DFSDM break signals.

Return values

- **HAL:** status

Notes

- Same mode has to be used for all channels

HAL_DFSDM_ChannelScdStop

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelScdStop (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to stop short circuit detection in polling mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status

HAL_DFSDM_ChannelScdStop_IT

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelScdStop_IT (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to stop short circuit detection in interrupt mode.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **HAL:** status

Notes

- Interrupt will be disabled for all channels

HAL_DFSDM_ChannelGetAwdValue

Function name

int16_t HAL_DFSDM_ChannelGetAwdValue (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to get channel analog watchdog value.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **Channel:** analog watchdog value.

HAL_DFSDM_ChannelModifyOffset

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelModifyOffset (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, int32_t Offset)

Function description

This function allows to modify channel offset value.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **Offset:** DFSDM channel offset. This parameter must be a number between Min_Data = -8388608 and Max_Data = 8388607.

Return values

- **HAL:** status.

HAL_DFSDM_ChannelPollForCkab

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelPollForCkab (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Timeout)

Function description

This function allows to poll for the clock absence detection.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **Timeout:** Timeout value in milliseconds.

Return values

- **HAL:** status

HAL_DFSDM_ChannelPollForScd

Function name

HAL_StatusTypeDef HAL_DFSDM_ChannelPollForScd (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t Timeout)

Function description

This function allows to poll for the short circuit detection.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **Timeout:** Timeout value in milliseconds.

Return values

- **HAL:** status

`HAL_DFSDM_ChannelCkabCallback`

Function name

void HAL_DFSDM_ChannelCkabCallback (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

Clock absence detection callback.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **None:**

`HAL_DFSDM_ChannelScdCallback`

Function name

void HAL_DFSDM_ChannelScdCallback (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

Short circuit detection callback.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **None:**

`HAL_DFSDM_ChannelGetState`

Function name

HAL_DFSDM_Channel_StateTypeDef HAL_DFSDM_ChannelGetState (DFSDM_Channel_HandleTypeDef * hdfsdm_channel)

Function description

This function allows to get the current DFSDM channel handle state.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.

Return values

- **DFSDM:** channel state.

`HAL_DFSDM_FilterInit`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Initialize the DFSDM filter according to the specified parameters in the DFSDM_FilterInitTypeDef structure and initialize the associated handle.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status.

HAL_DFSDM_FilterDeInit

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterDeInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

De-initializes the DFSDM filter.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status.

HAL_DFSDM_FilterMspInit

Function name

void HAL_DFSDM_FilterMspInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Initializes the DFSDM filter MSP.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

HAL_DFSDM_FilterMspDeInit

Function name

void HAL_DFSDM_FilterMspDeInit (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

De-initializes the DFSDM filter MSP.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

HAL_DFSDM_FilterConfigRegChannel

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterConfigRegChannel (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel, uint32_t ContinuousMode)

Function description

This function allows to select channel and to enable/disable continuous mode for regular conversion.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Channel for regular conversion. This parameter can be a value of DFSDM Channel Selection.
- **ContinuousMode:** Enable/disable continuous mode for regular conversion. This parameter can be a value of DFSDM Continuous Mode.

Return values

- **HAL:** status

`HAL_DFSDM_FilterConfigInjChannel`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterConfigInjChannel (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel)

Function description

This function allows to select channels for injected conversion.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Channels for injected conversion. This parameter can be a values combination of DFSDM Channel Selection.

Return values

- **HAL:** status

`HAL_DFSDM_FilterRegularStart`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularStart (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to start regular conversion in polling mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing.

`HAL_DFSDM_FilterRegularStart_IT`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularStart_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to start regular conversion in interrupt mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing.

HAL_DFSDM_FilterRegularStart_DMA

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int32_t * pData, uint32_t Length)

Function description

This function allows to start regular conversion in DMA mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **pData:** The destination buffer address.
- **Length:** The length of data to be transferred from DFSDM filter to memory.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing. Please note that data on buffer will contain signed regular conversion value on 24 most significant bits and corresponding channel on 3 least significant bits.

HAL_DFSDM_FilterRegularMsbStart_DMA

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularMsbStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int16_t * pData, uint32_t Length)

Function description

This function allows to start regular conversion in DMA mode and to get only the 16 most significant bits of conversion.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **pData:** The destination buffer address.
- **Length:** The length of data to be transferred from DFSDM filter to memory.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if injected conversion is ongoing. Please note that data on buffer will contain signed 16 most significant bits of regular conversion.

HAL_DFSDM_FilterRegularStop

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularStop (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop regular conversion in polling mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterRegularStop_IT

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularStop_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop regular conversion in interrupt mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterRegularStop_DMA

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterRegularStop_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop regular conversion in DMA mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only if regular conversion is ongoing.

HAL_DFSDM_FilterInjectedStart

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStart (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to start injected conversion in polling mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing.

`HAL_DFSDM_FilterInjectedStart_IT`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStart_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to start injected conversion in interrupt mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing.

`HAL_DFSDM_FilterInjectedStart_DMA`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int32_t * pData, uint32_t Length)

Function description

This function allows to start injected conversion in DMA mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **pData:** The destination buffer address.
- **Length:** The length of data to be transferred from DFSDM filter to memory.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing. Please note that data on buffer will contain signed injected conversion value on 24 most significant bits and corresponding channel on 3 least significant bits.

`HAL_DFSDM_FilterInjectedMsbStart_DMA`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedMsbStart_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, int16_t * pData, uint32_t Length)

Function description

This function allows to start injected conversion in DMA mode and to get only the 16 most significant bits of conversion.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **pData:** The destination buffer address.
- **Length:** The length of data to be transferred from DFSDM filter to memory.

Return values

- **HAL:** status

Notes

- This function should be called only when DFSDM filter instance is in idle state or if regular conversion is ongoing. Please note that data on buffer will contain signed 16 most significant bits of injected conversion.

`HAL_DFSDM_FilterInjectedStop`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStop (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop injected conversion in polling mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only if injected conversion is ongoing.

`HAL_DFSDM_FilterInjectedStop_IT`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStop_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop injected conversion in interrupt mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only if injected conversion is ongoing.

`HAL_DFSDM_FilterInjectedStop_DMA`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterInjectedStop_DMA (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop injected conversion in DMA mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

Notes

- This function should be called only if injected conversion is ongoing.

`HAL_DFSDM_FilterAwdStart_IT`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterAwdStart_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, DFSDM_Filter_AwdParamTypeDef * awdParam)

Function description

This function allows to start filter analog watchdog in interrupt mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **awdParam:** DFSDM filter analog watchdog parameters.

Return values

- **HAL:** status

`HAL_DFSDM_FilterAwdStop_IT`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterAwdStop_IT (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop filter analog watchdog in interrupt mode.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

`HAL_DFSDM_FilterExdStart`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterExdStart (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel)

Function description

This function allows to start extreme detector feature.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Channels where extreme detector is enabled. This parameter can be a values combination of DFSDM Channel Selection.

Return values

- **HAL:** status

`HAL_DFSDM_FilterExdStop`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterExdStop (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to stop extreme detector feature.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **HAL:** status

HAL_DFSDM_FilterGetRegularValue

Function name

int32_t HAL_DFSDM_FilterGetRegularValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)

Function description

This function allows to get regular conversion value.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Corresponding channel of regular conversion.

Return values

- **Regular:** conversion value

HAL_DFSDM_FilterGetInjectedValue

Function name

int32_t HAL_DFSDM_FilterGetInjectedValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)

Function description

This function allows to get injected conversion value.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Corresponding channel of injected conversion.

Return values

- **Injected:** conversion value

HAL_DFSDM_FilterGetExdMaxValue

Function name

int32_t HAL_DFSDM_FilterGetExdMaxValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)

Function description

This function allows to get extreme detector maximum value.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Corresponding channel.

Return values

- **Extreme:** detector maximum value This value is between Min_Data = -8388608 and Max_Data = 8388607.

HAL_DFSDM_FilterGetExdMinValue

Function name

int32_t HAL_DFSDM_FilterGetExdMinValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t * Channel)

Function description

This function allows to get extreme detector minimum value.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Corresponding channel.

Return values

- **Extreme:** detector minimum value This value is between Min_Data = -8388608 and Max_Data = 8388607.

HAL_DFSDM_FilterGetConvTimeValue

Function name

uint32_t HAL_DFSDM_FilterGetConvTimeValue (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to get conversion time value.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **Conversion:** time value

Notes

- To get time in second, this value has to be divided by DFSDM clock frequency.

HAL_DFSDM_IRQHandler

Function name

void HAL_DFSDM_IRQHandler (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function handles the DFSDM interrupts.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

HAL_DFSDM_FilterPollForRegConversion

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterPollForRegConversion (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Timeout)

Function description

This function allows to poll for the end of regular conversion.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Timeout:** Timeout value in milliseconds.

Return values

- **HAL:** status

Notes

- This function should be called only if regular conversion is ongoing.

`HAL_DFSDM_FilterPollForInjConversion`

Function name

HAL_StatusTypeDef HAL_DFSDM_FilterPollForInjConversion (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Timeout)

Function description

This function allows to poll for the end of injected conversion.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Timeout:** Timeout value in milliseconds.

Return values

- **HAL:** status

Notes

- This function should be called only if injected conversion is ongoing.

`HAL_DFSDM_FilterRegConvCpltCallback`

Function name

void HAL_DFSDM_FilterRegConvCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Regular conversion complete callback.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

Notes

- In interrupt mode, user has to read conversion value in this function using HAL_DFSDM_FilterGetRegularValue.

`HAL_DFSDM_FilterRegConvHalfCpltCallback`

Function name

void HAL_DFSDM_FilterRegConvHalfCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Half regular conversion complete callback.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

`HAL_DFSDM_FilterInjConvCpltCallback`

Function name

void HAL_DFSDM_FilterInjConvCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Injected conversion complete callback.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

Notes

- In interrupt mode, user has to read conversion value in this function using HAL_DFSDM_FilterGetInjectedValue.

`HAL_DFSDM_FilterInjConvHalfCpltCallback`

Function name

void HAL_DFSDM_FilterInjConvHalfCpltCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Half injected conversion complete callback.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

`HAL_DFSDM_FilterAwdCallback`

Function name

void HAL_DFSDM_FilterAwdCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter, uint32_t Channel, uint32_t Threshold)

Function description

Filter analog watchdog callback.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.
- **Channel:** Corresponding channel.
- **Threshold:** Low or high threshold has been reached.

Return values

- **None:**

`HAL_DFSDM_FilterErrorCallback`

Function name

void HAL_DFSDM_FilterErrorCallback (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

Error callback.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **None:**

`HAL_DFSDM_FilterGetState`

Function name

HAL_DFSDM_Filter_StateTypeDef HAL_DFSDM_FilterGetState (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to get the current DFSDM filter handle state.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **DFSDM:** filter state.

`HAL_DFSDM_FilterGetError`

Function name

uint32_t HAL_DFSDM_FilterGetError (DFSDM_Filter_HandleTypeDef * hdfsdm_filter)

Function description

This function allows to get the current DFSDM filter error.

Parameters

- **hdfsdm_filter:** DFSDM filter handle.

Return values

- **DFSDM:** filter error code.

19.3 DFSDM Firmware driver defines

The following section lists the various define and macros of the module.

19.3.1 DFSDM

DFSDM

DFSDM analog watchdog threshold

DFSDM_AWD_HIGH_THRESHOLD

Analog watchdog high threshold

DFSDM_AWD_LOW_THRESHOLD

Analog watchdog low threshold

DFSDM break signals

DFSDM_NO_BREAK_SIGNAL

No break signal

DFSDM_BREAK_SIGNAL_0

Break signal 0

DFSDM_BREAK_SIGNAL_1

Break signal 1

DFSDM_BREAK_SIGNAL_2

Break signal 2

DFSDM_BREAK_SIGNAL_3

Break signal 3

DFSDM channel analog watchdog filter order

DFSDM_CHANNEL_FASTSINC_ORDER

FastSinc filter type

DFSDM_CHANNEL_SINC1_ORDER

Sinc 1 filter type

DFSDM_CHANNEL_SINC2_ORDER

Sinc 2 filter type

DFSDM_CHANNEL_SINC3_ORDER

Sinc 3 filter type

DFSDM channel input data packing

DFSDM_CHANNEL_STANDARD_MODE

Standard data packing mode

DFSDM_CHANNEL_INTERLEAVED_MODE

Interleaved data packing mode

DFSDM_CHANNEL_DUAL_MODE

Dual data packing mode

DFSDM channel input multiplexer

DFSDM_CHANNEL_EXTERNAL_INPUTS

Data are taken from external inputs

DFSDM_CHANNEL_ADC_OUTPUT

Data are taken from ADC output

DFSDM_CHANNEL_INTERNAL_REGISTER

Data are taken from internal register

DFSDM channel input pins

DFSDM_CHANNEL_SAME_CHANNEL_PINS

Input from pins on same channel

DFSDM_CHANNEL_FOLLOWING_CHANNEL_PINS

Input from pins on following channel

DFSDM channel output clock selection

DFSDM_CHANNEL_OUTPUT_CLOCK_SYSTEM

Source for ouput clock is system clock

DFSDM_CHANNEL_OUTPUT_CLOCK_AUDIO

Source for ouput clock is audio clock

DFSDM Channel Selection

DFSDM_CHANNEL_0

DFSDM_CHANNEL_1

DFSDM_CHANNEL_2

DFSDM_CHANNEL_3

DFSDM_CHANNEL_4

DFSDM_CHANNEL_5

DFSDM_CHANNEL_6

DFSDM_CHANNEL_7

DFSDM channel serial interface type

DFSDM_CHANNEL_SPI_RISING

SPI with rising edge

DFSDM_CHANNEL_SPI_FALLING

SPI with falling edge

DFSDM_CHANNEL_MANCHESTER_RISING

Manchester with rising edge

DFSDM_CHANNEL_MANCHESTER_FALLING

Manchester with falling edge

DFSDM channel SPI clock selection

DFSDM_CHANNEL_SPI_CLOCK_EXTERNAL

External SPI clock

DFSDM_CHANNEL_SPI_CLOCK_INTERNAL

Internal SPI clock

DFSDM_CHANNEL_SPI_CLOCK_INTERNAL_DIV2_FALLING

Internal SPI clock divided by 2, falling edge

DFSDM_CHANNEL_SPI_CLOCK_INTERNAL_DIV2_RISING

Internal SPI clock divided by 2, rising edge

DFSDM Continuous Mode

DFSDM_CONTINUOUS_CONV_OFF

Conversion are not continuous

DFSDM_CONTINUOUS_CONV_ON

Conversion are continuous

DFSDM Exported Macros

__HAL_DFSDM_CHANNEL_RESET_HANDLE_STATE

Description:

- Reset DFSDM channel handle state.

Parameters:

- __HANDLE__: DFSDM channel handle.

Return value:

- None

__HAL_DFSDM_FILTER_RESET_HANDLE_STATE

Description:

- Reset DFSDM filter handle state.

Parameters:

- __HANDLE__: DFSDM filter handle.

Return value:

- None

DFSDM filter analog watchdog data source

DFSDM_FILTER_AWD_FILTER_DATA

From digital filter

DFSDM_FILTER_AWD_CHANNEL_DATA

From analog watchdog channel

DFSDM filter error code

DFSDM_FILTER_ERROR_NONE

No error

DFSDM_FILTER_ERROR_REGULAR_OVERRUN

Overrun occurs during regular conversion

DFSDM_FILTER_ERROR_INJECTED_OVERRUN

Overrun occurs during injected conversion

DFSDM_FILTER_ERROR_DMA

DMA error occurs

DFSDM filter external trigger

DFSDM_FILTER_EXT_TRIG_TIM1_TRGO

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM1_TRGO2

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM8_TRGO

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM8_TRGO2

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM3_TRGO

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM4_TRGO

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM16_OC1

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM6_TRGO

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_TIM7_TRGO

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_EXTI11

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_EXTI15

For all DFSDM filters

DFSDM_FILTER_EXT_TRIG_LPTIM1_OUT

For all DFSDM filters

DFSDM filter external trigger edge

DFSDM_FILTER_EXT_TRIG_RISING_EDGE

External rising edge

DFSDM_FILTER_EXT_TRIG_FALLING_EDGE

External falling edge

DFSDM_FILTER_EXT_TRIG_BOTH_EDGES

External rising and falling edges

DFSDM filter sinc order

DFSDM_FILTER_FASTSINC_ORDER

FastSinc filter type

DFSDM_FILTER_SINC1_ORDER

Sinc 1 filter type

DFSDM_FILTER_SINC2_ORDER

Sinc 2 filter type

DFSDM_FILTER_SINC3_ORDER

Sinc 3 filter type

DFSDM_FILTER_SINC4_ORDER

Sinc 4 filter type

DFSDM_FILTER_SINC5_ORDER

Sinc 5 filter type

DFSDM filter conversion trigger

DFSDM_FILTER_SW_TRIGGER

Software trigger

DFSDM_FILTER_SYNC_TRIGGER

Synchronous with DFSDM_FLT0

DFSDM_FILTER_EXT_TRIGGER

External trigger (only for injected conversion)

20 HAL DFSDM Extension Driver

20.1 DFSDMEx Firmware driver API description

The following section lists the various functions of the DFSDMEx library.

20.1.1 Extended channel operation functions

This section provides functions allowing to:

- Set and get value of pulses skipping on channel

This section contains the following APIs:

- ***HAL_DFDSMEx_ChannelSetPulsesSkipping***
- ***HAL_DFDSMEx_ChannelGetPulsesSkipping***

20.1.2 Detailed description of functions

`HAL_DFDSMEx_ChannelSetPulsesSkipping`

Function name

HAL_StatusTypeDef HAL_DFDSMEx_ChannelSetPulsesSkipping (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t PulsesValue)

Function description

Set value of pulses skipping.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **PulsesValue:** Value of pulses to be skipped. This parameter must be a number between Min_Data = 0 and Max_Data = 63.

Return values

- **HAL:** status.

`HAL_DFDSMEx_ChannelGetPulsesSkipping`

Function name

HAL_StatusTypeDef HAL_DFDSMEx_ChannelGetPulsesSkipping (DFSDM_Channel_HandleTypeDef * hdfsdm_channel, uint32_t * PulsesValue)

Function description

Get value of pulses skipping.

Parameters

- **hdfsdm_channel:** DFSDM channel handle.
- **PulsesValue:** Value of pulses to be skipped.

Return values

- **HAL:** status.

21 HAL DMA2D Generic Driver

21.1 DMA2D Firmware driver registers structures

21.1.1 DMA2D_CLUTCfgTypeDef

DMA2D_CLUTCfgTypeDef is defined in the stm32l4xx_hal_dma2d.h

Data Fields

- ***uint32_t * pCLUT***
- ***uint32_t CLUTColorMode***
- ***uint32_t Size***

Field Documentation

- ***uint32_t* DMA2D_CLUTCfgTypeDef::pCLUT***
  Configures the DMA2D CLUT memory address.
- ***uint32_t DMA2D_CLUTCfgTypeDef::CLUTColorMode***
  Configures the DMA2D CLUT color mode. This parameter can be one value of ***DMA2D_CLUT_CM***.
- ***uint32_t DMA2D_CLUTCfgTypeDef::Size***
  Configures the DMA2D CLUT size. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

21.1.2 DMA2D_InitTypeDef

DMA2D_InitTypeDef is defined in the stm32l4xx_hal_dma2d.h

Data Fields

- ***uint32_t Mode***
- ***uint32_t ColorMode***
- ***uint32_t OutputOffset***
- ***uint32_t AlphaInverted***
- ***uint32_t RedBlueSwap***
- ***uint32_t BytesSwap***
- ***uint32_t LineOffsetMode***

Field Documentation

- ***uint32_t DMA2D_InitTypeDef::Mode***
  Configures the DMA2D transfer mode. This parameter can be one value of ***DMA2D_Mode***.
- ***uint32_t DMA2D_InitTypeDef::ColorMode***
  Configures the color format of the output image. This parameter can be one value of ***DMA2D_Output_Color_Mode***.
- ***uint32_t DMA2D_InitTypeDef::OutputOffset***
  Specifies the Offset value. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF.
- ***uint32_t DMA2D_InitTypeDef::AlphaInverted***
  Select regular or inverted alpha value for the output pixel format converter. This parameter can be one value of ***DMA2D_Alpha_Inverted***.
- ***uint32_t DMA2D_InitTypeDef::RedBlueSwap***
  Select regular mode (RGB or ARGB) or swap mode (BGR or ABGR) for the output pixel format converter. This parameter can be one value of ***DMA2D_RB_Swap***.
- ***uint32_t DMA2D_InitTypeDef::BytesSwap***
  Select byte regular mode or bytes swap mode (two by two). This parameter can be one value of ***DMA2D_Bytes_Swap***.

- ***uint32_t DMA2D_InitTypeDef::LineOffsetMode***

  Configures how is expressed the line offset for the foreground, background and output. This parameter can be one value of ***DMA2D_Line_Offset_Mode***.

21.1.3 DMA2D_LayerCfgTypeDef

DMA2D_LayerCfgTypeDef is defined in the stm32l4xx_hal_dma2d.h

Data Fields

- ***uint32_t InputOffset***
- ***uint32_t InputColorMode***
- ***uint32_t AlphaMode***
- ***uint32_t InputAlpha***
- ***uint32_t AlphaInverted***
- ***uint32_t RedBlueSwap***

Field Documentation

- ***uint32_t DMA2D_LayerCfgTypeDef::InputOffset***

  Configures the DMA2D foreground or background offset. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF.
- ***uint32_t DMA2D_LayerCfgTypeDef::InputColorMode***

  Configures the DMA2D foreground or background color mode. This parameter can be one value of ***DMA2D_Input_Color_Mode***.
- ***uint32_t DMA2D_LayerCfgTypeDef::AlphaMode***

  Configures the DMA2D foreground or background alpha mode. This parameter can be one value of ***DMA2D_Alpha_Mode***.
- ***uint32_t DMA2D_LayerCfgTypeDef::InputAlpha***

  Specifies the DMA2D foreground or background alpha value and color value in case of A8 or A4 color mode. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF except for the color modes detailed below.

  Note:

  – In case of A8 or A4 color mode (ARGB), this parameter must be a number between Min_Data = 0x00000000 and Max_Data = 0xFFFFFFFF where
    - InputAlpha[24:31] is the alpha value ALPHA[0:7]
    - InputAlpha[16:23] is the red value RED[0:7]
    - InputAlpha[8:15] is the green value GREEN[0:7]
    - InputAlpha[0:7] is the blue value BLUE[0:7].
- ***uint32_t DMA2D_LayerCfgTypeDef::AlphaInverted***

  Select regular or inverted alpha value. This parameter can be one value of ***DMA2D_Alpha_Inverted***.
- ***uint32_t DMA2D_LayerCfgTypeDef::RedBlueSwap***

  Select regular mode (RGB or ARGB) or swap mode (BGR or ABGR). This parameter can be one value of ***DMA2D_RB_Swap***.

21.1.4 __DMA2D_HandleTypeDef

__DMA2D_HandleTypeDef is defined in the stm32l4xx_hal_dma2d.h

Data Fields

- ***DMA2D_TypeDef * Instance***
- ***DMA2D_InitTypeDef Init***
- ***void(* XferCpltCallback***
- ***void(* XferErrorCallback***
- ***DMA2D_LayerCfgTypeDef LayerCfg***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_DMA2D_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***DMA2D_TypeDef* __DMA2D_HandleTypeDef::Instance***
  DMA2D register base address.
- ***DMA2D_InitTypeDef __DMA2D_HandleTypeDef::Init***
  DMA2D communication parameters.
- ***void(* __DMA2D_HandleTypeDef::XferCpltCallback)(struct __DMA2D_HandleTypeDef *hdma2d)***
  DMA2D transfer complete callback.
- ***void(* __DMA2D_HandleTypeDef::XferErrorCallback)(struct __DMA2D_HandleTypeDef *hdma2d)***
  DMA2D transfer error callback.
- ***DMA2D_LayerCfgTypeDef __DMA2D_HandleTypeDef::LayerCfg[MAX_DMA2D_LAYER]***
  DMA2D Layers parameters
- ***HAL_LockTypeDef __DMA2D_HandleTypeDef::Lock***
  DMA2D lock.
- ***__IO HAL_DMA2D_StateTypeDef __DMA2D_HandleTypeDef::State***
  DMA2D transfer state.
- ***__IO uint32_t __DMA2D_HandleTypeDef::ErrorCode***
  DMA2D error code.

21.2 DMA2D Firmware driver API description

The following section lists the various functions of the DMA2D library.

21.2.1 How to use this driver

1. Program the required configuration through the following parameters: the transfer mode, the output color mode and the output offset using HAL_DMA2D_Init() function.
2. Program the required configuration through the following parameters: the input color mode, the input color, the input alpha value, the alpha mode, the red/blue swap mode, the inverted alpha mode and the input offset using HAL_DMA2D_ConfigLayer() function for foreground or/and background layer.

Polling mode IO operation

1. Configure pdata parameter (explained hereafter), destination and data length and enable the transfer using HAL_DMA2D_Start().
2. Wait for end of transfer using HAL_DMA2D_PollForTransfer(), at this stage user can specify the value of timeout according to his end application.

Interrupt mode IO operation

1. Configure pdata parameter, destination and data length and enable the transfer using HAL_DMA2D_Start_IT().
2. Use HAL_DMA2D_IRQHandler() called under DMA2D_IRQHandler() interrupt subroutine.
3. At the end of data transfer HAL_DMA2D_IRQHandler() function is executed and user can add his own function by customization of function pointer XferCpltCallback (member of DMA2D handle structure).
4. In case of error, the HAL_DMA2D_IRQHandler() function calls the callback XferErrorCallback.

Note: In Register-to-Memory transfer mode, pdata parameter is the register color, in Memory-to-memory or Memory-to-Memory with pixel format conversion pdata is the source address.

Note: Configure the foreground source address, the background source address, the destination and data length then Enable the transfer using HAL_DMA2D_BlendingStart() in polling mode and HAL_DMA2D_BlendingStart_IT() in interrupt mode.

Note: HAL_DMA2D_BlendingStart() and HAL_DMA2D_BlendingStart_IT() functions are used if the memory to memory with blending transfer mode is selected.

5. Optionally, configure and enable the CLUT using HAL_DMA2D_CLUTLoad() in polling mode or HAL_DMA2D_CLUTLoad_IT() in interrupt mode.
6. Optionally, configure the line watermark in using the API HAL_DMA2D_ProgramLineEvent().

7. Optionally, configure the dead time value in the AHB clock cycle inserted between two consecutive accesses on the AHB master port in using the API HAL_DMA2D_ConfigDeadTime() and enable/disable the functionality with the APIs HAL_DMA2D_EnableDeadTime() or HAL_DMA2D_DisableDeadTime().
8. The transfer can be suspended, resumed and aborted using the following functions: HAL_DMA2D_Suspend(), HAL_DMA2D_Resume(), HAL_DMA2D_Abort().
9. The CLUT loading can be suspended, resumed and aborted using the following functions: HAL_DMA2D_CLUTLoading_Suspend(), HAL_DMA2D_CLUTLoading_Resume(), HAL_DMA2D_CLUTLoading_Abort().
10. To control the DMA2D state, use the following function: HAL_DMA2D_GetState().
11. To read the DMA2D error code, use the following function: HAL_DMA2D_GetError().

DMA2D HAL driver macros list

Below the list of most used macros in DMA2D HAL driver :

- __HAL_DMA2D_ENABLE: Enable the DMA2D peripheral.
- __HAL_DMA2D_GET_FLAG: Get the DMA2D pending flags.
- __HAL_DMA2D_CLEAR_FLAG: Clear the DMA2D pending flags.
- __HAL_DMA2D_ENABLE_IT: Enable the specified DMA2D interrupts.
- __HAL_DMA2D_DISABLE_IT: Disable the specified DMA2D interrupts.
- __HAL_DMA2D_GET_IT_SOURCE: Check whether the specified DMA2D interrupt is enabled or not.

Callback registration

1. The compilation define USE_HAL_DMA2D_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use function @ref HAL_DMA2D_RegisterCallback() to register a user callback.
2. Function @ref HAL_DMA2D_RegisterCallback() allows to register following callbacks: (+) XferCpltCallback : callback for transfer complete. (+) XferErrorCallback : callback for transfer error. (+) LineEventCallback : callback for line event. (+) CLUTLoadingCpltCallback : callback for CLUT loading completion. (+) MspInitCallback : DMA2D MspInit. (+) MspDeInitCallback : DMA2D MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.
3. Use function @ref HAL_DMA2D_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_DMA2D_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks: (+) XferCpltCallback : callback for transfer complete. (+) XferErrorCallback : callback for transfer error. (+) LineEventCallback : callback for line event. (+) CLUTLoadingCpltCallback : callback for CLUT loading completion. (+) MspInitCallback : DMA2D MspInit. (+) MspDeInitCallback : DMA2D MspDeInit.
4. By default, after the @ref HAL_DMA2D_Init and if the state is HAL_DMA2D_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions: examples @ref HAL_DMA2D_LineEventCallback(), @ref HAL_DMA2D_CLUTLoadingCpltCallback() Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_DMA2D_Init and @ref HAL_DMA2D_DeInit only when these callbacks are null (not registered beforehand) If not, MspInit or MspDeInit are not null, the @ref HAL_DMA2D_Init and @ref HAL_DMA2D_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand). Exception as well for Transfer Completion and Transfer Error callbacks that are not defined as weak (surcharged) functions. They must be defined by the user to be resorted to. Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_DMA2D_RegisterCallback before calling @ref HAL_DMA2D_DeInit or @ref HAL_DMA2D_Init function. When The compilation define USE_HAL_DMA2D_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

(#) The compilation define USE_HAL_DMA2D_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use function @ref HAL_DMA2D_RegisterCallback() to register a user callback. (#) Function @ref HAL_DMA2D_RegisterCallback() allows to register following callbacks:

- XferCpltCallback : callback for transfer complete.
- XferErrorCallback : callback for transfer error.

- LineEventCallback : callback for line event.
- CLUTLoadingCpltCallback : callback for CLUT loading completion.
- MspInitCallback : DMA2D MspInit.
- MspDeInitCallback : DMA2D MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. (#) Use function @ref HAL_DMA2D_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_DMA2D_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:
- XferCpltCallback : callback for transfer complete.
- XferErrorCallback : callback for transfer error.
- LineEventCallback : callback for line event.
- CLUTLoadingCpltCallback : callback for CLUT loading completion.
- MspInitCallback : DMA2D MspInit.
- MspDeInitCallback : DMA2D MspDeInit. (#) By default, after the @ref HAL_DMA2D_Init and if the state is HAL_DMA2D_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions: examples @ref HAL_DMA2D_LineEventCallback(), @ref HAL_DMA2D_CLUTLoadingCpltCallback() Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_DMA2D_Init and @ref HAL_DMA2D_DeInit only when these callbacks are null (not registered beforehand) If not, MspInit or MspDeInit are not null, the @ref HAL_DMA2D_Init and @ref HAL_DMA2D_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand). Exception as well for Transfer Completion and Transfer Error callbacks that are not defined as weak (surcharged) functions. They must be defined by the user to be resorted to. Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_DMA2D_RegisterCallback before calling @ref HAL_DMA2D_DeInit or @ref HAL_DMA2D_Init function. When The compilation define USE_HAL_DMA2D_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

Note: You can refer to the DMA2D HAL driver header file for more useful macros

21.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the DMA2D
- De-initialize the DMA2D

This section contains the following APIs:

- ***HAL_DMA2D_Init***
- ***HAL_DMA2D_DeInit***
- ***HAL_DMA2D_MspInit***
- ***HAL_DMA2D_MspDeInit***

21.2.3 IO operation functions

This section provides functions allowing to:

- Configure the pdata, destination address and data size then start the DMA2D transfer.
- Configure the source for foreground and background, destination address and data size then start a MultiBuffer DMA2D transfer.
- Configure the pdata, destination address and data size then start the DMA2D transfer with interrupt.
- Configure the source for foreground and background, destination address and data size then start a MultiBuffer DMA2D transfer with interrupt.
- Abort DMA2D transfer.
- Suspend DMA2D transfer.
- Resume DMA2D transfer.
- Enable CLUT transfer.

- Configure CLUT loading then start transfer in polling mode.
- Configure CLUT loading then start transfer in interrupt mode.
- Abort DMA2D CLUT loading.
- Suspend DMA2D CLUT loading.
- Resume DMA2D CLUT loading.
- Poll for transfer complete.
- handle DMA2D interrupt request.
- Transfer watermark callback.
- CLUT Transfer Complete callback.

This section contains the following APIs:

- ***HAL_DMA2D_Start***
- ***HAL_DMA2D_Start_IT***
- ***HAL_DMA2D_BlendingStart***
- ***HAL_DMA2D_BlendingStart_IT***
- ***HAL_DMA2D_Abort***
- ***HAL_DMA2D_Suspend***
- ***HAL_DMA2D_Resume***
- ***HAL_DMA2D_EnableCLUT***
- ***HAL_DMA2D_CLUTStartLoad***
- ***HAL_DMA2D_CLUTStartLoad_IT***
- ***HAL_DMA2D_CLUTLoad***
- ***HAL_DMA2D_CLUTLoad_IT***
- ***HAL_DMA2D_CLUTLoading_Abort***
- ***HAL_DMA2D_CLUTLoading_Suspend***
- ***HAL_DMA2D_CLUTLoading_Resume***
- ***HAL_DMA2D_PollForTransfer***
- ***HAL_DMA2D_IRQHandler***
- ***HAL_DMA2D_LineEventCallback***
- ***HAL_DMA2D_CLUTLoadingCpltCallback***

21.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the DMA2D foreground or background layer parameters.
- Configure the DMA2D CLUT transfer.
- Configure the line watermark
- Configure the dead time value.
- Enable or disable the dead time value functionality.

This section contains the following APIs:

- ***HAL_DMA2D_ConfigLayer***
- ***HAL_DMA2D_ConfigCLUT***
- ***HAL_DMA2D_ProgramLineEvent***
- ***HAL_DMA2D_EnableDeadTime***
- ***HAL_DMA2D_DisableDeadTime***
- ***HAL_DMA2D_ConfigDeadTime***

21.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to:

- Get the DMA2D state

- Get the DMA2D error code

This section contains the following APIs:

- ***HAL_DMA2D_GetState***
- ***HAL_DMA2D_GetError***

21.2.6 Detailed description of functions

`HAL_DMA2D_Init`

Function name

HAL_StatusTypeDef HAL_DMA2D_Init (DMA2D_HandleTypeDef * hdma2d)

Function description

Initialize the DMA2D according to the specified parameters in the DMA2D_InitTypeDef and create the associated handle.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** status

`HAL_DMA2D_DeInit`

Function name

HAL_StatusTypeDef HAL_DMA2D_DeInit (DMA2D_HandleTypeDef * hdma2d)

Function description

Deinitializes the DMA2D peripheral registers to their default reset values.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **None:**

`HAL_DMA2D_MspInit`

Function name

void HAL_DMA2D_MspInit (DMA2D_HandleTypeDef * hdma2d)

Function description

Initializes the DMA2D MSP.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **None:**

`HAL_DMA2D_MspDeInit`

Function name

void HAL_DMA2D_MspDeInit (DMA2D_HandleTypeDef * hdma2d)

Function description

DeInitializes the DMA2D MSP.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **None:**

`HAL_DMA2D_Start`

Function name

HAL_StatusTypeDef HAL_DMA2D_Start (DMA2D_HandleTypeDef * hdma2d, uint32_t pdata, uint32_t DstAddress, uint32_t Width, uint32_t Height)

Function description

Start the DMA2D Transfer.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **pdata:** Configure the source memory Buffer address if Memory-to-Memory or Memory-to-Memory with pixel format conversion mode is selected, or configure the color value if Register-to-Memory mode is selected.
- **DstAddress:** The destination memory Buffer address.
- **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
- **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

`HAL_DMA2D_BlendingStart`

Function name

HAL_StatusTypeDef HAL_DMA2D_BlendingStart (DMA2D_HandleTypeDef * hdma2d, uint32_t SrcAddress1, uint32_t SrcAddress2, uint32_t DstAddress, uint32_t Width, uint32_t Height)

Function description

Start the multi-source DMA2D Transfer.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **SrcAddress1:** The source memory Buffer address for the foreground layer.
- **SrcAddress2:** The source memory Buffer address for the background layer.
- **DstAddress:** The destination memory Buffer address.
- **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
- **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

HAL_DMA2D_Start_IT

Function name

HAL_StatusTypeDef HAL_DMA2D_Start_IT (DMA2D_HandleTypeDef * hdma2d, uint32_t pdata, uint32_t DstAddress, uint32_t Width, uint32_t Height)

Function description

Start the DMA2D Transfer with interrupt enabled.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **pdata:** Configure the source memory Buffer address if the Memory-to-Memory or Memory-to-Memory with pixel format conversion mode is selected, or configure the color value if Register-to-Memory mode is selected.
- **DstAddress:** The destination memory Buffer address.
- **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
- **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

HAL_DMA2D_BlendingStart_IT

Function name

HAL_StatusTypeDef HAL_DMA2D_BlendingStart_IT (DMA2D_HandleTypeDef * hdma2d, uint32_t SrcAddress1, uint32_t SrcAddress2, uint32_t DstAddress, uint32_t Width, uint32_t Height)

Function description

Start the multi-source DMA2D Transfer with interrupt enabled.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **SrcAddress1:** The source memory Buffer address for the foreground layer.
- **SrcAddress2:** The source memory Buffer address for the background layer.
- **DstAddress:** The destination memory Buffer address.
- **Width:** The width of data to be transferred from source to destination (expressed in number of pixels per line).
- **Height:** The height of data to be transferred from source to destination (expressed in number of lines).

Return values

- **HAL:** status

HAL_DMA2D_Suspend

Function name

HAL_StatusTypeDef HAL_DMA2D_Suspend (DMA2D_HandleTypeDef * hdma2d)

Function description

Suspend the DMA2D Transfer.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** status

`HAL_DMA2D_Resume`

Function name

HAL_StatusTypeDef HAL_DMA2D_Resume (DMA2D_HandleTypeDef * hdma2d)

Function description

Resume the DMA2D Transfer.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** status

`HAL_DMA2D_Abort`

Function name

HAL_StatusTypeDef HAL_DMA2D_Abort (DMA2D_HandleTypeDef * hdma2d)

Function description

Abort the DMA2D Transfer.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** status

`HAL_DMA2D_EnableCLUT`

Function name

HAL_StatusTypeDef HAL_DMA2D_EnableCLUT (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)

Function description

Enable the DMA2D CLUT Transfer.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

HAL_DMA2D_CLUTStartLoad

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTStartLoad (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef * CLUTCfg, uint32_t LayerIdx)

Function description

Start DMA2D CLUT Loading.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **CLUTCfg:** Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

HAL_DMA2D_CLUTStartLoad_IT

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTStartLoad_IT (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef * CLUTCfg, uint32_t LayerIdx)

Function description

Start DMA2D CLUT Loading with interrupt enabled.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **CLUTCfg:** Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

HAL_DMA2D_CLUTLoad

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTLoad (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef CLUTCfg, uint32_t LayerIdx)

Function description

Start DMA2D CLUT Loading.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **CLUTCfg:** Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

Notes

- API obsolete and maintained for compatibility with legacy. User is invited to resort to HAL_DMA2D_CLUTStartLoad() instead to benefit from code compactness, code size and improved heap usage.

HAL_DMA2D_CLUTLoad_IT

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTLoad_IT (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef CLUTCfg, uint32_t LayerIdx)

Function description

Start DMA2D CLUT Loading with interrupt enabled.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **CLUTCfg:** Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

Notes

- API obsolete and maintained for compatibility with legacy. User is invited to resort to HAL_DMA2D_CLUTStartLoad_IT() instead to benefit from code compactness, code size and improved heap usage.

HAL_DMA2D_CLUTLoading_Abort

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTLoading_Abort (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)

Function description

Abort the DMA2D CLUT loading.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

HAL_DMA2D_CLUTLoading_Suspend

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTLoading_Suspend (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)

Function description

Suspend the DMA2D CLUT loading.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

`HAL_DMA2D_CLUTLoading_Resume`

Function name

HAL_StatusTypeDef HAL_DMA2D_CLUTLoading_Resume (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)

Function description

Resume the DMA2D CLUT loading.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

`HAL_DMA2D_PollForTransfer`

Function name

HAL_StatusTypeDef HAL_DMA2D_PollForTransfer (DMA2D_HandleTypeDef * hdma2d, uint32_t Timeout)

Function description

Polling for transfer complete or CLUT loading.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_DMA2D_IRQHandler`

Function name

void HAL_DMA2D_IRQHandler (DMA2D_HandleTypeDef * hdma2d)

Function description

Handle DMA2D interrupt request.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** status

`HAL_DMA2D_LineEventCallback`

Function name

void HAL_DMA2D_LineEventCallback (DMA2D_HandleTypeDef * hdma2d)

Function description

Transfer watermark callback.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **None:**

`HAL_DMA2D_CLUTLoadingCpltCallback`

Function name

void HAL_DMA2D_CLUTLoadingCpltCallback (DMA2D_HandleTypeDef * hdma2d)

Function description

CLUT Transfer Complete callback.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **None:**

`HAL_DMA2D_ConfigLayer`

Function name

HAL_StatusTypeDef HAL_DMA2D_ConfigLayer (DMA2D_HandleTypeDef * hdma2d, uint32_t LayerIdx)

Function description

Configure the DMA2D Layer according to the specified parameters in the DMA2D_HandleTypeDef.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

`HAL_DMA2D_ConfigCLUT`

Function name

HAL_StatusTypeDef HAL_DMA2D_ConfigCLUT (DMA2D_HandleTypeDef * hdma2d, DMA2D_CLUTCfgTypeDef CLUTCfg, uint32_t LayerIdx)

Function description

Configure the DMA2D CLUT Transfer.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **CLUTCfg:** Pointer to a DMA2D_CLUTCfgTypeDef structure that contains the configuration information for the color look up table.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: DMA2D_BACKGROUND_LAYER(0) / DMA2D_FOREGROUND_LAYER(1)

Return values

- **HAL:** status

Notes

- API obsolete and maintained for compatibility with legacy. User is invited to resort to HAL_DMA2D_CLUTStartLoad() instead to benefit from code compactness, code size and improved heap usage.

`HAL_DMA2D_ProgramLineEvent`

Function name

HAL_StatusTypeDef HAL_DMA2D_ProgramLineEvent (DMA2D_HandleTypeDef * hdma2d, uint32_t Line)

Function description

Configure the line watermark.

Parameters

- **hdma2d:** Pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.
- **Line:** Line Watermark configuration (maximum 16-bit long value expected).

Return values

- **HAL:** status

Notes

- HAL_DMA2D_ProgramLineEvent() API enables the transfer watermark interrupt.
- The transfer watermark interrupt is disabled once it has occurred.

`HAL_DMA2D_EnableDeadTime`

Function name

HAL_StatusTypeDef HAL_DMA2D_EnableDeadTime (DMA2D_HandleTypeDef * hdma2d)

Function description

Enable DMA2D dead time feature.

Parameters

- **hdma2d:** DMA2D handle.

Return values

- **HAL:** status

`HAL_DMA2D_DisableDeadTime`

Function name

HAL_StatusTypeDef HAL_DMA2D_DisableDeadTime (DMA2D_HandleTypeDef * hdma2d)

Function description

Disable DMA2D dead time feature.

Parameters

- **hdma2d:** DMA2D handle.

Return values

- **HAL:** status

`HAL_DMA2D_ConfigDeadTime`

Function name

HAL_StatusTypeDef HAL_DMA2D_ConfigDeadTime (DMA2D_HandleTypeDef * hdma2d, uint8_t DeadTime)

Function description

Configure dead time.

Parameters

- **hdma2d:** DMA2D handle.
- **DeadTime:** dead time value.

Return values

- **HAL:** status

Notes

- The dead time value represents the guaranteed minimum number of cycles between two consecutive transactions on the AHB bus.

`HAL_DMA2D_GetState`

Function name

HAL_DMA2D_StateTypeDef HAL_DMA2D_GetState (DMA2D_HandleTypeDef * hdma2d)

Function description

Return the DMA2D state.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for the DMA2D.

Return values

- **HAL:** state

`HAL_DMA2D_GetError`

Function name

uint32_t HAL_DMA2D_GetError (DMA2D_HandleTypeDef * hdma2d)

Function description

Return the DMA2D error code.

Parameters

- **hdma2d:** pointer to a DMA2D_HandleTypeDef structure that contains the configuration information for DMA2D.

Return values

- **DMA2D:** Error Code

21.3 DMA2D Firmware driver defines

The following section lists the various define and macros of the module.

21.3.1 DMA2D

DMA2D

DMA2D API Aliases

HAL_DMA2D_DisableCLUT

Aliased to HAL_DMA2D_CLUTLoading_Abort for compatibility with legacy code

DMA2D Alpha Inversion

DMA2D_REGULAR_ALPHA

No modification of the alpha channel value

DMA2D_INVERTED_ALPHA

Invert the alpha channel value

DMA2D Alpha Mode

DMA2D_NO_MODIF_ALPHA

No modification of the alpha channel value

DMA2D_REPLACE_ALPHA

Replace original alpha channel value by programmed alpha value

DMA2D_COMBINE_ALPHA

Replace original alpha channel value by programmed alpha value with original alpha channel value

DMA2D Bytes Swap

DMA2D_BYTES_REGULAR

Bytes in regular order in output FIFO

DMA2D_BYTES_SWAP

Bytes are swapped two by two in output FIFO

DMA2D CLUT Color Mode

DMA2D_CCM_ARGB8888

ARGB8888 DMA2D CLUT color mode

DMA2D_CCM_RGB888

RGB888 DMA2D CLUT color mode

DMA2D CLUT Size

DMA2D_CLUT_SIZE

DMA2D maximum CLUT size

DMA2D Color Value

DMA2D_COLOR_VALUE

Color value mask

DMA2D Error Code

HAL_DMA2D_ERROR_NONE

No error

HAL_DMA2D_ERROR_TE

Transfer error

HAL_DMA2D_ERROR_CE

Configuration error

HAL_DMA2D_ERROR_CAE

CLUT access error

HAL_DMA2D_ERROR_TIMEOUT

Timeout error

DMA2D Exported Macros

__HAL_DMA2D_RESET_HANDLE_STATE

Description:

- Reset DMA2D handle state.

Parameters:

- __HANDLE__: specifies the DMA2D handle.

Return value:

- None

__HAL_DMA2D_ENABLE

Description:

- Enable the DMA2D.

Parameters:

- __HANDLE__: DMA2D handle

Return value:

- None.

__HAL_DMA2D_GET_FLAG

Description:

- Get the DMA2D pending flags.

Parameters:

- __HANDLE__: DMA2D handle
- __FLAG__: flag to check. This parameter can be any combination of the following values:
  - DMA2D_FLAG_CE: Configuration error flag
  - DMA2D_FLAG_CTC: CLUT transfer complete flag
  - DMA2D_FLAG_CAE: CLUT access error flag
  - DMA2D_FLAG_TW: Transfer Watermark flag
  - DMA2D_FLAG_TC: Transfer complete flag
  - DMA2D_FLAG_TE: Transfer error flag

Return value:

- The: state of FLAG.

__HAL_DMA2D_CLEAR_FLAG

Description:

- Clear the DMA2D pending flags.

Parameters:

- __HANDLE__: DMA2D handle
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - DMA2D_FLAG_CE: Configuration error flag
  - DMA2D_FLAG_CTC: CLUT transfer complete flag
  - DMA2D_FLAG_CAE: CLUT access error flag
  - DMA2D_FLAG_TW: Transfer Watermark flag
  - DMA2D_FLAG_TC: Transfer complete flag
  - DMA2D_FLAG_TE: Transfer error flag

Return value:

- None

__HAL_DMA2D_ENABLE_IT

Description:

- Enable the specified DMA2D interrupts.

Parameters:

- __HANDLE__: DMA2D handle
- __INTERRUPT__: specifies the DMA2D interrupt sources to be enabled. This parameter can be any combination of the following values:
  - DMA2D_IT_CE: Configuration error interrupt mask
  - DMA2D_IT_CTC: CLUT transfer complete interrupt mask
  - DMA2D_IT_CAE: CLUT access error interrupt mask
  - DMA2D_IT_TW: Transfer Watermark interrupt mask
  - DMA2D_IT_TC: Transfer complete interrupt mask
  - DMA2D_IT_TE: Transfer error interrupt mask

Return value:

- None

__HAL_DMA2D_DISABLE_IT

Description:

- Disable the specified DMA2D interrupts.

Parameters:

- __HANDLE__: DMA2D handle
- __INTERRUPT__: specifies the DMA2D interrupt sources to be disabled. This parameter can be any combination of the following values:
  - DMA2D_IT_CE: Configuration error interrupt mask
  - DMA2D_IT_CTC: CLUT transfer complete interrupt mask
  - DMA2D_IT_CAE: CLUT access error interrupt mask
  - DMA2D_IT_TW: Transfer Watermark interrupt mask
  - DMA2D_IT_TC: Transfer complete interrupt mask
  - DMA2D_IT_TE: Transfer error interrupt mask

Return value:

- None

__HAL_DMA2D_GET_IT_SOURCE

Description:

- Check whether the specified DMA2D interrupt source is enabled or not.

Parameters:

- __HANDLE__: DMA2D handle
- __INTERRUPT__: specifies the DMA2D interrupt source to check. This parameter can be one of the following values:
  - DMA2D_IT_CE: Configuration error interrupt mask
  - DMA2D_IT_CTC: CLUT transfer complete interrupt mask
  - DMA2D_IT_CAE: CLUT access error interrupt mask
  - DMA2D_IT_TW: Transfer Watermark interrupt mask
  - DMA2D_IT_TC: Transfer complete interrupt mask
  - DMA2D_IT_TE: Transfer error interrupt mask

Return value:

- The: state of INTERRUPT source.

DMA2D Exported Types

MAX_DMA2D_LAYER

DMA2D maximum number of layers

DMA2D Flags

DMA2D_FLAG_CE

Configuration Error Interrupt Flag

DMA2D_FLAG_CTC

CLUT Transfer Complete Interrupt Flag

DMA2D_FLAG_CAE

CLUT Access Error Interrupt Flag

DMA2D_FLAG_TW

Transfer Watermark Interrupt Flag

DMA2D_FLAG_TC

Transfer Complete Interrupt Flag

DMA2D_FLAG_TE

Transfer Error Interrupt Flag

DMA2D Input Color Mode

DMA2D_INPUT_ARGB8888

ARGB8888 color mode

DMA2D_INPUT_RGB888

RGB888 color mode

DMA2D_INPUT_RGB565

RGB565 color mode

DMA2D_INPUT_ARGB1555

ARGB1555 color mode

DMA2D_INPUT_ARGB4444

ARGB4444 color mode

DMA2D_INPUT_L8

L8 color mode

DMA2D_INPUT_AL44

AL44 color mode

DMA2D_INPUT_AL88

AL88 color mode

DMA2D_INPUT_L4

L4 color mode

DMA2D_INPUT_A8

A8 color mode

DMA2D_INPUT_A4

A4 color mode

DMA2D Interrupts

DMA2D_IT_CE

Configuration Error Interrupt

DMA2D_IT_CTC

CLUT Transfer Complete Interrupt

DMA2D_IT_CAE

CLUT Access Error Interrupt

DMA2D_IT_TW

Transfer Watermark Interrupt

DMA2D_IT_TC

Transfer Complete Interrupt

DMA2D_IT_TE

Transfer Error Interrupt

DMA2D Layers

DMA2D_BACKGROUND_LAYER

DMA2D Background Layer (layer 0)

DMA2D_FOREGROUND_LAYER

DMA2D Foreground Layer (layer 1)

DMA2D Line Offset Mode

DMA2D_LOM_PIXELS

Line offsets expressed in pixels

DMA2D_LOM_BYTES

Line offsets expressed in bytes

DMA2D Maximum Line Watermark

DMA2D_LINE_WATERMARK_MAX

DMA2D maximum line watermark

DMA2D Maximum Number of Layers

DMA2D_MAX_LAYER

DMA2D maximum number of layers

DMA2D Mode

DMA2D_M2M

DMA2D memory to memory transfer mode

DMA2D_M2M_PFC

DMA2D memory to memory with pixel format conversion transfer mode

DMA2D_M2M_BLEND

DMA2D memory to memory with blending transfer mode

DMA2D_R2M

DMA2D register to memory transfer mode

DMA2D_M2M_BLEND_FG

DMA2D memory to memory with blending transfer mode and fixed color FG

DMA2D_M2M_BLEND_BG

DMA2D memory to memory with blending transfer mode and fixed color BG

DMA2D Offset

DMA2D_OFFSET

maximum Line Offset

DMA2D Output Color Mode

DMA2D_OUTPUT_ARGB8888

ARGB8888 DMA2D color mode

DMA2D_OUTPUT_RGB888

RGB888 DMA2D color mode

DMA2D_OUTPUT_RGB565

RGB565 DMA2D color mode

DMA2D_OUTPUT_ARGB1555

ARGB1555 DMA2D color mode

DMA2D_OUTPUT_ARGB4444

ARGB4444 DMA2D color mode

DMA2D Red and Blue Swap

DMA2D_RB_REGULAR

Select regular mode (RGB or ARGB)

DMA2D_RB_SWAP

Select swap mode (BGR or ABGR)

DMA2D Size

DMA2D_PIXEL

DMA2D maximum number of pixels per line

DMA2D_LINE

DMA2D maximum number of lines

DMA2D Time Out

DMA2D_TIMEOUT_ABORT

1s

DMA2D_TIMEOUT_SUSPEND

1s

22 HAL DMA Generic Driver

22.1 DMA Firmware driver registers structures

22.1.1 DMA_InitTypeDef

DMA_InitTypeDef is defined in the stm32l4xx_hal_dma.h

Data Fields

- ***uint32_t Request***
- ***uint32_t Direction***
- ***uint32_t PeriphInc***
- ***uint32_t MemInc***
- ***uint32_t PeriphDataAlignment***
- ***uint32_t MemDataAlignment***
- ***uint32_t Mode***
- ***uint32_t Priority***

Field Documentation

- ***uint32_t DMA_InitTypeDef::Request***

  Specifies the request selected for the specified channel. This parameter can be a value of ***DMA_request***
- ***uint32_t DMA_InitTypeDef::Direction***

  Specifies if the data will be transferred from memory to peripheral, from memory to memory or from peripheral to memory. This parameter can be a value of ***DMA_Data_transfer_direction***
- ***uint32_t DMA_InitTypeDef::PeriphInc***

  Specifies whether the Peripheral address register should be incremented or not. This parameter can be a value of ***DMA_Peripheral_incremented_mode***
- ***uint32_t DMA_InitTypeDef::MemInc***

  Specifies whether the memory address register should be incremented or not. This parameter can be a value of ***DMA_Memory_incremented_mode***
- ***uint32_t DMA_InitTypeDef::PeriphDataAlignment***

  Specifies the Peripheral data width. This parameter can be a value of ***DMA_Peripheral_data_size***
- ***uint32_t DMA_InitTypeDef::MemDataAlignment***

  Specifies the Memory data width. This parameter can be a value of ***DMA_Memory_data_size***
- ***uint32_t DMA_InitTypeDef::Mode***

  Specifies the operation mode of the DMAy Channelx. This parameter can be a value of ***DMA_mode***

  Note:

  – The circular buffer mode cannot be used if the memory-to-memory data transfer is configured on the selected Channel
- ***uint32_t DMA_InitTypeDef::Priority***

  Specifies the software priority for the DMAy Channelx. This parameter can be a value of ***DMA_Priority_level***

22.1.2 __DMA_HandleTypeDef

__DMA_HandleTypeDef is defined in the stm32l4xx_hal_dma.h

Data Fields

- ***DMA_Channel_TypeDef * Instance***
- ***DMA_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_DMA_StateTypeDef State***
- ***void * Parent***

- *void(* XferCpltCallback*
- *void(* XferHalfCpltCallback*
- *void(* XferErrorCallback*
- *void(* XferAbortCallback*
- *__IO uint32_t ErrorCode*
- *DMA_TypeDef * DmaBaseAddress*
- *uint32_t ChannelIndex*
- *DMAMUX_Channel_TypeDef * DMAmuxChannel*
- *DMAMUX_ChannelStatus_TypeDef * DMAmuxChannelStatus*
- *uint32_t DMAmuxChannelStatusMask*
- *DMAMUX_RequestGen_TypeDef * DMAmuxRequestGen*
- *DMAMUX_RequestGenStatus_TypeDef * DMAmuxRequestGenStatus*
- *uint32_t DMAmuxRequestGenStatusMask*

Field Documentation

- ***DMA_Channel_TypeDef* __DMA_HandleTypeDef::Instance***
  Register base address
- ***DMA_InitTypeDef __DMA_HandleTypeDef::Init***
  DMA communication parameters
- ***HAL_LockTypeDef __DMA_HandleTypeDef::Lock***
  DMA locking object
- ***__IO HAL_DMA_StateTypeDef __DMA_HandleTypeDef::State***
  DMA transfer state
- ***void* __DMA_HandleTypeDef::Parent***
  Parent object state
- ***void(* __DMA_HandleTypeDef::XferCpltCallback)(struct __DMA_HandleTypeDef *hdma)***
  DMA transfer complete callback
- ***void(* __DMA_HandleTypeDef::XferHalfCpltCallback)(struct __DMA_HandleTypeDef *hdma)***
  DMA Half transfer complete callback
- ***void(* __DMA_HandleTypeDef::XferErrorCallback)(struct __DMA_HandleTypeDef *hdma)***
  DMA transfer error callback
- ***void(* __DMA_HandleTypeDef::XferAbortCallback)(struct __DMA_HandleTypeDef *hdma)***
  DMA transfer abort callback
- ***__IO uint32_t __DMA_HandleTypeDef::ErrorCode***
  DMA Error code
- ***DMA_TypeDef* __DMA_HandleTypeDef::DmaBaseAddress***
  DMA Channel Base Address
- ***uint32_t __DMA_HandleTypeDef::ChannelIndex***
  DMA Channel Index
- ***DMAMUX_Channel_TypeDef* __DMA_HandleTypeDef::DMAmuxChannel***
  Register base address
- ***DMAMUX_ChannelStatus_TypeDef* __DMA_HandleTypeDef::DMAmuxChannelStatus***
  DMAMUX Channels Status Base Address
- ***uint32_t __DMA_HandleTypeDef::DMAmuxChannelStatusMask***
  DMAMUX Channel Status Mask
- ***DMAMUX_RequestGen_TypeDef* __DMA_HandleTypeDef::DMAmuxRequestGen***
  DMAMUX request generator Base Address
- ***DMAMUX_RequestGenStatus_TypeDef* __DMA_HandleTypeDef::DMAmuxRequestGenStatus***
  DMAMUX request generator Address

- ***uint32_t __DMA_HandleTypeDef::DMAmuxRequestGenStatusMask***
  DMAMUX request generator Status mask

22.2 DMA Firmware driver API description

The following section lists the various functions of the DMA library.

22.2.1 How to use this driver

1. Enable and configure the peripheral to be connected to the DMA Channel (except for internal SRAM / FLASH memories: no initialization is necessary). Please refer to the Reference manual for connection between peripherals and DMA requests.
2. For a given Channel, program the required configuration through the following parameters: Channel request, Transfer Direction, Source and Destination data formats, Circular or Normal mode, Channel Priority level, Source and Destination Increment mode using HAL_DMA_Init() function. Prior to HAL_DMA_Init the peripheral clock shall be enabled for both DMA & DMAMUX thanks to:
   a. DMA1 or DMA2: __HAL_RCC_DMA1_CLK_ENABLE() or __HAL_RCC_DMA2_CLK_ENABLE() ;
   b. DMAMUX1: __HAL_RCC_DMAMUX1_CLK_ENABLE();
3. Use HAL_DMA_GetState() function to return the DMA state and HAL_DMA_GetError() in case of error detection.
4. Use HAL_DMA_Abort() function to abort the current transfer

Note: In Memory-to-Memory transfer mode, Circular mode is not allowed.

Polling mode IO operation

- Use HAL_DMA_Start() to start DMA transfer after the configuration of Source address and destination address and the Length of data to be transferred
- Use HAL_DMA_PollForTransfer() to poll for the end of current transfer, in this case a fixed Timeout can be configured by User depending from his application.

Interrupt mode IO operation

- Configure the DMA interrupt priority using HAL_NVIC_SetPriority()
- Enable the DMA IRQ handler using HAL_NVIC_EnableIRQ()
- Use HAL_DMA_Start_IT() to start DMA transfer after the configuration of Source address and destination address and the Length of data to be transferred. In this case the DMA interrupt is configured
- Use HAL_DMA_IRQHandler() called under DMA_IRQHandler() Interrupt subroutine
- At the end of data transfer HAL_DMA_IRQHandler() function is executed and user can add his own function to register callbacks with HAL_DMA_RegisterCallback().

DMA HAL driver macros list

Below the list of macros in DMA HAL driver.

- __HAL_DMA_ENABLE: Enable the specified DMA Channel.
- __HAL_DMA_DISABLE: Disable the specified DMA Channel.
- __HAL_DMA_GET_FLAG: Get the DMA Channel pending flags.
- __HAL_DMA_CLEAR_FLAG: Clear the DMA Channel pending flags.
- __HAL_DMA_ENABLE_IT: Enable the specified DMA Channel interrupts.
- __HAL_DMA_DISABLE_IT: Disable the specified DMA Channel interrupts.
- __HAL_DMA_GET_IT_SOURCE: Check whether the specified DMA Channel interrupt is enabled or not.

Note: You can refer to the DMA HAL driver header file for more useful macros

22.2.2 Initialization and de-initialization functions

This section provides functions allowing to initialize the DMA Channel source and destination addresses, incrementation and data sizes, transfer direction, circular/normal mode selection, memory-to-memory mode selection and Channel priority value.

The HAL_DMA_Init() function follows the DMA configuration procedures as described in reference manual.
This section contains the following APIs:

- ***HAL_DMA_Init***
- ***HAL_DMA_DeInit***

22.2.3 IO operation functions

This section provides functions allowing to:

- Configure the source, destination address and data length and Start DMA transfer
- Configure the source, destination address and data length and Start DMA transfer with interrupt
- Abort DMA transfer
- Poll for transfer complete
- Handle DMA interrupt request

This section contains the following APIs:

- ***HAL_DMA_Start***
- ***HAL_DMA_Start_IT***
- ***HAL_DMA_Abort***
- ***HAL_DMA_Abort_IT***
- ***HAL_DMA_PollForTransfer***
- ***HAL_DMA_IRQHandler***
- ***HAL_DMA_RegisterCallback***
- ***HAL_DMA_UnRegisterCallback***

22.2.4 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DMA state
- Get error code

This section contains the following APIs:

- ***HAL_DMA_GetState***
- ***HAL_DMA_GetError***

22.2.5 Detailed description of functions

`HAL_DMA_Init`

Function name

HAL_StatusTypeDef HAL_DMA_Init (DMA_HandleTypeDef * hdma)

Function description

Initialize the DMA according to the specified parameters in the DMA_InitTypeDef and initialize the associated handle.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **HAL:** status

`HAL_DMA_DeInit`

Function name

HAL_StatusTypeDef HAL_DMA_DeInit (DMA_HandleTypeDef * hdma)

Function description

DeInitialize the DMA peripheral.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **HAL:** status

`HAL_DMA_Start`

Function name

HAL_StatusTypeDef HAL_DMA_Start (DMA_HandleTypeDef * hdma, uint32_t SrcAddress, uint32_t DstAddress, uint32_t DataLength)

Function description

Start the DMA Transfer.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.
- **SrcAddress:** The source memory Buffer address
- **DstAddress:** The destination memory Buffer address
- **DataLength:** The length of data to be transferred from source to destination

Return values

- **HAL:** status

`HAL_DMA_Start_IT`

Function name

HAL_StatusTypeDef HAL_DMA_Start_IT (DMA_HandleTypeDef * hdma, uint32_t SrcAddress, uint32_t DstAddress, uint32_t DataLength)

Function description

Start the DMA Transfer with interrupt enabled.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.
- **SrcAddress:** The source memory Buffer address
- **DstAddress:** The destination memory Buffer address
- **DataLength:** The length of data to be transferred from source to destination

Return values

- **HAL:** status

`HAL_DMA_Abort`

Function name

HAL_StatusTypeDef HAL_DMA_Abort (DMA_HandleTypeDef * hdma)

Function description

Abort the DMA Transfer.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **HAL:** status

`HAL_DMA_Abort_IT`

Function name

HAL_StatusTypeDef HAL_DMA_Abort_IT (DMA_HandleTypeDef * hdma)

Function description

Aborts the DMA Transfer in Interrupt mode.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **HAL:** status

`HAL_DMA_PollForTransfer`

Function name

HAL_StatusTypeDef HAL_DMA_PollForTransfer (DMA_HandleTypeDef * hdma, HAL_DMA_LevelCompleteTypeDef CompleteLevel, uint32_t Timeout)

Function description

Polling for transfer complete.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.
- **CompleteLevel:** Specifies the DMA level complete.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

`HAL_DMA_IRQHandler`

Function name

void HAL_DMA_IRQHandler (DMA_HandleTypeDef * hdma)

Function description

Handle DMA interrupt request.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **None:**

HAL_DMA_RegisterCallback

Function name

HAL_StatusTypeDef HAL_DMA_RegisterCallback (DMA_HandleTypeDef * hdma, HAL_DMA_CallbackIDTypeDef CallbackID, void(*)(DMA_HandleTypeDef *_hdma) pCallback)

Function description

Register callbacks.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.
- **CallbackID:** User Callback identifer a HAL_DMA_CallbackIDTypeDef ENUM as parameter.
- **pCallback:** pointer to private callbacsk function which has pointer to a DMA_HandleTypeDef structure as parameter.

Return values

- **HAL:** status

HAL_DMA_UnRegisterCallback

Function name

HAL_StatusTypeDef HAL_DMA_UnRegisterCallback (DMA_HandleTypeDef * hdma, HAL_DMA_CallbackIDTypeDef CallbackID)

Function description

UnRegister callbacks.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.
- **CallbackID:** User Callback identifer a HAL_DMA_CallbackIDTypeDef ENUM as parameter.

Return values

- **HAL:** status

HAL_DMA_GetState

Function name

HAL_DMA_StateTypeDef HAL_DMA_GetState (DMA_HandleTypeDef * hdma)

Function description

Return the DMA handle state.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **HAL:** state

HAL_DMA_GetError

Function name

uint32_t HAL_DMA_GetError (DMA_HandleTypeDef * hdma)

Function description

Return the DMA error code.

Parameters

- **hdma:** : pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA Channel.

Return values

- **DMA:** Error Code

22.3 DMA Firmware driver defines

The following section lists the various define and macros of the module.

22.3.1 DMA

DMA

DMA Data transfer direction

DMA_PERIPH_TO_MEMORY

Peripheral to memory direction

DMA_MEMORY_TO_PERIPH

Memory to peripheral direction

DMA_MEMORY_TO_MEMORY

Memory to memory direction

DMA Error Code

HAL_DMA_ERROR_NONE

No error

HAL_DMA_ERROR_TE

Transfer error

HAL_DMA_ERROR_NO_XFER

Abort requested with no Xfer ongoing

HAL_DMA_ERROR_TIMEOUT

Timeout error

HAL_DMA_ERROR_NOT_SUPPORTED

Not supported mode

HAL_DMA_ERROR_SYNC

DMAMUX sync overrun error

HAL_DMA_ERROR_REQGEN

DMAMUX request generator overrun error

DMA Exported Macros

__HAL_DMA_RESET_HANDLE_STATE

Description:

- Reset DMA handle state.

Parameters:

- __HANDLE__: DMA handle

Return value:

- None

__HAL_DMA_ENABLE

Description:

- Enable the specified DMA Channel.

Parameters:

- __HANDLE__: DMA handle

Return value:

- None

__HAL_DMA_DISABLE

Description:

- Disable the specified DMA Channel.

Parameters:

- __HANDLE__: DMA handle

Return value:

- None

__HAL_DMA_GET_TC_FLAG_INDEX

Description:

- Return the current DMA Channel transfer complete flag.

Parameters:

- __HANDLE__: DMA handle

Return value:

- The: specified transfer complete flag index.

__HAL_DMA_GET_HT_FLAG_INDEX

Description:

- Return the current DMA Channel half transfer complete flag.

Parameters:

- __HANDLE__: DMA handle

Return value:

- The: specified half transfer complete flag index.

__HAL_DMA_GET_TE_FLAG_INDEX

Description:

- Return the current DMA Channel transfer error flag.

Parameters:

- __HANDLE__: DMA handle

Return value:

- The: specified transfer error flag index.

__HAL_DMA_GET_GI_FLAG_INDEX

Description:

- Return the current DMA Channel Global interrupt flag.

Parameters:

- __HANDLE__: DMA handle

Return value:

- The: specified transfer error flag index.

__HAL_DMA_GET_FLAG

Description:

- Get the DMA Channel pending flags.

Parameters:

- __HANDLE__: DMA handle
- __FLAG__: Get the specified flag. This parameter can be any combination of the following values:
  - DMA_FLAG_TCx: Transfer complete flag
  - DMA_FLAG_HTx: Half transfer complete flag
  - DMA_FLAG_TEx: Transfer error flag
  - DMA_FLAG_GLx: Global interrupt flag Where x can be from 1 to 7 to select the DMA Channel x flag.

Return value:

- The: state of FLAG (SET or RESET).

__HAL_DMA_CLEAR_FLAG

Description:

- Clear the DMA Channel pending flags.

Parameters:

- __HANDLE__: DMA handle
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - DMA_FLAG_TCx: Transfer complete flag
  - DMA_FLAG_HTx: Half transfer complete flag
  - DMA_FLAG_TEx: Transfer error flag
  - DMA_FLAG_GLx: Global interrupt flag Where x can be from 1 to 7 to select the DMA Channel x flag.

Return value:

- None

__HAL_DMA_ENABLE_IT

Description:

- Enable the specified DMA Channel interrupts.

Parameters:

- __HANDLE__: DMA handle
- __INTERRUPT__: specifies the DMA interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
  - DMA_IT_TC: Transfer complete interrupt mask
  - DMA_IT_HT: Half transfer complete interrupt mask
  - DMA_IT_TE: Transfer error interrupt mask

Return value:

- None

__HAL_DMA_DISABLE_IT

Description:

- Disable the specified DMA Channel interrupts.

Parameters:

- __HANDLE__: DMA handle
- __INTERRUPT__: specifies the DMA interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
  - DMA_IT_TC: Transfer complete interrupt mask
  - DMA_IT_HT: Half transfer complete interrupt mask
  - DMA_IT_TE: Transfer error interrupt mask

Return value:

- None

__HAL_DMA_GET_IT_SOURCE

Description:

- Check whether the specified DMA Channel interrupt is enabled or not.

Parameters:

- __HANDLE__: DMA handle
- __INTERRUPT__: specifies the DMA interrupt source to check. This parameter can be one of the following values:
  - DMA_IT_TC: Transfer complete interrupt mask
  - DMA_IT_HT: Half transfer complete interrupt mask
  - DMA_IT_TE: Transfer error interrupt mask

Return value:

- The: state of DMA_IT (SET or RESET).

__HAL_DMA_GET_COUNTER

Description:

- Return the number of remaining data units in the current DMA Channel transfer.

Parameters:

- __HANDLE__: DMA handle

Return value:

- The: number of remaining data units in the current DMA Channel transfer.

DMA flag definitions

DMA_FLAG_GL1

DMA_FLAG_TC1

DMA_FLAG_HT1

DMA_FLAG_TE1

DMA_FLAG_GL2

DMA_FLAG_TC2

DMA_FLAG_HT2

DMA_FLAG_TE2

DMA_FLAG_GL3

DMA_FLAG_TC3

DMA_FLAG_HT3

DMA_FLAG_TE3

DMA_FLAG_GL4

DMA_FLAG_TC4

DMA_FLAG_HT4

DMA_FLAG_TE4

DMA_FLAG_GL5

DMA_FLAG_TC5

DMA_FLAG_HT5

DMA_FLAG_TE5

DMA_FLAG_GL6

DMA_FLAG_TC6

DMA_FLAG_HT6

DMA_FLAG_TE6

DMA_FLAG_GL7

DMA_FLAG_TC7

DMA_FLAG_HT7

DMA_FLAG_TE7

TIM DMA Handle Index

TIM_DMA_ID_UPDATE

Index of the DMA handle used for Update DMA requests

TIM_DMA_ID_CC1

Index of the DMA handle used for Capture/Compare 1 DMA requests

TIM_DMA_ID_CC2

Index of the DMA handle used for Capture/Compare 2 DMA requests

TIM_DMA_ID_CC3

Index of the DMA handle used for Capture/Compare 3 DMA requests

TIM_DMA_ID_CC4

Index of the DMA handle used for Capture/Compare 4 DMA requests

TIM_DMA_ID_COMMUTATION

Index of the DMA handle used for Commutation DMA requests

TIM_DMA_ID_TRIGGER

Index of the DMA handle used for Trigger DMA requests

DMA interrupt enable definitions

DMA_IT_TC

DMA_IT_HT

DMA_IT_TE

DMA Memory data size

DMA_MDATAALIGN_BYTE

Memory data alignment : Byte

DMA_MDATAALIGN_HALFWORD

Memory data alignment : HalfWord

DMA_MDATAALIGN_WORD

Memory data alignment : Word

DMA Memory incremented mode

DMA_MINC_ENABLE

Memory increment mode Enable

DMA_MINC_DISABLE

Memory increment mode Disable

DMA mode

DMA_NORMAL

Normal mode

DMA_CIRCULAR

Circular mode

DMA Peripheral data size

DMA_PDATAALIGN_BYTE

Peripheral data alignment : Byte

DMA_PDATAALIGN_HALFWORD

Peripheral data alignment : HalfWord

DMA_PDATAALIGN_WORD

Peripheral data alignment : Word

DMA Peripheral incremented mode

DMA_PINC_ENABLE

Peripheral increment mode Enable

DMA_PINC_DISABLE

Peripheral increment mode Disable

DMA Priority level

DMA_PRIORITY_LOW

Priority level : Low

DMA_PRIORITY_MEDIUM

Priority level : Medium

DMA_PRIORITY_HIGH

Priority level : High

DMA_PRIORITY_VERY_HIGH

Priority level : Very_High

DMA request

DMA_REQUEST_MEM2MEM

memory to memory transfer

DMA_REQUEST_GENERATOR0

DMAMUX1 request generator 0

DMA_REQUEST_GENERATOR1

DMAMUX1 request generator 1

DMA_REQUEST_GENERATOR2

DMAMUX1 request generator 2

DMA_REQUEST_GENERATOR3

DMAMUX1 request generator 3

DMA_REQUEST_ADC1

DMAMUX1 ADC1 request

DMA_REQUEST_DAC1_CH1

DMAMUX1 DAC1 CH1 request

DMA_REQUEST_DAC1_CH2

DMAMUX1 DAC1 CH2 request

DMA_REQUEST_TIM6_UP

DMAMUX1 TIM6 UP request

DMA_REQUEST_TIM7_UP

DMAMUX1 TIM7 UP request

DMA_REQUEST_SPI1_RX

DMAMUX1 SPI1 RX request

DMA_REQUEST_SPI1_TX

DMAMUX1 SPI1 TX request

DMA_REQUEST_SPI2_RX

DMAMUX1 SPI2 RX request

DMA_REQUEST_SPI2_TX

DMAMUX1 SPI2 TX request

DMA_REQUEST_SPI3_RX

DMAMUX1 SPI3 RX request

DMA_REQUEST_SPI3_TX

DMAMUX1 SPI3 TX request

DMA_REQUEST_I2C1_RX

DMAMUX1 I2C1 RX request

DMA_REQUEST_I2C1_TX

DMAMUX1 I2C1 TX request

DMA_REQUEST_I2C2_RX

DMAMUX1 I2C2 RX request

DMA_REQUEST_I2C2_TX

DMAMUX1 I2C2 TX request

DMA_REQUEST_I2C3_RX

DMAMUX1 I2C3 RX request

DMA_REQUEST_I2C3_TX

DMAMUX1 I2C3 TX request

DMA_REQUEST_I2C4_RX

DMAMUX1 I2C4 RX request

DMA_REQUEST_I2C4_TX

DMAMUX1 I2C4 TX request

DMA_REQUEST_USART1_RX

DMAMUX1 USART1 RX request

DMA_REQUEST_USART1_TX

DMAMUX1 USART1 TX request

DMA_REQUEST_USART2_RX

DMAMUX1 USART2 RX request

DMA_REQUEST_USART2_TX

DMAMUX1 USART2 TX request

DMA_REQUEST_USART3_RX

DMAMUX1 USART3 RX request

DMA_REQUEST_USART3_TX

DMAMUX1 USART3 TX request

DMA_REQUEST_UART4_RX

DMAMUX1 UART4 RX request

DMA_REQUEST_UART4_TX

DMAMUX1 UART4 TX request

DMA_REQUEST_UART5_RX

DMAMUX1 UART5 RX request

DMA_REQUEST_UART5_TX

DMAMUX1 UART5 TX request

DMA_REQUEST_LPUART1_RX

DMAMUX1 LP_UART1_RX request

DMA_REQUEST_LPUART1_TX

DMAMUX1 LP_UART1_RX request

DMA_REQUEST_SAI1_A

DMAMUX1 SAI1 A request

DMA_REQUEST_SAI1_B

DMAMUX1 SAI1 B request

DMA_REQUEST_SAI2_A

DMAMUX1 SAI2 A request

DMA_REQUEST_SAI2_B

DMAMUX1 SAI2 B request

DMA_REQUEST_OCTOSPI1

DMAMUX1 OCTOSPI1 request

DMA_REQUEST_OCTOSPI2

DMAMUX1 OCTOSPI2 request

DMA_REQUEST_TIM1_CH1

DMAMUX1 TIM1 CH1 request

DMA_REQUEST_TIM1_CH2

DMAMUX1 TIM1 CH2 request

DMA_REQUEST_TIM1_CH3

DMAMUX1 TIM1 CH3 request

DMA_REQUEST_TIM1_CH4

DMAMUX1 TIM1 CH4 request

DMA_REQUEST_TIM1_UP

DMAMUX1 TIM1 UP request

DMA_REQUEST_TIM1_TRIG

DMAMUX1 TIM1 TRIG request

DMA_REQUEST_TIM1_COM

DMAMUX1 TIM1 COM request

DMA_REQUEST_TIM8_CH1

DMAMUX1 TIM8 CH1 request

DMA_REQUEST_TIM8_CH2

DMAMUX1 TIM8 CH2 request

DMA_REQUEST_TIM8_CH3

DMAMUX1 TIM8 CH3 request

DMA_REQUEST_TIM8_CH4

DMAMUX1 TIM8 CH4 request

DMA_REQUEST_TIM8_UP

DMAMUX1 TIM8 UP request

DMA_REQUEST_TIM8_TRIG

DMAMUX1 TIM8 TRIG request

DMA_REQUEST_TIM8_COM

DMAMUX1 TIM8 COM request

DMA_REQUEST_TIM2_CH1

DMAMUX1 TIM2 CH1 request

DMA_REQUEST_TIM2_CH2

DMAMUX1 TIM2 CH2 request

DMA_REQUEST_TIM2_CH3

DMAMUX1 TIM2 CH3 request

DMA_REQUEST_TIM2_CH4

DMAMUX1 TIM2 CH4 request

DMA_REQUEST_TIM2_UP

DMAMUX1 TIM2 UP request

DMA_REQUEST_TIM3_CH1

DMAMUX1 TIM3 CH1 request

DMA_REQUEST_TIM3_CH2

DMAMUX1 TIM3 CH2 request

DMA_REQUEST_TIM3_CH3

DMAMUX1 TIM3 CH3 request

DMA_REQUEST_TIM3_CH4

DMAMUX1 TIM3 CH4 request

DMA_REQUEST_TIM3_UP

DMAMUX1 TIM3 UP request

DMA_REQUEST_TIM3_TRIG

DMAMUX1 TIM3 TRIG request

DMA_REQUEST_TIM4_CH1

DMAMUX1 TIM4 CH1 request

DMA_REQUEST_TIM4_CH2

DMAMUX1 TIM4 CH2 request

DMA_REQUEST_TIM4_CH3

DMAMUX1 TIM4 CH3 request

DMA_REQUEST_TIM4_CH4

DMAMUX1 TIM4 CH4 request

DMA_REQUEST_TIM4_UP

DMAMUX1 TIM4 UP request

DMA_REQUEST_TIM5_CH1

DMAMUX1 TIM5 CH1 request

DMA_REQUEST_TIM5_CH2

DMAMUX1 TIM5 CH2 request

DMA_REQUEST_TIM5_CH3

DMAMUX1 TIM5 CH3 request

DMA_REQUEST_TIM5_CH4

DMAMUX1 TIM5 CH4 request

DMA_REQUEST_TIM5_UP

DMAMUX1 TIM5 UP request

DMA_REQUEST_TIM5_TRIG

DMAMUX1 TIM5 TRIG request

DMA_REQUEST_TIM15_CH1

DMAMUX1 TIM15 CH1 request

DMA_REQUEST_TIM15_UP

DMAMUX1 TIM15 UP request

DMA_REQUEST_TIM15_TRIG

DMAMUX1 TIM15 TRIG request

DMA_REQUEST_TIM15_COM

DMAMUX1 TIM15 COM request

DMA_REQUEST_TIM16_CH1

DMAMUX1 TIM16 CH1 request

DMA_REQUEST_TIM16_UP

DMAMUX1 TIM16 UP request

DMA_REQUEST_TIM17_CH1

DMAMUX1 TIM17 CH1 request

DMA_REQUEST_TIM17_UP

DMAMUX1 TIM17 UP request

DMA_REQUEST_DFSDM1_FLT0

DMAMUX1 DFSDM1 Filter0 request

DMA_REQUEST_DFSDM1_FLT1

DMAMUX1 DFSDM1 Filter1 request

DMA_REQUEST_DFSDM1_FLT2

DMAMUX1 DFSDM1 Filter2 request

DMA_REQUEST_DFSDM1_FLT3

DMAMUX1 DFSDM1 Filter3 request

DMA_REQUEST_DCMI

DMAMUX1 DCMI request

DMA_REQUEST_AES_IN

DMAMUX1 AES IN request

DMA_REQUEST_AES_OUT

DMAMUX1 AES OUT request

DMA_REQUEST_HASH_IN

DMAMUX1 HASH IN request

23 HAL DMA Extension Driver

23.1 DMAEx Firmware driver registers structures

23.1.1 HAL_DMA_MuxSyncConfigTypeDef

HAL_DMA_MuxSyncConfigTypeDef is defined in the stm32l4xx_hal_dma_ex.h

Data Fields

- ***uint32_t SyncSignalID***
- ***uint32_t SyncPolarity***
- ***FunctionalState SyncEnable***
- ***FunctionalState EventEnable***
- ***uint32_t RequestNumber***

Field Documentation

- ***uint32_t HAL_DMA_MuxSyncConfigTypeDef::SyncSignalID***

  Specifies the synchronization signal gating the DMA request in periodic mode. This parameter can be a value of ***DMAEx_DMAMUX_SyncSignalID_selection***
- ***uint32_t HAL_DMA_MuxSyncConfigTypeDef::SyncPolarity***

  Specifies the polarity of the signal on which the DMA request is synchronized. This parameter can be a value of ***DMAEx_DMAMUX_SyncPolarity_selection***
- ***FunctionalState HAL_DMA_MuxSyncConfigTypeDef::SyncEnable***

  Specifies if the synchronization shall be enabled or disabled This parameter can take the value ENABLE or DISABLE
- ***FunctionalState HAL_DMA_MuxSyncConfigTypeDef::EventEnable***

  Specifies if an event shall be generated once the RequestNumber is reached. This parameter can take the value ENABLE or DISABLE
- ***uint32_t HAL_DMA_MuxSyncConfigTypeDef::RequestNumber***

  Specifies the number of DMA request that will be authorized after a sync event This parameter must be a number between Min_Data = 1 and Max_Data = 32

23.1.2 HAL_DMA_MuxRequestGeneratorConfigTypeDef

HAL_DMA_MuxRequestGeneratorConfigTypeDef is defined in the stm32l4xx_hal_dma_ex.h

Data Fields

- ***uint32_t SignalID***
- ***uint32_t Polarity***
- ***uint32_t RequestNumber***

Field Documentation

- ***uint32_t HAL_DMA_MuxRequestGeneratorConfigTypeDef::SignalID***

  Specifies the ID of the signal used for DMAMUX request generator This parameter can be a value of ***DMAEx_DMAMUX_SignalGeneratorID_selection***
- ***uint32_t HAL_DMA_MuxRequestGeneratorConfigTypeDef::Polarity***

  Specifies the polarity of the signal on which the request is generated. This parameter can be a value of ***DMAEx_DMAMUX_RequestGeneneratorPolarity_selection***
- ***uint32_t HAL_DMA_MuxRequestGeneratorConfigTypeDef::RequestNumber***

  Specifies the number of DMA request that will be generated after a signal event This parameter must be a number between Min_Data = 1 and Max_Data = 32

23.2 DMAEx Firmware driver API description

The following section lists the various functions of the DMAEx library.

23.2.1 How to use this driver

The DMA Extension HAL driver can be used as follows:

- Configure the DMA_MUX Synchronization Block using HAL_DMAEx_ConfigMuxSync function.
- Configure the DMA_MUX Request Generator Block using HAL_DMAEx_ConfigMuxRequestGenerator function. Functions HAL_DMAEx_EnableMuxRequestGenerator and HAL_DMAEx_DisableMuxRequestGenerator can then be used to respectively enable/disable the request generator.
- To handle the DMAMUX Interrupts, the function HAL_DMAEx_MUX_IRQHandler should be called from the DMAMUX IRQ handler i.e DMAMUX1_OVR_IRQHandler. As only one interrupt line is available for all DMAMUX channels and request generators , HAL_DMAEx_MUX_IRQHandler should be called with, as parameter, the appropriate DMA handle as many as used DMAs in the user project (exception done if a given DMA is not using the DMAMUX SYNC block neither a request generator)

Note: In Memory-to-Memory transfer mode, Multi (Double) Buffer mode is not allowed.

Note: When Multi (Double) Buffer mode is enabled, the transfer is circular by default.

Note: In Multi (Double) buffer mode, it is possible to update the base address for the AHB memory port on the fly (DMA_CM0ARx or DMA_CM1ARx) when the channel is enabled.

23.2.2 Extended features functions

This section provides functions allowing to:

- Configure the DMAMUX Synchronization Block using HAL_DMAEx_ConfigMuxSync function.
- Configure the DMAMUX Request Generator Block using HAL_DMAEx_ConfigMuxRequestGenerator function. Functions HAL_DMAEx_EnableMuxRequestGenerator and HAL_DMAEx_DisableMuxRequestGenerator can then be used to respectively enable/disable the request generator.

This section contains the following APIs:

- ***HAL_DMAEx_ConfigMuxSync***
- ***HAL_DMAEx_ConfigMuxRequestGenerator***
- ***HAL_DMAEx_EnableMuxRequestGenerator***
- ***HAL_DMAEx_DisableMuxRequestGenerator***
- ***HAL_DMAEx_MUX_IRQHandler***

23.2.3 Detailed description of functions

`HAL_DMAEx_ConfigMuxRequestGenerator`

Function name

HAL_StatusTypeDef HAL_DMAEx_ConfigMuxRequestGenerator (DMA_HandleTypeDef * hdma, HAL_DMA_MuxRequestGeneratorConfigTypeDef * pRequestGeneratorConfig)

Function description

Configure the DMAMUX request generator block used by the given DMA channel (instance).

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA channel.
- **pRequestGeneratorConfig:** : pointer to HAL_DMA_MuxRequestGeneratorConfigTypeDef : contains the request generator parameters.

Return values

- **HAL:** status

HAL_DMAEx_EnableMuxRequestGenerator

Function name

HAL_StatusTypeDef HAL_DMAEx_EnableMuxRequestGenerator (DMA_HandleTypeDef * hdma)

Function description

Enable the DMAMUX request generator block used by the given DMA channel (instance).

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA channel.

Return values

- **HAL:** status

HAL_DMAEx_DisableMuxRequestGenerator

Function name

HAL_StatusTypeDef HAL_DMAEx_DisableMuxRequestGenerator (DMA_HandleTypeDef * hdma)

Function description

Disable the DMAMUX request generator block used by the given DMA channel (instance).

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA channel.

Return values

- **HAL:** status

HAL_DMAEx_ConfigMuxSync

Function name

HAL_StatusTypeDef HAL_DMAEx_ConfigMuxSync (DMA_HandleTypeDef * hdma, HAL_DMA_MuxSyncConfigTypeDef * pSyncConfig)

Function description

Configure the DMAMUX synchronization parameters for a given DMA channel (instance).

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA channel.
- **pSyncConfig:** : pointer to HAL_DMA_MuxSyncConfigTypeDef : contains the DMAMUX synchronization parameters

Return values

- **HAL:** status

HAL_DMAEx_MUX_IRQHandler

Function name

void HAL_DMAEx_MUX_IRQHandler (DMA_HandleTypeDef * hdma)

Function description

Handles DMAMUX interrupt request.

Parameters

- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA channel.

Return values

- **None:**

23.3 DMAEx Firmware driver defines

The following section lists the various define and macros of the module.

23.3.1 DMAEx

DMAEx

DMAMUX RequestGeneneratorPolarity selection

HAL_DMAMUX_REQ_GEN_NO_EVENT

block request generator events

HAL_DMAMUX_REQ_GEN_RISING

generate request on rising edge events

HAL_DMAMUX_REQ_GEN_FALLING

generate request on falling edge events

HAL_DMAMUX_REQ_GEN_RISING_FALLING

generate request on rising and falling edge events

DMAMUX SignalGeneratorID selection

HAL_DMAMUX1_REQ_GEN_EXTI0

Request generator Signal is EXTI0 IT

HAL_DMAMUX1_REQ_GEN_EXTI1

Request generator Signal is EXTI1 IT

HAL_DMAMUX1_REQ_GEN_EXTI2

Request generator Signal is EXTI2 IT

HAL_DMAMUX1_REQ_GEN_EXTI3

Request generator Signal is EXTI3 IT

HAL_DMAMUX1_REQ_GEN_EXTI4

Request generator Signal is EXTI4 IT

HAL_DMAMUX1_REQ_GEN_EXTI5

Request generator Signal is EXTI5 IT

HAL_DMAMUX1_REQ_GEN_EXTI6

Request generator Signal is EXTI6 IT

HAL_DMAMUX1_REQ_GEN_EXTI7

Request generator Signal is EXTI7 IT

HAL_DMAMUX1_REQ_GEN_EXTI8

Request generator Signal is EXTI8 IT

HAL_DMAMUX1_REQ_GEN_EXTI9

Request generator Signal is EXTI9 IT

HAL_DMAMUX1_REQ_GEN_EXTI10

Request generator Signal is EXTI10 IT

HAL_DMAMUX1_REQ_GEN_EXTI11

Request generator Signal is EXTI11 IT

HAL_DMAMUX1_REQ_GEN_EXTI12

Request generator Signal is EXTI12 IT

HAL_DMAMUX1_REQ_GEN_EXTI13

Request generator Signal is EXTI13 IT

HAL_DMAMUX1_REQ_GEN_EXTI14

Request generator Signal is EXTI14 IT

HAL_DMAMUX1_REQ_GEN_EXTI15

Request generator Signal is EXTI15 IT

HAL_DMAMUX1_REQ_GEN_DMAMUX1_CH0_EVT

Request generator Signal is DMAMUX1 Channel0 Event

HAL_DMAMUX1_REQ_GEN_DMAMUX1_CH1_EVT

Request generator Signal is DMAMUX1 Channel1 Event

HAL_DMAMUX1_REQ_GEN_DMAMUX1_CH2_EVT

Request generator Signal is DMAMUX1 Channel2 Event

HAL_DMAMUX1_REQ_GEN_DMAMUX1_CH3_EVT

Request generator Signal is DMAMUX1 Channel3 Event

HAL_DMAMUX1_REQ_GEN_LPTIM1_OUT

Request generator Signal is LPTIM1 OUT

HAL_DMAMUX1_REQ_GEN_LPTIM2_OUT

Request generator Signal is LPTIM2 OUT

HAL_DMAMUX1_REQ_GEN_DSI_TE

Request generator Signal is DSI Tearing Effect

HAL_DMAMUX1_REQ_GEN_DSI_EOT

Request generator Signal is DSI End of refresh

HAL_DMAMUX1_REQ_GEN_DMA2D_EOT

Request generator Signal is DMA2D End of Transfer

HAL_DMAMUX1_REQ_GEN_LTDC_IT

Request generator Signal is LTDC IT

DMAMUX SyncPolarity selection

HAL_DMAMUX_SYNC_NO_EVENT

block synchronization events

HAL_DMAMUX_SYNC_RISING

synchronize with rising edge events

HAL_DMAMUX_SYNC_FALLING

synchronize with falling edge events

HAL_DMAMUX_SYNC_RISING_FALLING

synchronize with rising and falling edge events

DMAMUX SyncSignalID selection

HAL_DMAMUX1_SYNC_EXTI0

Synchronization Signal is EXTI0 IT

HAL_DMAMUX1_SYNC_EXTI1

Synchronization Signal is EXTI1 IT

HAL_DMAMUX1_SYNC_EXTI2

Synchronization Signal is EXTI2 IT

HAL_DMAMUX1_SYNC_EXTI3

Synchronization Signal is EXTI3 IT

HAL_DMAMUX1_SYNC_EXTI4

Synchronization Signal is EXTI4 IT

HAL_DMAMUX1_SYNC_EXTI5

Synchronization Signal is EXTI5 IT

HAL_DMAMUX1_SYNC_EXTI6

Synchronization Signal is EXTI6 IT

HAL_DMAMUX1_SYNC_EXTI7

Synchronization Signal is EXTI7 IT

HAL_DMAMUX1_SYNC_EXTI8

Synchronization Signal is EXTI8 IT

HAL_DMAMUX1_SYNC_EXTI9

Synchronization Signal is EXTI9 IT

HAL_DMAMUX1_SYNC_EXTI10

Synchronization Signal is EXTI10 IT

HAL_DMAMUX1_SYNC_EXTI11

Synchronization Signal is EXTI11 IT

HAL_DMAMUX1_SYNC_EXTI12

Synchronization Signal is EXTI12 IT

HAL_DMAMUX1_SYNC_EXTI13

Synchronization Signal is EXTI13 IT

HAL_DMAMUX1_SYNC_EXTI14

Synchronization Signal is EXTI14 IT

HAL_DMAMUX1_SYNC_EXTI15

Synchronization Signal is EXTI15 IT

HAL_DMAMUX1_SYNC_DMAMUX1_CH0_EVT

Synchronization Signal is DMAMUX1 Channel0 Event

HAL_DMAMUX1_SYNC_DMAMUX1_CH1_EVT

Synchronization Signal is DMAMUX1 Channel1 Event

HAL_DMAMUX1_SYNC_DMAMUX1_CH2_EVT

Synchronization Signal is DMAMUX1 Channel2 Event

HAL_DMAMUX1_SYNC_DMAMUX1_CH3_EVT

Synchronization Signal is DMAMUX1 Channel3 Event

HAL_DMAMUX1_SYNC_LPTIM1_OUT

Synchronization Signal is LPTIM1 OUT

HAL_DMAMUX1_SYNC_LPTIM2_OUT

Synchronization Signal is LPTIM2 OUT

HAL_DMAMUX1_SYNC_DSI_TE

Synchronization Signal is DSI Tearing Effect

HAL_DMAMUX1_SYNC_DSI_EOT

Synchronization Signal is DSI End of refresh

HAL_DMAMUX1_SYNC_DMA2D_EOT

Synchronization Signal is DMA2D End of Transfer

HAL_DMAMUX1_SYNC_LDTC_IT

Synchronization Signal is LDTC IT

24 HAL DSI Generic Driver

24.1 DSI Firmware driver registers structures

24.1.1 DSI_InitTypeDef

DSI_InitTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t AutomaticClockLaneControl***
- ***uint32_t TXEscapeCkdiv***
- ***uint32_t NumberOfLanes***

Field Documentation

- ***uint32_t DSI_InitTypeDef::AutomaticClockLaneControl***
  Automatic clock lane control This parameter can be any value of ***DSI_Automatic_Clk_Lane_Control***
- ***uint32_t DSI_InitTypeDef::TXEscapeCkdiv***
  TX Escape clock division The values 0 and 1 stop the TX_ESC clock generation
- ***uint32_t DSI_InitTypeDef::NumberOfLanes***
  Number of lanes This parameter can be any value of ***DSI_Number_Of_Lanes***

24.1.2 DSI_PLLInitTypeDef

DSI_PLLInitTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t PLLNDIV***
- ***uint32_t PLLIDF***
- ***uint32_t PLLODF***

Field Documentation

- ***uint32_t DSI_PLLInitTypeDef::PLLNDIV***
  PLL Loop Division Factor This parameter must be a value between 10 and 125
- ***uint32_t DSI_PLLInitTypeDef::PLLIDF***
  PLL Input Division Factor This parameter can be any value of ***DSI_PLL_IDF***
- ***uint32_t DSI_PLLInitTypeDef::PLLODF***
  PLL Output Division Factor This parameter can be any value of ***DSI_PLL_ODF***

24.1.3 DSI_VidCfgTypeDef

DSI_VidCfgTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t VirtualChannelID***
- ***uint32_t ColorCoding***
- ***uint32_t LooselyPacked***
- ***uint32_t Mode***
- ***uint32_t PacketSize***
- ***uint32_t NumberOfChunks***
- ***uint32_t NullPacketSize***
- ***uint32_t HSPolarity***
- ***uint32_t VSPolarity***
- ***uint32_t DEPolarity***
- ***uint32_t HorizontalSyncActive***
- ***uint32_t HorizontalBackPorch***

- ***uint32_t HorizontalLine***
- ***uint32_t VerticalSyncActive***
- ***uint32_t VerticalBackPorch***
- ***uint32_t VerticalFrontPorch***
- ***uint32_t VerticalActive***
- ***uint32_t LPCommandEnable***
- ***uint32_t LPLargestPacketSize***
- ***uint32_t LPVACTLargestPacketSize***
- ***uint32_t LPHorizontalFrontPorchEnable***
- ***uint32_t LPHorizontalBackPorchEnable***
- ***uint32_t LPVerticalActiveEnable***
- ***uint32_t LPVerticalFrontPorchEnable***
- ***uint32_t LPVerticalBackPorchEnable***
- ***uint32_t LPVerticalSyncActiveEnable***
- ***uint32_t FrameBTAAcknowledgeEnable***

Field Documentation

- ***uint32_t DSI_VidCfgTypeDef::VirtualChannelID***
  Virtual channel ID
- ***uint32_t DSI_VidCfgTypeDef::ColorCoding***
  Color coding for LTDC interface This parameter can be any value of ***DSI_Color_Coding***
- ***uint32_t DSI_VidCfgTypeDef::LooselyPacked***
  Enable or disable loosely packed stream (needed only when using 18-bit configuration). This parameter can be any value of ***DSI_LooselyPacked***
- ***uint32_t DSI_VidCfgTypeDef::Mode***
  Video mode type This parameter can be any value of ***DSI_Video_Mode_Type***
- ***uint32_t DSI_VidCfgTypeDef::PacketSize***
  Video packet size
- ***uint32_t DSI_VidCfgTypeDef::NumberOfChunks***
  Number of chunks
- ***uint32_t DSI_VidCfgTypeDef::NullPacketSize***
  Null packet size
- ***uint32_t DSI_VidCfgTypeDef::HSPolarity***
  HSYNC pin polarity This parameter can be any value of ***DSI_HSYNC_Polarity***
- ***uint32_t DSI_VidCfgTypeDef::VSPolarity***
  VSYNC pin polarity This parameter can be any value of ***DSI_VSYNC_Active_Polarity***
- ***uint32_t DSI_VidCfgTypeDef::DEPolarity***
  Data Enable pin polarity This parameter can be any value of ***DSI_DATA_ENABLE_Polarity***
- ***uint32_t DSI_VidCfgTypeDef::HorizontalSyncActive***
  Horizontal synchronism active duration (in lane byte clock cycles)
- ***uint32_t DSI_VidCfgTypeDef::HorizontalBackPorch***
  Horizontal back-porch duration (in lane byte clock cycles)
- ***uint32_t DSI_VidCfgTypeDef::HorizontalLine***
  Horizontal line duration (in lane byte clock cycles)
- ***uint32_t DSI_VidCfgTypeDef::VerticalSyncActive***
  Vertical synchronism active duration
- ***uint32_t DSI_VidCfgTypeDef::VerticalBackPorch***
  Vertical back-porch duration
- ***uint32_t DSI_VidCfgTypeDef::VerticalFrontPorch***
  Vertical front-porch duration

- ***uint32_t DSI_VidCfgTypeDef::VerticalActive***
  Vertical active duration
- ***uint32_t DSI_VidCfgTypeDef::LPCommandEnable***
  Low-power command enable This parameter can be any value of ***DSI_LP_Command***
- ***uint32_t DSI_VidCfgTypeDef::LPLargestPacketSize***
  The size, in bytes, of the low power largest packet that can fit in a line during VSA, VBP and VFP regions
- ***uint32_t DSI_VidCfgTypeDef::LPVACTLargestPacketSize***
  The size, in bytes, of the low power largest packet that can fit in a line during VACT region
- ***uint32_t DSI_VidCfgTypeDef::LPHorizontalFrontPorchEnable***
  Low-power horizontal front-porch enable This parameter can be any value of ***DSI_LP_HFP***
- ***uint32_t DSI_VidCfgTypeDef::LPHorizontalBackPorchEnable***
  Low-power horizontal back-porch enable This parameter can be any value of ***DSI_LP_HBP***
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalActiveEnable***
  Low-power vertical active enable This parameter can be any value of ***DSI_LP_VACT***
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalFrontPorchEnable***
  Low-power vertical front-porch enable This parameter can be any value of ***DSI_LP_VFP***
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalBackPorchEnable***
  Low-power vertical back-porch enable This parameter can be any value of ***DSI_LP_VBP***
- ***uint32_t DSI_VidCfgTypeDef::LPVerticalSyncActiveEnable***
  Low-power vertical sync active enable This parameter can be any value of ***DSI_LP_VSYNC***
- ***uint32_t DSI_VidCfgTypeDef::FrameBTAAcknowledgeEnable***
  Frame bus-turn-around acknowledge enable This parameter can be any value of ***DSI_FBTA_acknowledge***

24.1.4 DSI_CmdCfgTypeDef

DSI_CmdCfgTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t VirtualChannelID***
- ***uint32_t ColorCoding***
- ***uint32_t CommandSize***
- ***uint32_t TearingEffectSource***
- ***uint32_t TearingEffectPolarity***
- ***uint32_t HSPolarity***
- ***uint32_t VSPolarity***
- ***uint32_t DEPolarity***
- ***uint32_t VSyncPol***
- ***uint32_t AutomaticRefresh***
- ***uint32_t TEAcknowledgeRequest***

Field Documentation

- ***uint32_t DSI_CmdCfgTypeDef::VirtualChannelID***
  Virtual channel ID
- ***uint32_t DSI_CmdCfgTypeDef::ColorCoding***
  Color coding for LTDC interface This parameter can be any value of ***DSI_Color_Coding***
- ***uint32_t DSI_CmdCfgTypeDef::CommandSize***
  Maximum allowed size for an LTDC write memory command, measured in pixels. This parameter can be any value between 0x00 and 0xFFFFU
- ***uint32_t DSI_CmdCfgTypeDef::TearingEffectSource***
  Tearing effect source This parameter can be any value of ***DSI_TearingEffectSource***
- ***uint32_t DSI_CmdCfgTypeDef::TearingEffectPolarity***
  Tearing effect pin polarity This parameter can be any value of ***DSI_TearingEffectPolarity***

- ***uint32_t DSI_CmdCfgTypeDef::HSPolarity***
  HSYNC pin polarity This parameter can be any value of ***DSI_HSYNC_Polarity***
- ***uint32_t DSI_CmdCfgTypeDef::VSPolarity***
  VSYNC pin polarity This parameter can be any value of ***DSI_VSYNC_Active_Polarity***
- ***uint32_t DSI_CmdCfgTypeDef::DEPolarity***
  Data Enable pin polarity This parameter can be any value of ***DSI_DATA_ENABLE_Polarity***
- ***uint32_t DSI_CmdCfgTypeDef::VSyncPol***
  VSync edge on which the LTDC is halted This parameter can be any value of ***DSI_Vsync_Polarity***
- ***uint32_t DSI_CmdCfgTypeDef::AutomaticRefresh***
  Automatic refresh mode This parameter can be any value of ***DSI_AutomaticRefresh***
- ***uint32_t DSI_CmdCfgTypeDef::TEAcknowledgeRequest***
  Tearing Effect Acknowledge Request Enable This parameter can be any value of ***DSI_TE_AcknowledgeRequest***

24.1.5 DSI_LPCmdTypeDef

DSI_LPCmdTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t LPGenShortWriteNoP***
- ***uint32_t LPGenShortWriteOneP***
- ***uint32_t LPGenShortWriteTwoP***
- ***uint32_t LPGenShortReadNoP***
- ***uint32_t LPGenShortReadOneP***
- ***uint32_t LPGenShortReadTwoP***
- ***uint32_t LPGenLongWrite***
- ***uint32_t LPDcsShortWriteNoP***
- ***uint32_t LPDcsShortWriteOneP***
- ***uint32_t LPDcsShortReadNoP***
- ***uint32_t LPDcsLongWrite***
- ***uint32_t LPMaxReadPacket***
- ***uint32_t AcknowledgeRequest***

Field Documentation

- ***uint32_t DSI_LPCmdTypeDef::LPGenShortWriteNoP***
  Generic Short Write Zero parameters Transmission This parameter can be any value of ***DSI_LP_LPGenShortWriteNoP***
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortWriteOneP***
  Generic Short Write One parameter Transmission This parameter can be any value of ***DSI_LP_LPGenShortWriteOneP***
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortWriteTwoP***
  Generic Short Write Two parameters Transmission This parameter can be any value of ***DSI_LP_LPGenShortWriteTwoP***
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortReadNoP***
  Generic Short Read Zero parameters Transmission This parameter can be any value of ***DSI_LP_LPGenShortReadNoP***
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortReadOneP***
  Generic Short Read One parameter Transmission This parameter can be any value of ***DSI_LP_LPGenShortReadOneP***
- ***uint32_t DSI_LPCmdTypeDef::LPGenShortReadTwoP***
  Generic Short Read Two parameters Transmission This parameter can be any value of ***DSI_LP_LPGenShortReadTwoP***
- ***uint32_t DSI_LPCmdTypeDef::LPGenLongWrite***
  Generic Long Write Transmission This parameter can be any value of ***DSI_LP_LPGenLongWrite***

- ***uint32_t DSI_LPCmdTypeDef::LPDcsShortWriteNoP***
  DCS Short Write Zero parameters Transmission This parameter can be any value of ***DSI_LP_LPDcsShortWriteNoP***
- ***uint32_t DSI_LPCmdTypeDef::LPDcsShortWriteOneP***
  DCS Short Write One parameter Transmission This parameter can be any value of ***DSI_LP_LPDcsShortWriteOneP***
- ***uint32_t DSI_LPCmdTypeDef::LPDcsShortReadNoP***
  DCS Short Read Zero parameters Transmission This parameter can be any value of ***DSI_LP_LPDcsShortReadNoP***
- ***uint32_t DSI_LPCmdTypeDef::LPDcsLongWrite***
  DCS Long Write Transmission This parameter can be any value of ***DSI_LP_LPDcsLongWrite***
- ***uint32_t DSI_LPCmdTypeDef::LPMaxReadPacket***
  Maximum Read Packet Size Transmission This parameter can be any value of ***DSI_LP_LPMaxReadPacket***
- ***uint32_t DSI_LPCmdTypeDef::AcknowledgeRequest***
  Acknowledge Request Enable This parameter can be any value of ***DSI_AcknowledgeRequest***

24.1.6 DSI_PHY_TimerTypeDef

DSI_PHY_TimerTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t ClockLaneHS2LPTime***
- ***uint32_t ClockLaneLP2HSTime***
- ***uint32_t DataLaneHS2LPTime***
- ***uint32_t DataLaneLP2HSTime***
- ***uint32_t DataLaneMaxReadTime***
- ***uint32_t StopWaitTime***

Field Documentation

- ***uint32_t DSI_PHY_TimerTypeDef::ClockLaneHS2LPTime***
  The maximum time that the D-PHY clock lane takes to go from high-speed to low-power transmission
- ***uint32_t DSI_PHY_TimerTypeDef::ClockLaneLP2HSTime***
  The maximum time that the D-PHY clock lane takes to go from low-power to high-speed transmission
- ***uint32_t DSI_PHY_TimerTypeDef::DataLaneHS2LPTime***
  The maximum time that the D-PHY data lanes takes to go from high-speed to low-power transmission
- ***uint32_t DSI_PHY_TimerTypeDef::DataLaneLP2HSTime***
  The maximum time that the D-PHY data lanes takes to go from low-power to high-speed transmission
- ***uint32_t DSI_PHY_TimerTypeDef::DataLaneMaxReadTime***
  The maximum time required to perform a read command
- ***uint32_t DSI_PHY_TimerTypeDef::StopWaitTime***
  The minimum wait period to request a High-Speed transmission after the Stop state

24.1.7 DSI_HOST_TimeoutTypeDef

DSI_HOST_TimeoutTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***uint32_t TimeoutCkdiv***
- ***uint32_t HighSpeedTransmissionTimeout***
- ***uint32_t LowPowerReceptionTimeout***
- ***uint32_t HighSpeedReadTimeout***
- ***uint32_t LowPowerReadTimeout***
- ***uint32_t HighSpeedWriteTimeout***
- ***uint32_t HighSpeedWritePrespMode***
- ***uint32_t LowPowerWriteTimeout***

- ***uint32_t BTATimeout***

Field Documentation

- ***uint32_t DSI_HOST_TimeoutTypeDef::TimeoutCkdiv***
  Time-out clock division
- ***uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedTransmissionTimeout***
  High-speed transmission time-out
- ***uint32_t DSI_HOST_TimeoutTypeDef::LowPowerReceptionTimeout***
  Low-power reception time-out
- ***uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedReadTimeout***
  High-speed read time-out
- ***uint32_t DSI_HOST_TimeoutTypeDef::LowPowerReadTimeout***
  Low-power read time-out
- ***uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedWriteTimeout***
  High-speed write time-out
- ***uint32_t DSI_HOST_TimeoutTypeDef::HighSpeedWritePrespMode***
  High-speed write presp mode This parameter can be any value of ***DSI_HS_PrespMode***
- ***uint32_t DSI_HOST_TimeoutTypeDef::LowPowerWriteTimeout***
  Low-speed write time-out
- ***uint32_t DSI_HOST_TimeoutTypeDef::BTATimeout***
  BTA time-out

24.1.8 DSI_HandleTypeDef

DSI_HandleTypeDef is defined in the stm32l4xx_hal_dsi.h

Data Fields

- ***DSI_TypeDef * Instance***
- ***DSI_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_DSI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***uint32_t ErrorMsk***

Field Documentation

- ***DSI_TypeDef* DSI_HandleTypeDef::Instance***
  Register base address
- ***DSI_InitTypeDef DSI_HandleTypeDef::Init***
  DSI required parameters
- ***HAL_LockTypeDef DSI_HandleTypeDef::Lock***
  DSI peripheral status
- ***__IO HAL_DSI_StateTypeDef DSI_HandleTypeDef::State***
  DSI communication state
- ***__IO uint32_t DSI_HandleTypeDef::ErrorCode***
  DSI Error code
- ***uint32_t DSI_HandleTypeDef::ErrorMsk***
  DSI Error monitoring mask

24.2 DSI Firmware driver API description

The following section lists the various functions of the DSI library.

24.2.1 How to use this driver

The DSI HAL driver can be used as follows:

1. Declare a DSI_HandleTypeDef handle structure, for example: DSI_HandleTypeDef hdsi;
2. Initialize the DSI low level resources by implementing the HAL_DSI_MspInit() API:
   a. Enable the DSI interface clock
   b. NVIC configuration if you need to use interrupt process
      - Configure the DSI interrupt priority
      - Enable the NVIC DSI IRQ Channel
3. Initialize the DSI Host peripheral, the required PLL parameters, number of lances and TX Escape clock divider by calling the HAL_DSI_Init() API which calls HAL_DSI_MspInit().

Configuration

1. Use HAL_DSI_ConfigAdaptedCommandMode() function to configure the DSI host in adapted command mode.
2. When operating in video mode , use HAL_DSI_ConfigVideoMode() to configure the DSI host.
3. Function HAL_DSI_ConfigCommand() is used to configure the DSI commands behavior in low power mode.
4. To configure the DSI PHY timings parameters, use function HAL_DSI_ConfigPhyTimer().
5. The DSI Host can be started/stopped using respectively functions HAL_DSI_Start() and HAL_DSI_Stop(). Functions HAL_DSI_ShortWrite(), HAL_DSI_LongWrite() and HAL_DSI_Read() allows respectively to write DSI short packets, long packets and to read DSI packets.
6. The DSI Host Offers two Low power modes :
   – Low Power Mode on data lanes only: Only DSI data lanes are shut down. It is possible to enter/exit from this mode using respectively functions HAL_DSI_EnterULPMData() and HAL_DSI_ExitULPMData()
   – Low Power Mode on data and clock lanes : All DSI lanes are shut down including data and clock lanes. It is possible to enter/exit from this mode using respectively functions HAL_DSI_EnterULPM() and HAL_DSI_ExitULPM()
7. To control DSI state you can use the following function: HAL_DSI_GetState()

Error management

1. User can select the DSI errors to be reported/monitored using function HAL_DSI_ConfigErrorMonitor() When an error occurs, the callback HAL_DSI_ErrorCallback() is asserted and then user can retrieve the error code by calling function HAL_DSI_GetError()

DSI HAL driver macros list

Below the list of most used macros in DSI HAL driver.

- __HAL_DSI_ENABLE: Enable the DSI Host.
- __HAL_DSI_DISABLE: Disable the DSI Host.
- __HAL_DSI_WRAPPER_ENABLE: Enables the DSI wrapper.
- __HAL_DSI_WRAPPER_DISABLE: Disable the DSI wrapper.
- __HAL_DSI_PLL_ENABLE: Enables the DSI PLL.
- __HAL_DSI_PLL_DISABLE: Disables the DSI PLL.
- __HAL_DSI_REG_ENABLE: Enables the DSI regulator.
- __HAL_DSI_REG_DISABLE: Disables the DSI regulator.
- __HAL_DSI_GET_FLAG: Get the DSI pending flags.
- __HAL_DSI_CLEAR_FLAG: Clears the DSI pending flags.
- __HAL_DSI_ENABLE_IT: Enables the specified DSI interrupts.
- __HAL_DSI_DISABLE_IT: Disables the specified DSI interrupts.
- __HAL_DSI_GET_IT_SOURCE: Checks whether the specified DSI interrupt source is enabled or not.

Note: You can refer to the DSI HAL driver header file for more useful macros

Callback registration

The compilation define USE_HAL_DSI_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Function HAL_DSI_RegisterCallback() to register a callback.

Function HAL_DSI_RegisterCallback() allows to register following callbacks:

- TearingEffectCallback : DSI Tearing Effect Callback.
- EndOfRefreshCallback : DSI End Of Refresh Callback.
- ErrorCallback : DSI Error Callback
- MspInitCallback : DSI MspInit.
- MspDeInitCallback : DSI MspDeInit.

This function takes as parameters the HAL peripheral handle, the callback ID and a pointer to the user callback function.

Use function HAL_DSI_UnRegisterCallback() to reset a callback to the default weak function. HAL_DSI_UnRegisterCallback takes as parameters the HAL peripheral handle, and the callback ID.

This function allows to reset following callbacks:

- TearingEffectCallback : DSI Tearing Effect Callback.
- EndOfRefreshCallback : DSI End Of Refresh Callback.
- ErrorCallback : DSI Error Callback
- MspInitCallback : DSI MspInit.
- MspDeInitCallback : DSI MspDeInit.

By default, after the HAL_DSI_Init and when the state is HAL_DSI_STATE_RESET all callbacks are set to the corresponding weak functions: examples HAL_DSI_TearingEffectCallback(), HAL_DSI_EndOfRefreshCallback(). Exception done for MspInit and MspDeInit functions that are respectively reset to the legacy weak (surcharged) functions in the HAL_DSI_Init() and HAL_DSI_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the HAL_DSI_Init() and HAL_DSI_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_DSI_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_DSI_STATE_READY or HAL_DSI_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using HAL_DSI_RegisterCallback() before calling HAL_DSI_DeInit() or HAL_DSI_Init() function.

When The compilation define USE_HAL_DSI_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

24.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the DSI
- De-initialize the DSI

This section contains the following APIs:

- ***HAL_DSI_Init***
- ***HAL_DSI_DeInit***
- ***HAL_DSI_ConfigErrorMonitor***
- ***HAL_DSI_MspInit***
- ***HAL_DSI_MspDeInit***

24.2.3 IO operation functions

This section provides function allowing to:

- Handle DSI interrupt request

This section contains the following APIs:

- ***HAL_DSI_IRQHandler***
- ***HAL_DSI_TearingEffectCallback***

- ***HAL_DSI_EndOfRefreshCallback***
- ***HAL_DSI_ErrorCallback***

24.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the Generic interface read-back Virtual Channel ID
- Select video mode and configure the corresponding parameters
- Configure command transmission mode: High-speed or Low-power
- Configure the flow control
- Configure the DSI PHY timer
- Configure the DSI HOST timeout
- Configure the DSI HOST timeout
- Start/Stop the DSI module
- Refresh the display in command mode
- Controls the display color mode in Video mode
- Control the display shutdown in Video mode
- write short DCS or short Generic command
- write long DCS or long Generic command
- Read command (DCS or generic)
- Enter/Exit the Ultra Low Power Mode on data only (D-PHY PLL running)
- Enter/Exit the Ultra Low Power Mode on data only and clock (D-PHY PLL turned off)
- Start/Stop test pattern generation
- Slew-Rate And Delay Tuning
- Low-Power Reception Filter Tuning
- Activate an additional current path on all lanes to meet the SDDTx parameter
- Custom lane pins configuration
- Set custom timing for the PHY
- Force the Clock/Data Lane in TX Stop Mode
- Force LP Receiver in Low-Power Mode
- Force Data Lanes in RX Mode after a BTA
- Enable a pull-down on the lanes to prevent from floating states when unused
- Switch off the contention detection on data lanes

This section contains the following APIs:

- ***HAL_DSI_SetGenericVCID***
- ***HAL_DSI_ConfigVideoMode***
- ***HAL_DSI_ConfigAdaptedCommandMode***
- ***HAL_DSI_ConfigCommand***
- ***HAL_DSI_ConfigFlowControl***
- ***HAL_DSI_ConfigPhyTimer***
- ***HAL_DSI_ConfigHostTimeouts***
- ***HAL_DSI_Start***
- ***HAL_DSI_Stop***
- ***HAL_DSI_Refresh***
- ***HAL_DSI_ColorMode***
- ***HAL_DSI_Shutdown***
- ***HAL_DSI_ShortWrite***
- ***HAL_DSI_LongWrite***
- ***HAL_DSI_Read***

- *HAL_DSI_EnterULPMData*
- *HAL_DSI_ExitULPMData*
- *HAL_DSI_EnterULPM*
- *HAL_DSI_ExitULPM*
- *HAL_DSI_PatternGeneratorStart*
- *HAL_DSI_PatternGeneratorStop*
- *HAL_DSI_SetSlewRateAndDelayTuning*
- *HAL_DSI_SetLowPowerRXFilter*
- *HAL_DSI_SetSDD*
- *HAL_DSI_SetLanePinsConfiguration*
- *HAL_DSI_SetPHYTimings*
- *HAL_DSI_ForceTXStopMode*
- *HAL_DSI_ForceRXLowPower*
- *HAL_DSI_ForceDataLanesInRX*
- *HAL_DSI_SetPullDown*
- *HAL_DSI_SetContentionDetectionOff*

24.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the DSI state.
- Get error code.

This section contains the following APIs:

- *HAL_DSI_GetState*
- *HAL_DSI_GetError*

24.2.6 Detailed description of functions

`HAL_DSI_Init`

Function name

HAL_StatusTypeDef HAL_DSI_Init (DSI_HandleTypeDef * hdsi, DSI_PLLInitTypeDef * PLLInit)

Function description

Initializes the DSI according to the specified parameters in the DSI_InitTypeDef and create the associated handle.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **PLLInit:** pointer to a DSI_PLLInitTypeDef structure that contains the PLL Clock structure definition for the DSI.

Return values

- **HAL:** status

`HAL_DSI_DeInit`

Function name

HAL_StatusTypeDef HAL_DSI_DeInit (DSI_HandleTypeDef * hdsi)

Function description

De-initializes the DSI peripheral registers to their default reset values.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_MspInit`

Function name

void HAL_DSI_MspInit (DSI_HandleTypeDef * hdsi)

Function description

Initializes the DSI MSP.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **None:**

`HAL_DSI_MspDeInit`

Function name

void HAL_DSI_MspDeInit (DSI_HandleTypeDef * hdsi)

Function description

De-initializes the DSI MSP.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **None:**

`HAL_DSI_IRQHandler`

Function name

void HAL_DSI_IRQHandler (DSI_HandleTypeDef * hdsi)

Function description

Handles DSI interrupt request.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_TearingEffectCallback`

Function name

void HAL_DSI_TearingEffectCallback (DSI_HandleTypeDef * hdsi)

Function description

Tearing Effect DSI callback.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **None:**

`HAL_DSI_EndOfRefreshCallback`

Function name

void HAL_DSI_EndOfRefreshCallback (DSI_HandleTypeDef * hdsi)

Function description

End of Refresh DSI callback.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **None:**

`HAL_DSI_ErrorCallback`

Function name

void HAL_DSI_ErrorCallback (DSI_HandleTypeDef * hdsi)

Function description

Operation Error DSI callback.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **None:**

`HAL_DSI_SetGenericVCID`

Function name

HAL_StatusTypeDef HAL_DSI_SetGenericVCID (DSI_HandleTypeDef * hdsi, uint32_t VirtualChannelID)

Function description

Configure the Generic interface read-back Virtual Channel ID.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **VirtualChannelID:** Virtual channel ID

Return values

- **HAL:** status

`HAL_DSI_ConfigVideoMode`

Function name

HAL_StatusTypeDef HAL_DSI_ConfigVideoMode (DSI_HandleTypeDef * hdsi, DSI_VidCfgTypeDef * VidCfg)

Function description

Select video mode and configure the corresponding parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **VidCfg:** pointer to a DSI_VidCfgTypeDef structure that contains the DSI video mode configuration parameters

Return values

- **HAL:** status

HAL_DSI_ConfigAdaptedCommandMode

Function name

HAL_StatusTypeDef HAL_DSI_ConfigAdaptedCommandMode (DSI_HandleTypeDef * hdsi, DSI_CmdCfgTypeDef * CmdCfg)

Function description

Select adapted command mode and configure the corresponding parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **CmdCfg:** pointer to a DSI_CmdCfgTypeDef structure that contains the DSI command mode configuration parameters

Return values

- **HAL:** status

HAL_DSI_ConfigCommand

Function name

HAL_StatusTypeDef HAL_DSI_ConfigCommand (DSI_HandleTypeDef * hdsi, DSI_LPCmdTypeDef * LPCmd)

Function description

Configure command transmission mode: High-speed or Low-power and enable/disable acknowledge request after packet transmission.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **LPCmd:** pointer to a DSI_LPCmdTypeDef structure that contains the DSI command transmission mode configuration parameters

Return values

- **HAL:** status

HAL_DSI_ConfigFlowControl

Function name

HAL_StatusTypeDef HAL_DSI_ConfigFlowControl (DSI_HandleTypeDef * hdsi, uint32_t FlowControl)

Function description

Configure the flow control parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **FlowControl:** flow control feature(s) to be enabled. This parameter can be any combination of
  - DSI_FlowControl.

Return values

- **HAL:** status

`HAL_DSI_ConfigPhyTimer`

Function name

HAL_StatusTypeDef HAL_DSI_ConfigPhyTimer (DSI_HandleTypeDef * hdsi, DSI_PHY_TimerTypeDef * PhyTimers)

Function description

Configure the DSI PHY timer parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **PhyTimers:** DSI_PHY_TimerTypeDef structure that contains the DSI PHY timing parameters

Return values

- **HAL:** status

`HAL_DSI_ConfigHostTimeouts`

Function name

HAL_StatusTypeDef HAL_DSI_ConfigHostTimeouts (DSI_HandleTypeDef * hdsi, DSI_HOST_TimeoutTypeDef * HostTimeouts)

Function description

Configure the DSI HOST timeout parameters.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **HostTimeouts:** DSI_HOST_TimeoutTypeDef structure that contains the DSI host timeout parameters

Return values

- **HAL:** status

`HAL_DSI_Start`

Function name

HAL_StatusTypeDef HAL_DSI_Start (DSI_HandleTypeDef * hdsi)

Function description

Start the DSI module.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_Stop`

Function name

HAL_StatusTypeDef HAL_DSI_Stop (DSI_HandleTypeDef * hdsi)

Function description

Stop the DSI module.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_Refresh`

Function name

HAL_StatusTypeDef HAL_DSI_Refresh (DSI_HandleTypeDef * hdsi)

Function description

Refresh the display in command mode.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_ColorMode`

Function name

HAL_StatusTypeDef HAL_DSI_ColorMode (DSI_HandleTypeDef * hdsi, uint32_t ColorMode)

Function description

Controls the display color mode in Video mode.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **ColorMode:** Color mode (full or 8-colors). This parameter can be any value of
  - DSI_Color_Mode

Return values

- **HAL:** status

`HAL_DSI_Shutdown`

Function name

HAL_StatusTypeDef HAL_DSI_Shutdown (DSI_HandleTypeDef * hdsi, uint32_t Shutdown)

Function description

Control the display shutdown in Video mode.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **Shutdown:** Shut-down (Display-ON or Display-OFF). This parameter can be any value of
  - DSI_ShutDown

Return values

- **HAL:** status

HAL_DSI_ShortWrite

Function name

HAL_StatusTypeDef HAL_DSI_ShortWrite (DSI_HandleTypeDef * hdsi, uint32_t ChannelID, uint32_t Mode, uint32_t Param1, uint32_t Param2)

Function description

write short DCS or short Generic command

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **ChannelID:** Virtual channel ID.
- **Mode:** DSI short packet data type. This parameter can be any value of
  - DSI_SHORT_WRITE_PKT_Data_Type.
- **Param1:** DSC command or first generic parameter. This parameter can be any value of
  - DSI_DCS_Command or a generic command code.
- **Param2:** DSC parameter or second generic parameter.

Return values

- **HAL:** status

HAL_DSI_LongWrite

Function name

HAL_StatusTypeDef HAL_DSI_LongWrite (DSI_HandleTypeDef * hdsi, uint32_t ChannelID, uint32_t Mode, uint32_t NbParams, uint32_t Param1, uint8_t * ParametersTable)

Function description

write long DCS or long Generic command

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **ChannelID:** Virtual channel ID.
- **Mode:** DSI long packet data type. This parameter can be any value of
  - DSI_LONG_WRITE_PKT_Data_Type.
- **NbParams:** Number of parameters.
- **Param1:** DSC command or first generic parameter. This parameter can be any value of
  - DSI_DCS_Command or a generic command code
- **ParametersTable:** Pointer to parameter values table.

Return values

- **HAL:** status

HAL_DSI_Read

Function name

HAL_StatusTypeDef HAL_DSI_Read (DSI_HandleTypeDef * hdsi, uint32_t ChannelNbr, uint8_t * Array, uint32_t Size, uint32_t Mode, uint32_t DCSCmd, uint8_t * ParametersTable)

Function description

Read command (DCS or generic)

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **ChannelNbr:** Virtual channel ID
- **Array:** pointer to a buffer to store the payload of a read back operation.
- **Size:** Data size to be read (in byte).
- **Mode:** DSI read packet data type. This parameter can be any value of
  – DSI_SHORT_READ_PKT_Data_Type.
- **DCSCmd:** DCS get/read command.
- **ParametersTable:** Pointer to parameter values table.

Return values

- **HAL:** status

`HAL_DSI_EnterULPMData`

Function name

HAL_StatusTypeDef HAL_DSI_EnterULPMData (DSI_HandleTypeDef * hdsi)

Function description

Enter the ULPM (Ultra Low Power Mode) with the D-PHY PLL running (only data lanes are in ULPM)

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_ExitULPMData`

Function name

HAL_StatusTypeDef HAL_DSI_ExitULPMData (DSI_HandleTypeDef * hdsi)

Function description

Exit the ULPM (Ultra Low Power Mode) with the D-PHY PLL running (only data lanes are in ULPM)

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

`HAL_DSI_EnterULPM`

Function name

HAL_StatusTypeDef HAL_DSI_EnterULPM (DSI_HandleTypeDef * hdsi)

Function description

Enter the ULPM (Ultra Low Power Mode) with the D-PHY PLL turned off (both data and clock lanes are in ULPM)

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

HAL_DSI_ExitULPM

Function name

HAL_StatusTypeDef HAL_DSI_ExitULPM (DSI_HandleTypeDef * hdsi)

Function description

Exit the ULPM (Ultra Low Power Mode) with the D-PHY PLL turned off (both data and clock lanes are in ULPM)

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

HAL_DSI_PatternGeneratorStart

Function name

HAL_StatusTypeDef HAL_DSI_PatternGeneratorStart (DSI_HandleTypeDef * hdsi, uint32_t Mode, uint32_t Orientation)

Function description

Start test pattern generation.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **Mode:** Pattern generator mode This parameter can be one of the following values: 0 : Color bars (horizontal or vertical) 1 : BER pattern (vertical only)
- **Orientation:** Pattern generator orientation This parameter can be one of the following values: 0 : Vertical color bars 1 : Horizontal color bars

Return values

- **HAL:** status

HAL_DSI_PatternGeneratorStop

Function name

HAL_StatusTypeDef HAL_DSI_PatternGeneratorStop (DSI_HandleTypeDef * hdsi)

Function description

Stop test pattern generation.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** status

HAL_DSI_SetSlewRateAndDelayTuning

Function name

HAL_StatusTypeDef HAL_DSI_SetSlewRateAndDelayTuning (DSI_HandleTypeDef * hdsi, uint32_t CommDelay, uint32_t Lane, uint32_t Value)

Function description

Set Slew-Rate And Delay Tuning.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **CommDelay:** Communication delay to be adjusted. This parameter can be any value of
  - DSI_Communication_Delay
- **Lane:** select between clock or data lanes. This parameter can be any value of
  - DSI_Lane_Group
- **Value:** Custom value of the slew-rate or delay

Return values

- **HAL:** status

`HAL_DSI_SetLowPowerRXFilter`

Function name

HAL_StatusTypeDef HAL_DSI_SetLowPowerRXFilter (DSI_HandleTypeDef * hdsi, uint32_t Frequency)

Function description

Low-Power Reception Filter Tuning.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **Frequency:** cutoff frequency of low-pass filter at the input of LPRX

Return values

- **HAL:** status

`HAL_DSI_SetSDD`

Function name

HAL_StatusTypeDef HAL_DSI_SetSDD (DSI_HandleTypeDef * hdsi, FunctionalState State)

Function description

Activate an additional current path on all lanes to meet the SDDTx parameter defined in the MIPI D-PHY specification.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

`HAL_DSI_SetLanePinsConfiguration`

Function name

HAL_StatusTypeDef HAL_DSI_SetLanePinsConfiguration (DSI_HandleTypeDef * hdsi, uint32_t CustomLane, uint32_t Lane, FunctionalState State)

Function description

Custom lane pins configuration.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **CustomLane:** Function to be applyed on selected lane. This parameter can be any value of
  - DSI_CustomLane
- **Lane:** select between clock or data lane 0 or data lane 1. This parameter can be any value of
  - DSI_Lane_Select
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

`HAL_DSI_SetPHYTimings`

Function name

HAL_StatusTypeDef HAL_DSI_SetPHYTimings (DSI_HandleTypeDef * hdsi, uint32_t Timing, FunctionalState State, uint32_t Value)

Function description

Set custom timing for the PHY.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **Timing:** PHY timing to be adjusted. This parameter can be any value of
  - DSI_PHY_Timing
- **State:** ENABLE or DISABLE
- **Value:** Custom value of the timing

Return values

- **HAL:** status

`HAL_DSI_ForceTXStopMode`

Function name

HAL_StatusTypeDef HAL_DSI_ForceTXStopMode (DSI_HandleTypeDef * hdsi, uint32_t Lane, FunctionalState State)

Function description

Force the Clock/Data Lane in TX Stop Mode.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **Lane:** select between clock or data lanes. This parameter can be any value of
  - DSI_Lane_Group
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

`HAL_DSI_ForceRXLowPower`

Function name

HAL_StatusTypeDef HAL_DSI_ForceRXLowPower (DSI_HandleTypeDef * hdsi, FunctionalState State)

Function description

Force LP Receiver in Low-Power Mode.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

`HAL_DSI_ForceDataLanesInRX`

Function name

HAL_StatusTypeDef HAL_DSI_ForceDataLanesInRX (DSI_HandleTypeDef * hdsi, FunctionalState State)

Function description

Force Data Lanes in RX Mode after a BTA.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

`HAL_DSI_SetPullDown`

Function name

HAL_StatusTypeDef HAL_DSI_SetPullDown (DSI_HandleTypeDef * hdsi, FunctionalState State)

Function description

Enable a pull-down on the lanes to prevent from floating states when unused.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

`HAL_DSI_SetContentionDetectionOff`

Function name

HAL_StatusTypeDef HAL_DSI_SetContentionDetectionOff (DSI_HandleTypeDef * hdsi, FunctionalState State)

Function description

Switch off the contention detection on data lanes.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **State:** ENABLE or DISABLE

Return values

- **HAL:** status

HAL_DSI_GetError

Function name

uint32_t HAL_DSI_GetError (DSI_HandleTypeDef * hdsi)

Function description

Return the DSI error code.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **DSI:** Error Code

HAL_DSI_ConfigErrorMonitor

Function name

HAL_StatusTypeDef HAL_DSI_ConfigErrorMonitor (DSI_HandleTypeDef * hdsi, uint32_t ActiveErrors)

Function description

Enable the error monitor flags.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.
- **ActiveErrors:** indicates which error interrupts will be enabled. This parameter can be any combination of
  – DSI_Error_Data_Type.

Return values

- **HAL:** status

HAL_DSI_GetState

Function name

HAL_DSI_StateTypeDef HAL_DSI_GetState (DSI_HandleTypeDef * hdsi)

Function description

Return the DSI state.

Parameters

- **hdsi:** pointer to a DSI_HandleTypeDef structure that contains the configuration information for the DSI.

Return values

- **HAL:** state

24.3 DSI Firmware driver defines

The following section lists the various define and macros of the module.

24.3.1 DSI

DSI

DSI Acknowledge Request

DSI_ACKNOWLEDGE_DISABLE

DSI_ACKNOWLEDGE_ENABLE

DSI Automatic Refresh

DSI_AR_DISABLE

DSI_AR_ENABLE

DSI Automatic Clk Lane Control

DSI_AUTO_CLK_LANE_CTRL_DISABLE

DSI_AUTO_CLK_LANE_CTRL_ENABLE

DSI Color Coding

DSI_RGB565

The values 0x00000001 and 0x00000002 can also be used for the RGB565 color mode configuration

DSI_RGB666

The value 0x00000004 can also be used for the RGB666 color mode configuration

DSI_RGB888

DSI Color Mode

DSI_COLOR_MODE_FULL

DSI_COLOR_MODE_EIGHT

DSI Communication Delay

DSI_SLEW_RATE_HSTX

DSI_SLEW_RATE_LPTX

DSI_HS_DELAY

DSI CustomLane

DSI_SWAP_LANE_PINS

DSI_INVERT_HS_SIGNAL

DSI DATA ENABLE Polarity

DSI_DATA_ENABLE_ACTIVE_HIGH

DSI_DATA_ENABLE_ACTIVE_LOW

DSI DCS Command

DSI_ENTER_IDLE_MODE

DSI_ENTER_INVERT_MODE

DSI_ENTER_NORMAL_MODE

DSI_ENTER_PARTIAL_MODE

DSI_ENTER_SLEEP_MODE

DSI_EXIT_IDLE_MODE

DSI_EXIT_INVERT_MODE

DSI_EXIT_SLEEP_MODE

DSI_GET_3D_CONTROL

DSI_GET_ADDRESS_MODE

DSI_GET_BLUE_CHANNEL

DSI_GET_DIAGNOSTIC_RESULT

DSI_GET_DISPLAY_MODE

DSI_GET_GREEN_CHANNEL

DSI_GET_PIXEL_FORMAT

DSI_GET_POWER_MODE

DSI_GET_RED_CHANNEL

DSI_GET_SCANLINE

DSI_GET_SIGNAL_MODE

DSI_NOP

DSI_READ_DDB_CONTINUE

DSI_READ_DDB_START

DSI_READ_MEMORY_CONTINUE

DSI_READ_MEMORY_START

DSI_SET_3D_CONTROL

DSI_SET_ADDRESS_MODE

DSI_SET_COLUMN_ADDRESS

DSI_SET_DISPLAY_OFF

DSI_SET_DISPLAY_ON

DSI_SET_GAMMA_CURVE

DSI_SET_PAGE_ADDRESS

DSI_SET_PARTIAL_COLUMNS

DSI_SET_PARTIAL_ROWS

DSI_SET_PIXEL_FORMAT

DSI_SET_SCROLL_AREA

DSI_SET_SCROLL_START

DSI_SET_TEAR_OFF

DSI_SET_TEAR_ON

DSI_SET_TEAR_SCANLINE

DSI_SET_VSYNC_TIMING

DSI_SOFT_RESET

DSI_WRITE_LUT

DSI_WRITE_MEMORY_CONTINUE

DSI_WRITE_MEMORY_START

DSI Error Data Type

HAL_DSI_ERROR_NONE

HAL_DSI_ERROR_ACK

acknowledge errors

HAL_DSI_ERROR_PHY

PHY related errors

HAL_DSI_ERROR_TX

transmission error

HAL_DSI_ERROR_RX

reception error

HAL_DSI_ERROR_ECC

ECC errors

HAL_DSI_ERROR_CRC

CRC error

HAL_DSI_ERROR_PSE

Packet Size error

HAL_DSI_ERROR_EOT

End Of Transmission error

HAL_DSI_ERROR_OVF

FIFO overflow error

HAL_DSI_ERROR_GEN

Generic FIFO related errors

DSI Exported Macros

__HAL_DSI_RESET_HANDLE_STATE

Description:

- Reset DSI handle state.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None

__HAL_DSI_ENABLE

Description:

- Enables the DSI host.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_DISABLE

Description:

- Disables the DSI host.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_WRAPPER_ENABLE

Description:

- Enables the DSI wrapper.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_WRAPPER_DISABLE

Description:

- Disable the DSI wrapper.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_PLL_ENABLE

Description:

- Enables the DSI PLL.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_PLL_DISABLE

Description:

- Disables the DSI PLL.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_REG_ENABLE

Description:

- Enables the DSI regulator.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_REG_DISABLE

Description:

- Disables the DSI regulator.

Parameters:

- __HANDLE__: DSI handle

Return value:

- None.

__HAL_DSI_GET_FLAG

Description:

- Get the DSI pending flags.

Parameters:

- __HANDLE__: DSI handle.
- __FLAG__: Get the specified flag. This parameter can be any combination of the following values:
  - DSI_FLAG_TE : Tearing Effect Interrupt Flag
  - DSI_FLAG_ER : End of Refresh Interrupt Flag
  - DSI_FLAG_BUSY : Busy Flag
  - DSI_FLAG_PLLLS: PLL Lock Status
  - DSI_FLAG_PLLL : PLL Lock Interrupt Flag
  - DSI_FLAG_PLLU : PLL Unlock Interrupt Flag
  - DSI_FLAG_RRS : Regulator Ready Flag
  - DSI_FLAG_RR : Regulator Ready Interrupt Flag

Return value:

- The: state of FLAG (SET or RESET).

__HAL_DSI_CLEAR_FLAG

Description:

- Clears the DSI pending flags.

Parameters:

- __HANDLE__: DSI handle.
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - DSI_FLAG_TE : Tearing Effect Interrupt Flag
  - DSI_FLAG_ER : End of Refresh Interrupt Flag
  - DSI_FLAG_PLLL : PLL Lock Interrupt Flag
  - DSI_FLAG_PLLU : PLL Unlock Interrupt Flag
  - DSI_FLAG_RR : Regulator Ready Interrupt Flag

Return value:

- None

__HAL_DSI_ENABLE_IT

Description:

- Enables the specified DSI interrupts.

Parameters:

- __HANDLE__: DSI handle.
- __INTERRUPT__: specifies the DSI interrupt sources to be enabled. This parameter can be any combination of the following values:
  - DSI_IT_TE : Tearing Effect Interrupt
  - DSI_IT_ER : End of Refresh Interrupt
  - DSI_IT_PLLL: PLL Lock Interrupt
  - DSI_IT_PLLU: PLL Unlock Interrupt
  - DSI_IT_RR : Regulator Ready Interrupt

Return value:

- None

__HAL_DSI_DISABLE_IT

Description:

- Disables the specified DSI interrupts.

Parameters:

- __HANDLE__: DSI handle
- __INTERRUPT__: specifies the DSI interrupt sources to be disabled. This parameter can be any combination of the following values:
  - DSI_IT_TE : Tearing Effect Interrupt
  - DSI_IT_ER : End of Refresh Interrupt
  - DSI_IT_PLLL: PLL Lock Interrupt
  - DSI_IT_PLLU: PLL Unlock Interrupt
  - DSI_IT_RR : Regulator Ready Interrupt

Return value:

- None

__HAL_DSI_GET_IT_SOURCE

Description:

- Checks whether the specified DSI interrupt source is enabled or not.

Parameters:

- __HANDLE__: DSI handle
- __INTERRUPT__: specifies the DSI interrupt source to check. This parameter can be one of the following values:
  - DSI_IT_TE : Tearing Effect Interrupt
  - DSI_IT_ER : End of Refresh Interrupt
  - DSI_IT_PLLL: PLL Lock Interrupt
  - DSI_IT_PLLU: PLL Unlock Interrupt
  - DSI_IT_RR : Regulator Ready Interrupt

Return value:

- The: state of INTERRUPT (SET or RESET).

DSI FBTA Acknowledge

DSI_FBTAA_DISABLE

DSI_FBTAA_ENABLE

DSI Flags

DSI_FLAG_TE

DSI_FLAG_ER

DSI_FLAG_BUSY

DSI_FLAG_PLLLS

DSI_FLAG_PLLL

DSI_FLAG_PLLU

DSI_FLAG_RRS

DSI_FLAG_RR

DSI Flow Control

DSI_FLOW_CONTROL_CRC_RX

DSI_FLOW_CONTROL_ECC_RX

DSI_FLOW_CONTROL_BTA

DSI_FLOW_CONTROL_EOTP_RX

DSI_FLOW_CONTROL_EOTP_TX

DSI_FLOW_CONTROL_ALL

DSI HSYNC Polarity

DSI_HSYNC_ACTIVE_HIGH

DSI_HSYNC_ACTIVE_LOW

DSI HS Presp Mode

DSI_HS_PM_DISABLE

DSI_HS_PM_ENABLE

DSI Interrupts

DSI_IT_TE

DSI_IT_ER

DSI_IT_PLLL

DSI_IT_PLLU

DSI_IT_RR

DSI Lane Group

DSI_CLOCK_LANE

DSI_DATA_LANES

DSI Lane Select

DSI_CLK_LANE

DSI_DATA_LANE0

DSI_DATA_LANE1

DSI LONG WRITE PKT Data Type

DSI_DCS_LONG_PKT_WRITE

DCS long write

DSI_GEN_LONG_PKT_WRITE

Generic long write

DSI Loosely Packed

DSI_LOOSELY_PACKED_ENABLE

DSI_LOOSELY_PACKED_DISABLE

DSI LP Command

DSI_LP_COMMAND_DISABLE

DSI_LP_COMMAND_ENABLE

DSI LP HBP

DSI_LP_HBP_DISABLE

DSI_LP_HBP_ENABLE

DSI LP HFP

DSI_LP_HFP_DISABLE

DSI_LP_HFP_ENABLE

DSI LP LPDcs Long Write

DSI_LP_DLW_DISABLE

DSI_LP_DLW_ENABLE

DSI LP LPDcs Short Read NoP

DSI_LP_DSR0P_DISABLE

DSI_LP_DSR0P_ENABLE

DSI LP LPDcs Short Write NoP

DSI_LP_DSW0P_DISABLE

DSI_LP_DSW0P_ENABLE

DSI LP LPDcs Short Write OneP

DSI_LP_DSW1P_DISABLE

DSI_LP_DSW1P_ENABLE

DSI LP LPGen LongWrite

DSI_LP_GLW_DISABLE

DSI_LP_GLW_ENABLE

DSI LP LPGen Short Read NoP

DSI_LP_GSR0P_DISABLE

DSI_LP_GSR0P_ENABLE

DSI LP LPGen Short Read OneP

DSI_LP_GSR1P_DISABLE

DSI_LP_GSR1P_ENABLE

DSI LP LPGen Short Read TwoP

DSI_LP_GSR2P_DISABLE

DSI_LP_GSR2P_ENABLE

DSI LP LPGen Short Write NoP

DSI_LP_GSW0P_DISABLE

DSI_LP_GSW0P_ENABLE

DSI LP LPGen Short Write OneP

DSI_LP_GSW1P_DISABLE

DSI_LP_GSW1P_ENABLE

DSI LP LPGen Short Write TwoP

DSI_LP_GSW2P_DISABLE

DSI_LP_GSW2P_ENABLE

DSI LP LPMax Read Packet

DSI_LP_MRDP_DISABLE

DSI_LP_MRDP_ENABLE

DSI LP VACT

DSI_LP_VACT_DISABLE

DSI_LP_VACT_ENABLE

DSI LP VBP

DSI_LP_VBP_DISABLE

DSI_LP_VBP_ENABLE

DSI LP VFP

DSI_LP_VFP_DISABLE

DSI_LP_VFP_ENABLE

DSI LP VSYNC

DSI_LP_VSYNC_DISABLE

DSI_LP_VSYNC_ENABLE

DSI Number Of Lanes

DSI_ONE_DATA_LANE

DSI_TWO_DATA_LANES

DSI PHY Timing

DSI_TCLK_POST

DSI_TLPX_CLK

DSI_THS_EXIT

DSI_TLPX_DATA

DSI_THS_ZERO

DSI_THS_TRAIL

DSI_THS_PREPARE

DSI_TCLK_ZERO

DSI_TCLK_PREPARE

DSI PLL IDF

DSI_PLL_IN_DIV1

DSI_PLL_IN_DIV2

DSI_PLL_IN_DIV3

DSI_PLL_IN_DIV4

DSI_PLL_IN_DIV5

DSI_PLL_IN_DIV6

DSI_PLL_IN_DIV7

DSI PLL ODF

DSI_PLL_OUT_DIV1

DSI_PLL_OUT_DIV2

DSI_PLL_OUT_DIV4

DSI_PLL_OUT_DIV8

DSI SHORT READ PKT Data Type

DSI_DCS_SHORT_PKT_READ

DCS short read

DSI_GEN_SHORT_PKT_READ_P0

Generic short read, no parameters

DSI_GEN_SHORT_PKT_READ_P1

Generic short read, one parameter

DSI_GEN_SHORT_PKT_READ_P2

Generic short read, two parameters

DSI SHORT WRITE PKT Data Type

DSI_DCS_SHORT_PKT_WRITE_P0

DCS short write, no parameters

DSI_DCS_SHORT_PKT_WRITE_P1

DCS short write, one parameter

DSI_GEN_SHORT_PKT_WRITE_P0

Generic short write, no parameters

DSI_GEN_SHORT_PKT_WRITE_P1

Generic short write, one parameter

DSI_GEN_SHORT_PKT_WRITE_P2

Generic short write, two parameters

DSI ShutDown

DSI_DISPLAY_ON

DSI_DISPLAY_OFF

DSI Tearing Effect Polarity

DSI_TE_RISING_EDGE

DSI_TE_FALLING_EDGE

DSI Tearing Effect Source

DSI_TE_DSILINK

DSI_TE_EXTERNAL

DSI TE Acknowledge Request

DSI_TE_ACKNOWLEDGE_DISABLE

DSI_TE_ACKNOWLEDGE_ENABLE

DSI Video Mode Type

DSI_VID_MODE_NB_PULSES

DSI_VID_MODE_NB_EVENTS

DSI_VID_MODE_BURST

DSI VSYNC Active Polarity

DSI_VSYNC_ACTIVE_HIGH

DSI_VSYNC_ACTIVE_LOW

DSI Vsync Polarity

DSI_VSYNC_FALLING

DSI_VSYNC_RISING

25 HAL EXTI Generic Driver

25.1 EXTI Firmware driver registers structures

25.1.1 EXTI_HandleTypeDef

EXTI_HandleTypeDef is defined in the stm32l4xx_hal_exti.h

Data Fields

- ***uint32_t Line***
- ***void(* PendingCallback***

Field Documentation

- ***uint32_t EXTI_HandleTypeDef::Line***
  Exti line number
- ***void(* EXTI_HandleTypeDef::PendingCallback)(void)***
  Exti pending callback

25.1.2 EXTI_ConfigTypeDef

EXTI_ConfigTypeDef is defined in the stm32l4xx_hal_exti.h

Data Fields

- ***uint32_t Line***
- ***uint32_t Mode***
- ***uint32_t Trigger***
- ***uint32_t GPIOSel***

Field Documentation

- ***uint32_t EXTI_ConfigTypeDef::Line***
  The Exti line to be configured. This parameter can be a value of ***EXTI_Line***
- ***uint32_t EXTI_ConfigTypeDef::Mode***
  The Exit Mode to be configured for a core. This parameter can be a combination of ***EXTI_Mode***
- ***uint32_t EXTI_ConfigTypeDef::Trigger***
  The Exti Trigger to be configured. This parameter can be a value of ***EXTI_Trigger***
- ***uint32_t EXTI_ConfigTypeDef::GPIOSel***
  The Exti GPIO multiplexer selection to be configured. This parameter is only possible for line 0 to 15. It can be a value of ***EXTI_GPIOSel***

25.2 EXTI Firmware driver API description

The following section lists the various functions of the EXTI library.

25.2.1 EXTI Peripheral features

- Each Exti line can be configured within this driver.
- Exti line can be configured in 3 different modes
  - Interrupt
  - Event
  - Both of them
- Configurable Exti lines can be configured with 3 different triggers
  - Rising
  - Falling
  - Both of them

- When set in interrupt mode, configurable Exti lines have two different interrupts pending registers which allow to distinguish which transition occurs:
  - Rising edge pending interrupt
  - Falling
- Exti lines 0 to 15 are linked to gpio pin number 0 to 15. Gpio port can be selected through multiplexer.

25.2.2 How to use this driver

1. Configure the EXTI line using HAL_EXTI_SetConfigLine().
   - Choose the interrupt line number by setting "Line" member from EXTI_ConfigTypeDef structure.
   - Configure the interrupt and/or event mode using "Mode" member from EXTI_ConfigTypeDef structure.
   - For configurable lines, configure rising and/or falling trigger "Trigger" member from EXTI_ConfigTypeDef structure.
   - For Exti lines linked to gpio, choose gpio port using "GPIOSel" member from GPIO_InitTypeDef structure.
2. Get current Exti configuration of a dedicated line using HAL_EXTI_GetConfigLine().
   - Provide exiting handle as parameter.
   - Provide pointer on EXTI_ConfigTypeDef structure as second parameter.
3. Clear Exti configuration of a dedicated line using HAL_EXTI_GetConfigLine().
   - Provide exiting handle as parameter.
4. Register callback to treat Exti interrupts using HAL_EXTI_RegisterCallback().
   - Provide exiting handle as first parameter.
   - Provide which callback will be registered using one value from EXTI_CallbackIDTypeDef.
   - Provide callback function pointer.
5. Get interrupt pending bit using HAL_EXTI_GetPending().
6. Clear interrupt pending bit using HAL_EXTI_GetPending().
7. Generate software interrupt using HAL_EXTI_GenerateSWI().

25.2.3 Configuration functions

This section contains the following APIs:

- ***HAL_EXTI_SetConfigLine***
- ***HAL_EXTI_GetConfigLine***
- ***HAL_EXTI_ClearConfigLine***
- ***HAL_EXTI_RegisterCallback***
- ***HAL_EXTI_GetHandle***

25.2.4 Detailed description of functions

`HAL_EXTI_SetConfigLine`

Function name

HAL_StatusTypeDef HAL_EXTI_SetConfigLine (EXTI_HandleTypeDef * hexti, EXTI_ConfigTypeDef * pExtiConfig)

Function description

Set configuration of a dedicated Exti line.

Parameters

- **hexti:** Exti handle.
- **pExtiConfig:** Pointer on EXTI configuration to be set.

Return values

- **HAL:** Status.

HAL_EXTI_GetConfigLine

Function name

HAL_StatusTypeDef HAL_EXTI_GetConfigLine (EXTI_HandleTypeDef * hexti, EXTI_ConfigTypeDef * pExtiConfig)

Function description

Get configuration of a dedicated Exti line.

Parameters

- **hexti:** Exti handle.
- **pExtiConfig:** Pointer on structure to store Exti configuration.

Return values

- **HAL:** Status.

HAL_EXTI_ClearConfigLine

Function name

HAL_StatusTypeDef HAL_EXTI_ClearConfigLine (EXTI_HandleTypeDef * hexti)

Function description

Clear whole configuration of a dedicated Exti line.

Parameters

- **hexti:** Exti handle.

Return values

- **HAL:** Status.

HAL_EXTI_RegisterCallback

Function name

HAL_StatusTypeDef HAL_EXTI_RegisterCallback (EXTI_HandleTypeDef * hexti, EXTI_CallbackIDTypeDef CallbackID, void(*)(void) pPendingCbfn)

Function description

Register callback for a dedicated Exti line.

Parameters

- **hexti:** Exti handle.
- **CallbackID:** User callback identifier. This parameter can be one of
  - EXTI_CallbackIDTypeDef values.
- **pPendingCbfn:** function pointer to be stored as callback.

Return values

- **HAL:** Status.

HAL_EXTI_GetHandle

Function name

HAL_StatusTypeDef HAL_EXTI_GetHandle (EXTI_HandleTypeDef * hexti, uint32_t ExtiLine)

Function description

Store line number as handle private field.

Parameters

- **hexti:** Exti handle.
- **ExtiLine:** Exti line number. This parameter can be from 0 to EXTI_LINE_NB.

Return values

- **HAL:** Status.

`HAL_EXTI_IRQHandler`

Function name

void HAL_EXTI_IRQHandler (EXTI_HandleTypeDef * hexti)

Function description

Handle EXTI interrupt request.

Parameters

- **hexti:** Exti handle.

Return values

- **none.:**

`HAL_EXTI_GetPending`

Function name

uint32_t HAL_EXTI_GetPending (EXTI_HandleTypeDef * hexti, uint32_t Edge)

Function description

Get interrupt pending bit of a dedicated line.

Parameters

- **hexti:** Exti handle.
- **Edge:** Specify which pending edge as to be checked. This parameter can be one of the following values:
  - EXTI_TRIGGER_RISING_FALLING This parameter is kept for compatibility with other series.

Return values

- **1:** if interrupt is pending else 0.

`HAL_EXTI_ClearPending`

Function name

void HAL_EXTI_ClearPending (EXTI_HandleTypeDef * hexti, uint32_t Edge)

Function description

Clear interrupt pending bit of a dedicated line.

Parameters

- **hexti:** Exti handle.
- **Edge:** Specify which pending edge as to be clear. This parameter can be one of the following values:
  - EXTI_TRIGGER_RISING_FALLING This parameter is kept for compatibility with other series.

Return values

- **None.:**

HAL_EXTI_GenerateSWI

Function name

void HAL_EXTI_GenerateSWI (EXTI_HandleTypeDef * hexti)

Function description

Generate a software interrupt for a dedicated line.

Parameters

- **hexti:** Exti handle.

Return values

- **None.:**

25.3 EXTI Firmware driver defines

The following section lists the various define and macros of the module.

25.3.1 EXTI

EXTI

EXTI GPIOSel

EXTI_GPIOA

EXTI_GPIOB

EXTI_GPIOC

EXTI_GPIOD

EXTI_GPIOE

EXTI_GPIOF

EXTI_GPIOG

EXTI_GPIOH

EXTI_GPIOI

EXTI Line

EXTI_LINE_0

EXTI_LINE_1

EXTI_LINE_2

EXTI_LINE_3

EXTI_LINE_4

EXTI_LINE_5

EXTI_LINE_6

EXTI_LINE_7

EXTI_LINE_8

EXTI_LINE_9

EXTI_LINE_10

EXTI_LINE_11

EXTI_LINE_12

EXTI_LINE_13

EXTI_LINE_14

EXTI_LINE_15

EXTI_LINE_16

EXTI_LINE_17

EXTI_LINE_18

EXTI_LINE_19

EXTI_LINE_20

EXTI_LINE_21

EXTI_LINE_22

EXTI_LINE_23

EXTI_LINE_24

EXTI_LINE_25

EXTI_LINE_26

EXTI_LINE_27

EXTI_LINE_28

EXTI_LINE_29

EXTI_LINE_30

EXTI_LINE_31

EXTI_LINE_32

EXTI_LINE_33

EXTI_LINE_34

EXTI_LINE_35

EXTI_LINE_36

EXTI_LINE_37

EXTI_LINE_38

EXTI_LINE_39

EXTI_LINE_40

EXTI Mode

EXTI_MODE_NONE

EXTI_MODE_INTERRUPT

EXTI_MODE_EVENT

EXTI Trigger

EXTI_TRIGGER_NONE

EXTI_TRIGGER_RISING

EXTI_TRIGGER_FALLING

EXTI_TRIGGER_RISING_FALLING

26 HAL FIREWALL Generic Driver

26.1 FIREWALL Firmware driver registers structures

26.1.1 FIREWALL_InitTypeDef

FIREWALL_InitTypeDef is defined in the stm32l4xx_hal_firewall.h

Data Fields

- ***uint32_t CodeSegmentStartAddress***
- ***uint32_t CodeSegmentLength***
- ***uint32_t NonVDataSegmentStartAddress***
- ***uint32_t NonVDataSegmentLength***
- ***uint32_t VDataSegmentStartAddress***
- ***uint32_t VDataSegmentLength***
- ***uint32_t VolatileDataExecution***
- ***uint32_t VolatileDataShared***

Field Documentation

- ***uint32_t FIREWALL_InitTypeDef::CodeSegmentStartAddress***

  Protected code segment start address. This value is 24-bit long, the 8 LSB bits are reserved and forced to 0 in order to allow a 256-byte granularity.
- ***uint32_t FIREWALL_InitTypeDef::CodeSegmentLength***

  Protected code segment length in bytes. This value is 22-bit long, the 8 LSB bits are reserved and forced to 0 for the length to be a multiple of 256 bytes.
- ***uint32_t FIREWALL_InitTypeDef::NonVDataSegmentStartAddress***

  Protected non-volatile data segment start address. This value is 24-bit long, the 8 LSB bits are reserved and forced to 0 in order to allow a 256-byte granularity.
- ***uint32_t FIREWALL_InitTypeDef::NonVDataSegmentLength***

  Protected non-volatile data segment length in bytes. This value is 22-bit long, the 8 LSB bits are reserved and forced to 0 for the length to be a multiple of 256 bytes.
- ***uint32_t FIREWALL_InitTypeDef::VDataSegmentStartAddress***

  Protected volatile data segment start address. This value is 17-bit long, the 6 LSB bits are reserved and forced to 0 in order to allow a 64-byte granularity.
- ***uint32_t FIREWALL_InitTypeDef::VDataSegmentLength***

  Protected volatile data segment length in bytes. This value is 17-bit long, the 6 LSB bits are reserved and forced to 0 for the length to be a multiple of 64 bytes.
- ***uint32_t FIREWALL_InitTypeDef::VolatileDataExecution***

  Set VDE bit specifying whether or not the volatile data segment can be executed. When VDS = 1 (set by parameter VolatileDataShared), VDE bit has no meaning. This parameter can be a value of ***FIREWALL_VolatileData_Executable***
- ***uint32_t FIREWALL_InitTypeDef::VolatileDataShared***

  Set VDS bit in specifying whether or not the volatile data segment can be shared with a non-protected application code. This parameter can be a value of ***FIREWALL_VolatileData_Shared***

26.2 FIREWALL Firmware driver API description

The following section lists the various functions of the FIREWALL library.

26.2.1 How to use this driver

The FIREWALL HAL driver can be used as follows:

1. Declare a FIREWALL_InitTypeDef initialization structure.

2. Resort to HAL_FIREWALL_Config() API to initialize the Firewall
3. Enable the FIREWALL in calling HAL_FIREWALL_EnableFirewall() API
4. To ensure that any code executed outside the protected segment closes the FIREWALL, the user must set the flag FIREWALL_PRE_ARM_SET in calling __HAL_FIREWALL_PREARM_ENABLE() macro if called within a protected code segment or HAL_FIREWALL_EnablePreArmFlag() API if called outside of protected code segment after HAL_FIREWALL_Config() call.

26.2.2 Initialization and Configuration functions

This subsection provides the functions allowing to initialize the Firewall. Initialization is done by HAL_FIREWALL_Config():

- Enable the Firewall clock thru __HAL_RCC_FIREWALL_CLK_ENABLE() macro.
- Set the protected code segment address start and length.
- Set the protected non-volatile and/or volatile data segments address starts and lengths if applicable.
- Set the volatile data segment execution and sharing status.
- Length must be set to 0 for an unprotected segment.

This section contains the following APIs:

- ***HAL_FIREWALL_Config***
- ***HAL_FIREWALL_GetConfig***
- ***HAL_FIREWALL_EnableFirewall***
- ***HAL_FIREWALL_EnablePreArmFlag***
- ***HAL_FIREWALL_DisablePreArmFlag***

26.2.3 Detailed description of functions

`HAL_FIREWALL_Config`

Function name

HAL_StatusTypeDef HAL_FIREWALL_Config (FIREWALL_InitTypeDef * fw_init)

Function description

Initialize the Firewall according to the FIREWALL_InitTypeDef structure parameters.

Parameters

- **fw_init:** Firewall initialization structure

Return values

- **HAL:** status

Notes

- The API returns HAL_ERROR if the Firewall is already enabled.

`HAL_FIREWALL_GetConfig`

Function name

void HAL_FIREWALL_GetConfig (FIREWALL_InitTypeDef * fw_config)

Function description

Retrieve the Firewall configuration.

Parameters

- **fw_config:** Firewall configuration, type is same as initialization structure

Return values

- **None:**

Notes

- This API can't be executed inside a code area protected by the Firewall when the Firewall is enabled
- If NVDSL register is different from 0, that is, if the non volatile data segment is defined, this API can't be executed when the Firewall is enabled.
- User should resort to __HAL_FIREWALL_GET_PREARM() macro to retrieve FPA bit status

HAL_FIREWALL_EnableFirewall

Function name

void HAL_FIREWALL_EnableFirewall (void)

Function description

Enable FIREWALL.

Return values

- **None:**

Notes

- Firewall is enabled in clearing FWDIS bit of SYSCFG CFGR1 register. Once enabled, the Firewall cannot be disabled by software. Only a system reset can set again FWDIS bit.

HAL_FIREWALL_EnablePreArmFlag

Function name

void HAL_FIREWALL_EnablePreArmFlag (void)

Function description

Enable FIREWALL pre arm.

Return values

- **None:**

Notes

- When FPA bit is set, any code executed outside the protected segment will close the Firewall.
- This API provides the same service as __HAL_FIREWALL_PREARM_ENABLE() macro but can't be executed inside a code area protected by the Firewall.
- When the Firewall is disabled, user can resort to HAL_FIREWALL_EnablePreArmFlag() API any time.
- When the Firewall is enabled and NVDSL register is equal to 0 (that is, when the non volatile data segment is not defined), ** this API can be executed when the Firewall is closed ** when the Firewall is opened, user should resort to __HAL_FIREWALL_PREARM_ENABLE() macro instead
- When the Firewall is enabled and NVDSL register is different from 0 (that is, when the non volatile data segment is defined) ** FW_CR register can be accessed only when the Firewall is opened: user should resort to __HAL_FIREWALL_PREARM_ENABLE() macro instead.

HAL_FIREWALL_DisablePreArmFlag

Function name

void HAL_FIREWALL_DisablePreArmFlag (void)

Function description

Disable FIREWALL pre arm.

Return values

- **None:**

Notes

- When FPA bit is reset, any code executed outside the protected segment when the Firewall is opened will generate a system reset.
- This API provides the same service as __HAL_FIREWALL_PREARM_DISABLE() macro but can't be executed inside a code area protected by the Firewall.
- When the Firewall is disabled, user can resort to HAL_FIREWALL_EnablePreArmFlag() API any time.
- When the Firewall is enabled and NVDSL register is equal to 0 (that is, when the non volatile data segment is not defined), ** this API can be executed when the Firewall is closed ** when the Firewall is opened, user should resort to __HAL_FIREWALL_PREARM_DISABLE() macro instead
- When the Firewall is enabled and NVDSL register is different from 0 (that is, when the non volatile data segment is defined) ** FW_CR register can be accessed only when the Firewall is opened: user should resort to __HAL_FIREWALL_PREARM_DISABLE() macro instead.

26.3 FIREWALL Firmware driver defines

The following section lists the various define and macros of the module.

26.3.1 FIREWALL

FIREWALL

FIREWALL Exported Macros

__HAL_FIREWALL_IS_ENABLED

Description:

- Check whether the FIREWALL is enabled or not.

Return value:

- FIREWALL: enabling status (TRUE or FALSE).

__HAL_FIREWALL_PREARM_ENABLE

Notes:

- When FPA bit is set, any code executed outside the protected segment closes the Firewall, otherwise it generates a system reset. This macro provides the same service as HAL_FIREWALL_EnablePreArmFlag() API but can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_PREARM_DISABLE

Notes:

- When FPA bit is set, any code executed outside the protected segment closes the Firewall, otherwise, it generates a system reset. This macro provides the same service as HAL_FIREWALL_DisablePreArmFlag() API but can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_VOLATILEDATA_SHARED_ENABLE

Notes:

- When VDS bit is set, the volatile data segment is shared with non-protected application code. It can be accessed whatever the Firewall state (opened or closed). This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_VOLATILEDATA_SHARED_DISABLE

Notes:

- When VDS bit is reset, the volatile data segment is not shared and cannot be hit by a non protected executable code when the Firewall is closed. If it is accessed in such a condition, a system reset is generated by the Firewall. This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_VOLATILEDATA_EXECUTION_ENABLE

Notes:

- VDE bit is ignored when VDS is set. IF VDS = 1, the Volatile data segment can be executed whatever the VDE bit value. When VDE bit is set (with VDS = 0), the volatile data segment is executable. When the Firewall call is closed, a "call gate" entry procedure is required to open first the Firewall. This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_VOLATILEDATA_EXECUTION_DISABLE

Notes:

- VDE bit is ignored when VDS is set. IF VDS = 1, the Volatile data segment can be executed whatever the VDE bit value. When VDE bit is reset (with VDS = 0), the volatile data segment cannot be executed. This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_GET_VOLATILEDATA_SHARED

Description:

- Check whether or not the volatile data segment is shared.

Return value:

- VDS: bit setting status (TRUE or FALSE).

Notes:

- This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_GET_VOLATILEDATA_EXECUTION

Description:

- Check whether or not the volatile data segment is declared executable.

Return value:

- VDE: bit setting status (TRUE or FALSE).

Notes:

- This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

__HAL_FIREWALL_GET_PREARM

Description:

- Check whether or not the Firewall pre arm bit is set.

Return value:

- FPA: bit setting status (TRUE or FALSE).

Notes:

- This macro can be executed inside a code area protected by the Firewall. This macro can be executed whatever the Firewall state (opened or closed) when NVDSL register is equal to 0. Otherwise (when NVDSL register is different from 0, that is, when the non volatile data segment is defined), the macro can be executed only when the Firewall is opened.

FIREWALL pre arm status

FIREWALL_PRE_ARM_RESET

FIREWALL_PRE_ARM_SET

FIREWALL volatile data segment execution status

FIREWALL_VOLATILEDATA_NOT_EXECUTABLE

FIREWALL_VOLATILEDATA_EXECUTABLE

FIREWALL volatile data segment share status

FIREWALL_VOLATILEDATA_NOT_SHARED

FIREWALL_VOLATILEDATA_SHARED

27 HAL FLASH Generic Driver

27.1 FLASH Firmware driver registers structures

27.1.1 FLASH_EraseInitTypeDef

FLASH_EraseInitTypeDef is defined in the stm32l4xx_hal_flash.h

Data Fields

- ***uint32_t TypeErase***
- ***uint32_t Banks***
- ***uint32_t Page***
- ***uint32_t NbPages***

Field Documentation

- ***uint32_t FLASH_EraseInitTypeDef::TypeErase***

  Mass erase or page erase. This parameter can be a value of ***FLASH_Type_Erase***
- ***uint32_t FLASH_EraseInitTypeDef::Banks***

  Select bank to erase. This parameter must be a value of ***FLASH_Banks*** (FLASH_BANK_BOTH should be used only for mass erase)
- ***uint32_t FLASH_EraseInitTypeDef::Page***

  Initial Flash page to erase when page erase is disabled This parameter must be a value between 0 and (max number of pages in the bank - 1) (eg : 255 for 1MB dual bank)
- ***uint32_t FLASH_EraseInitTypeDef::NbPages***

  Number of pages to be erased. This parameter must be a value between 1 and (max number of pages in the bank - value of initial page)

27.1.2 FLASH_OBProgramInitTypeDef

FLASH_OBProgramInitTypeDef is defined in the stm32l4xx_hal_flash.h

Data Fields

- ***uint32_t OptionType***
- ***uint32_t WRPArea***
- ***uint32_t WRPStartOffset***
- ***uint32_t WRPEndOffset***
- ***uint32_t RDPLevel***
- ***uint32_t USERType***
- ***uint32_t USERConfig***
- ***uint32_t PCROPConfig***
- ***uint32_t PCROPStartAddr***
- ***uint32_t PCROPEndAddr***

Field Documentation

- ***uint32_t FLASH_OBProgramInitTypeDef::OptionType***

  Option byte to be configured. This parameter can be a combination of the values of ***FLASH_OB_Type***
- ***uint32_t FLASH_OBProgramInitTypeDef::WRPArea***

  Write protection area to be programmed (used for OPTIONBYTE_WRP). Only one WRP area could be programmed at the same time. This parameter can be value of ***FLASH_OB_WRP_Area***
- ***uint32_t FLASH_OBProgramInitTypeDef::WRPStartOffset***

  Write protection start offset (used for OPTIONBYTE_WRP). This parameter must be a value between 0 and (max number of pages in the bank - 1) (eg : 25 for 1MB dual bank)

- ***uint32_t FLASH_OBProgramInitTypeDef::WRPEndOffset***
  Write protection end offset (used for OPTIONBYTE_WRP). This parameter must be a value between WRPStartOffset and (max number of pages in the bank - 1)
- ***uint32_t FLASH_OBProgramInitTypeDef::RDPLevel***
  Set the read protection level.. (used for OPTIONBYTE_RDP). This parameter can be a value of *FLASH_OB_Read_Protection*
- ***uint32_t FLASH_OBProgramInitTypeDef::USERType***
  User option byte(s) to be configured (used for OPTIONBYTE_USER). This parameter can be a combination of *FLASH_OB_USER_Type*
- ***uint32_t FLASH_OBProgramInitTypeDef::USERConfig***
  Value of the user option byte (used for OPTIONBYTE_USER). This parameter can be a combination of *FLASH_OB_USER_BOR_LEVEL*, *FLASH_OB_USER_nRST_STOP*, *FLASH_OB_USER_nRST_STANDBY*, *FLASH_OB_USER_nRST_SHUTDOWN*, *FLASH_OB_USER_IWDG_SW*, *FLASH_OB_USER_IWDG_STOP*, *FLASH_OB_USER_IWDG_STANDBY*, *FLASH_OB_USER_WWDG_SW*, *FLASH_OB_USER_BFB2*, *FLASH_OB_USER_DUALBANK*, *FLASH_OB_USER_nBOOT1*, *FLASH_OB_USER_SRAM2_PE* and *FLASH_OB_USER_SRAM2_RST*
- ***uint32_t FLASH_OBProgramInitTypeDef::PCROPConfig***
  Configuration of the PCROP (used for OPTIONBYTE_PCROP). This parameter must be a combination of *FLASH_Banks* (except FLASH_BANK_BOTH) and *FLASH_OB_PCROP_RDP*
- ***uint32_t FLASH_OBProgramInitTypeDef::PCROPStartAddr***
  PCROP Start address (used for OPTIONBYTE_PCROP). This parameter must be a value between begin and end of bank => Be careful of the bank swapping for the address
- ***uint32_t FLASH_OBProgramInitTypeDef::PCROPEndAddr***
  PCROP End address (used for OPTIONBYTE_PCROP). This parameter must be a value between PCROP Start address and end of bank

27.1.3 FLASH_ProcessTypeDef

FLASH_ProcessTypeDef is defined in the stm32l4xx_hal_flash.h

Data Fields

- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t ErrorCode***
- ***__IO FLASH_ProcedureTypeDef ProcedureOnGoing***
- ***__IO uint32_t Address***
- ***__IO uint32_t Bank***
- ***__IO uint32_t Page***
- ***__IO uint32_t NbPagesToErase***
- ***__IO FLASH_CacheTypeDef CacheToReactivate***

Field Documentation

- ***HAL_LockTypeDef FLASH_ProcessTypeDef::Lock***
- ***__IO uint32_t FLASH_ProcessTypeDef::ErrorCode***
- ***__IO FLASH_ProcedureTypeDef FLASH_ProcessTypeDef::ProcedureOnGoing***
- ***__IO uint32_t FLASH_ProcessTypeDef::Address***
- ***__IO uint32_t FLASH_ProcessTypeDef::Bank***
- ***__IO uint32_t FLASH_ProcessTypeDef::Page***
- ***__IO uint32_t FLASH_ProcessTypeDef::NbPagesToErase***
- ***__IO FLASH_CacheTypeDef FLASH_ProcessTypeDef::CacheToReactivate***

27.2 FLASH Firmware driver API description

The following section lists the various functions of the FLASH library.

27.2.1 FLASH peripheral features

The Flash memory interface manages CPU AHB I-Code and D-Code accesses to the Flash memory. It implements the erase and program Flash memory operations and the read and write protection mechanisms.

The Flash memory interface accelerates code execution with a system of instruction prefetch and cache lines.

The FLASH main features are:

- Flash memory read operations
- Flash memory program/erase operations
- Read / write protections
- Option bytes programming
- Prefetch on I-Code
- 32 cache lines of 4*64 bits on I-Code
- 8 cache lines of 4*64 bits on D-Code
- Error code correction (ECC) : Data in flash are 72-bits word (8 bits added per double word)

27.2.2 How to use this driver

This driver provides functions and macros to configure and program the FLASH memory of all STM32L4xx devices.

1. Flash Memory IO Programming functions:
   - Lock and Unlock the FLASH interface using HAL_FLASH_Unlock() and HAL_FLASH_Lock() functions
   - Program functions: double word and fast program (full row programming)
   - There Two modes of programming :
     - Polling mode using HAL_FLASH_Program() function
     - Interrupt mode using HAL_FLASH_Program_IT() function
2. Interrupts and flags management functions :
   - Handle FLASH interrupts by calling HAL_FLASH_IRQHandler()
   - Callback functions are called when the flash operations are finished : HAL_FLASH_EndOfOperationCallback() when everything is ok, otherwise HAL_FLASH_OperationErrorCallback()
   - Get error flag status by calling HAL_GetError()
3. Option bytes management functions :
   - Lock and Unlock the option bytes using HAL_FLASH_OB_Unlock() and HAL_FLASH_OB_Lock() functions
   - Launch the reload of the option bytes using HAL_FLASH_Launch() function. In this case, a reset is generated

In addition to these functions, this driver includes a set of macros allowing to handle the following operations:

- Set the latency
- Enable/Disable the prefetch buffer
- Enable/Disable the Instruction cache and the Data cache
- Reset the Instruction cache and the Data cache
- Enable/Disable the Flash power-down during low-power run and sleep modes
- Enable/Disable the Flash interrupts
- Monitor the Flash flags status

27.2.3 Programming operation functions

This subsection provides a set of functions allowing to manage the FLASH program operations.

This section contains the following APIs:

- ***HAL_FLASH_Program***
- ***HAL_FLASH_Program_IT***
- ***HAL_FLASH_IRQHandler***
- ***HAL_FLASH_EndOfOperationCallback***

- *HAL_FLASH_OperationErrorCallback*

27.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the FLASH memory operations.

This section contains the following APIs:

- *HAL_FLASH_Unlock*
- *HAL_FLASH_Lock*
- *HAL_FLASH_OB_Unlock*
- *HAL_FLASH_OB_Lock*
- *HAL_FLASH_OB_Launch*

27.2.5 Peripheral Errors functions

This subsection permits to get in run-time Errors of the FLASH peripheral.

This section contains the following APIs:

- *HAL_FLASH_GetError*

27.2.6 Detailed description of functions

HAL_FLASH_Program

Function name

HAL_StatusTypeDef HAL_FLASH_Program (uint32_t TypeProgram, uint32_t Address, uint64_t Data)

Function description

Program double word or fast program of a row at a specified address.

Parameters

- **TypeProgram:** Indicate the way to program at a specified address. This parameter can be a value of FLASH Program Type
- **Address:** specifies the address to be programmed.
- **Data:** specifies the data to be programmed This parameter is the data for the double word program and the address where are stored the data for the row fast program

Return values

- **HAL_StatusTypeDef:** HAL Status

HAL_FLASH_Program_IT

Function name

HAL_StatusTypeDef HAL_FLASH_Program_IT (uint32_t TypeProgram, uint32_t Address, uint64_t Data)

Function description

Program double word or fast program of a row at a specified address with interrupt enabled.

Parameters

- **TypeProgram:** Indicate the way to program at a specified address. This parameter can be a value of FLASH Program Type
- **Address:** specifies the address to be programmed.
- **Data:** specifies the data to be programmed This parameter is the data for the double word program and the address where are stored the data for the row fast program

Return values

- **HAL:** Status

HAL_FLASH_IRQHandler

Function name

void HAL_FLASH_IRQHandler (void)

Function description

Handle FLASH interrupt request.

Return values

- **None:**

HAL_FLASH_EndOfOperationCallback

Function name

void HAL_FLASH_EndOfOperationCallback (uint32_t ReturnValue)

Function description

FLASH end of operation interrupt callback.

Parameters

- **ReturnValue:** The value saved in this parameter depends on the ongoing procedure Mass Erase: Bank number which has been requested to erase Page Erase: Page which has been erased (if 0xFFFFFFFF, it means that all the selected pages have been erased) Program: Address which was selected for data program

Return values

- **None:**

HAL_FLASH_OperationErrorCallback

Function name

void HAL_FLASH_OperationErrorCallback (uint32_t ReturnValue)

Function description

FLASH operation error interrupt callback.

Parameters

- **ReturnValue:** The value saved in this parameter depends on the ongoing procedure Mass Erase: Bank number which has been requested to erase Page Erase: Page number which returned an error Program: Address which was selected for data program

Return values

- **None:**

HAL_FLASH_Unlock

Function name

HAL_StatusTypeDef HAL_FLASH_Unlock (void)

Function description

Unlock the FLASH control register access.

Return values

- **HAL:** Status

HAL_FLASH_Lock

Function name

HAL_StatusTypeDef HAL_FLASH_Lock (void)

Function description

Lock the FLASH control register access.

Return values

- **HAL:** Status

HAL_FLASH_OB_Unlock

Function name

HAL_StatusTypeDef HAL_FLASH_OB_Unlock (void)

Function description

Unlock the FLASH Option Bytes Registers access.

Return values

- **HAL:** Status

HAL_FLASH_OB_Lock

Function name

HAL_StatusTypeDef HAL_FLASH_OB_Lock (void)

Function description

Lock the FLASH Option Bytes Registers access.

Return values

- **HAL:** Status

HAL_FLASH_OB_Launch

Function name

HAL_StatusTypeDef HAL_FLASH_OB_Launch (void)

Function description

Launch the option byte loading.

Return values

- **HAL:** Status

HAL_FLASH_GetError

Function name

uint32_t HAL_FLASH_GetError (void)

Function description

Get the specific FLASH error flag.

Return values

- **FLASH_ErrorCode:** The returned value can be:
  - HAL_FLASH_ERROR_RD: FLASH Read Protection error flag (PCROP)
  - HAL_FLASH_ERROR_PGS: FLASH Programming Sequence error flag
  - HAL_FLASH_ERROR_PGP: FLASH Programming Parallelism error flag
  - HAL_FLASH_ERROR_PGA: FLASH Programming Alignment error flag
  - HAL_FLASH_ERROR_WRP: FLASH Write protected error flag
  - HAL_FLASH_ERROR_OPERATION: FLASH operation Error flag
  - HAL_FLASH_ERROR_NONE: No error set
  - HAL_FLASH_ERROR_OP: FLASH Operation error
  - HAL_FLASH_ERROR_PROG: FLASH Programming error
  - HAL_FLASH_ERROR_WRP: FLASH Write protection error
  - HAL_FLASH_ERROR_PGA: FLASH Programming alignment error
  - HAL_FLASH_ERROR_SIZ: FLASH Size error
  - HAL_FLASH_ERROR_PGS: FLASH Programming sequence error
  - HAL_FLASH_ERROR_MIS: FLASH Fast programming data miss error
  - HAL_FLASH_ERROR_FAST: FLASH Fast programming error
  - HAL_FLASH_ERROR_RD: FLASH PCROP read error
  - HAL_FLASH_ERROR_OPTV: FLASH Option validity error
  - FLASH_FLAG_PEMPTY : FLASH Boot from not programmed flash (apply only for STM32L43x/ STM32L44x devices)

`FLASH_WaitForLastOperation`

Function name

HAL_StatusTypeDef FLASH_WaitForLastOperation (uint32_t Timeout)

Function description

Wait for a FLASH operation to complete.

Parameters

- **Timeout:** maximum flash operation timeout

Return values

- **HAL_StatusTypeDef:** HAL Status

27.3 FLASH Firmware driver defines

The following section lists the various define and macros of the module.

27.3.1 FLASH

FLASH

FLASH Banks

FLASH_BANK_1

Bank 1

FLASH_BANK_2

Bank 2

FLASH_BANK_BOTH

Bank1 and Bank2

FLASH Error

HAL_FLASH_ERROR_NONE

HAL_FLASH_ERROR_OP

HAL_FLASH_ERROR_PROG

HAL_FLASH_ERROR_WRP

HAL_FLASH_ERROR_PGA

HAL_FLASH_ERROR_SIZ

HAL_FLASH_ERROR_PGS

HAL_FLASH_ERROR_MIS

HAL_FLASH_ERROR_FAST

HAL_FLASH_ERROR_RD

HAL_FLASH_ERROR_OPTV

HAL_FLASH_ERROR_ECCC

HAL_FLASH_ERROR_ECCD

HAL_FLASH_ERROR_PEMPTY

FLASH Exported Macros

__HAL_FLASH_SET_LATENCY

Description:

- Set the FLASH Latency.

Parameters:

- __LATENCY__: FLASH Latency This parameter can be one of the following values :
  - FLASH_LATENCY_0: FLASH Zero wait state
  - FLASH_LATENCY_1: FLASH One wait state
  - FLASH_LATENCY_2: FLASH Two wait states
  - FLASH_LATENCY_3: FLASH Three wait states
  - FLASH_LATENCY_4: FLASH Four wait states

Return value:

- None

__HAL_FLASH_GET_LATENCY

Description:

- Get the FLASH Latency.

Return value:

- FLASH: Latency This parameter can be one of the following values :
  - FLASH_LATENCY_0: FLASH Zero wait state
  - FLASH_LATENCY_1: FLASH One wait state
  - FLASH_LATENCY_2: FLASH Two wait states
  - FLASH_LATENCY_3: FLASH Three wait states
  - FLASH_LATENCY_4: FLASH Four wait states

__HAL_FLASH_PREFETCH_BUFFER_ENABLE

Description:

- Enable the FLASH prefetch buffer.

Return value:

- None

__HAL_FLASH_PREFETCH_BUFFER_DISABLE

Description:

- Disable the FLASH prefetch buffer.

Return value:

- None

__HAL_FLASH_INSTRUCTION_CACHE_ENABLE

Description:

- Enable the FLASH instruction cache.

Return value:

- none

__HAL_FLASH_INSTRUCTION_CACHE_DISABLE

Description:

- Disable the FLASH instruction cache.

Return value:

- none

__HAL_FLASH_DATA_CACHE_ENABLE

Description:

- Enable the FLASH data cache.

Return value:

- none

__HAL_FLASH_DATA_CACHE_DISABLE

Description:

- Disable the FLASH data cache.

Return value:

- none

__HAL_FLASH_INSTRUCTION_CACHE_RESET

Description:

- Reset the FLASH instruction Cache.

Return value:

- None

Notes:

- This function must be used only when the Instruction Cache is disabled.

__HAL_FLASH_DATA_CACHE_RESET

Description:

- Reset the FLASH data Cache.

Return value:

- None

Notes:

- This function must be used only when the data Cache is disabled.

__HAL_FLASH_POWER_DOWN_ENABLE

Notes:

- Writing this bit to 0 this bit, automatically the keys are loss and a new unlock sequence is necessary to re-write it to 1.

__HAL_FLASH_POWER_DOWN_DISABLE

Notes:

- Writing this bit to 0 this bit, automatically the keys are loss and a new unlock sequence is necessary to re-write it to 1.

__HAL_FLASH_SLEEP_POWERDOWN_ENABLE

Description:

- Enable the FLASH power down during Low-Power sleep mode.

Return value:

- none

__HAL_FLASH_SLEEP_POWERDOWN_DISABLE

Description:

- Disable the FLASH power down during Low-Power sleep mode.

Return value:

- none

FLASH Flags Definition

FLASH_FLAG_EOP

FLASH End of operation flag

FLASH_FLAG_OPERR

FLASH Operation error flag

FLASH_FLAG_PROGERR

FLASH Programming error flag

FLASH_FLAG_WRPERR

FLASH Write protection error flag

FLASH_FLAG_PGAERR

FLASH Programming alignment error flag

FLASH_FLAG_SIZERR

FLASH Size error flag

FLASH_FLAG_PGSERR

FLASH Programming sequence error flag

FLASH_FLAG_MISERR

FLASH Fast programming data miss error flag

FLASH_FLAG_FASTERR

FLASH Fast programming error flag

FLASH_FLAG_RDERR

FLASH PCROP read error flag

FLASH_FLAG_OPTVERR

FLASH Option validity error flag

FLASH_FLAG_BSY

FLASH Busy flag

FLASH_FLAG_PEMPTY

FLASH Program empty

FLASH_FLAG_SR_ERRORS

FLASH_FLAG_ECCC

FLASH ECC correction

FLASH_FLAG_ECCD

FLASH ECC detection

FLASH_FLAG_ECCR_ERRORS

FLASH_FLAG_ALL_ERRORS

FLASH Interrupts Macros

__HAL_FLASH_ENABLE_IT

Description:

- Enable the specified FLASH interrupt.

Parameters:

- __INTERRUPT__: FLASH interrupt This parameter can be any combination of the following values:
  - FLASH_IT_EOP: End of FLASH Operation Interrupt
  - FLASH_IT_OPERR: Error Interrupt
  - FLASH_IT_RDERR: PCROP Read Error Interrupt
  - FLASH_IT_ECCC: ECC Correction Interrupt

Return value:

- none

__HAL_FLASH_DISABLE_IT

Description:

- Disable the specified FLASH interrupt.

Parameters:

- __INTERRUPT__: FLASH interrupt This parameter can be any combination of the following values:
  - FLASH_IT_EOP: End of FLASH Operation Interrupt
  - FLASH_IT_OPERR: Error Interrupt
  - FLASH_IT_RDERR: PCROP Read Error Interrupt
  - FLASH_IT_ECCC: ECC Correction Interrupt

Return value:

- none

__HAL_FLASH_GET_FLAG

Description:

- Check whether the specified FLASH flag is set or not.

Parameters:

- __FLAG__: specifies the FLASH flag to check. This parameter can be one of the following values:
  - FLASH_FLAG_EOP: FLASH End of Operation flag
  - FLASH_FLAG_OPERR: FLASH Operation error flag
  - FLASH_FLAG_PROGERR: FLASH Programming error flag
  - FLASH_FLAG_WRPERR: FLASH Write protection error flag
  - FLASH_FLAG_PGAERR: FLASH Programming alignment error flag
  - FLASH_FLAG_SIZERR: FLASH Size error flag
  - FLASH_FLAG_PGSERR: FLASH Programming sequence error flag
  - FLASH_FLAG_MISERR: FLASH Fast programming data miss error flag
  - FLASH_FLAG_FASTERR: FLASH Fast programming error flag
  - FLASH_FLAG_RDERR: FLASH PCROP read error flag
  - FLASH_FLAG_OPTVERR: FLASH Option validity error flag
  - FLASH_FLAG_BSY: FLASH write/erase operations in progress flag
  - FLASH_FLAG_PEMPTY : FLASH Boot from not programmed flash (apply only for STM32L43x/ STM32L44x devices)
  - FLASH_FLAG_ECCC: FLASH one ECC error has been detected and corrected
  - FLASH_FLAG_ECCD: FLASH two ECC errors have been detected

Return value:

- The: new state of FLASH_FLAG (SET or RESET).

__HAL_FLASH_CLEAR_FLAG

Description:

- Clear the FLASH's pending flags.

Parameters:

- __FLAG__: specifies the FLASH flags to clear. This parameter can be any combination of the following values:
  - FLASH_FLAG_EOP: FLASH End of Operation flag
  - FLASH_FLAG_OPERR: FLASH Operation error flag
  - FLASH_FLAG_PROGERR: FLASH Programming error flag
  - FLASH_FLAG_WRPERR: FLASH Write protection error flag
  - FLASH_FLAG_PGAERR: FLASH Programming alignment error flag
  - FLASH_FLAG_SIZERR: FLASH Size error flag
  - FLASH_FLAG_PGSERR: FLASH Programming sequence error flag
  - FLASH_FLAG_MISERR: FLASH Fast programming data miss error flag
  - FLASH_FLAG_FASTERR: FLASH Fast programming error flag
  - FLASH_FLAG_RDERR: FLASH PCROP read error flag
  - FLASH_FLAG_OPTVERR: FLASH Option validity error flag
  - FLASH_FLAG_ECCC: FLASH one ECC error has been detected and corrected
  - FLASH_FLAG_ECCD: FLASH two ECC errors have been detected
  - FLASH_FLAG_ALL_ERRORS: FLASH All errors flags

Return value:

- None

FLASH Interrupts Definition

FLASH_IT_EOP

End of FLASH Operation Interrupt source

FLASH_IT_OPERR

Error Interrupt source

FLASH_IT_RDERR

PCROP Read Error Interrupt source

FLASH_IT_ECCC

ECC Correction Interrupt source

FLASH Keys

FLASH_KEY1

Flash key1

FLASH_KEY2

Flash key2: used with FLASH_KEY1 to unlock the FLASH registers access

FLASH_PDKEY1

Flash power down key1

FLASH_PDKEY2

Flash power down key2: used with FLASH_PDKEY1 to unlock the RUN_PD bit in FLASH_ACR

FLASH_OPTKEY1

Flash option byte key1

FLASH_OPTKEY2

Flash option byte key2: used with FLASH_OPTKEY1 to allow option bytes operations

FLASH Latency

FLASH_LATENCY_0

FLASH Zero wait state

FLASH_LATENCY_1

FLASH One wait state

FLASH_LATENCY_2

FLASH Two wait states

FLASH_LATENCY_3

FLASH Three wait states

FLASH_LATENCY_4

FLASH Four wait states

FLASH_LATENCY_5

FLASH Five wait state

FLASH_LATENCY_6

FLASH Six wait state

FLASH_LATENCY_7

FLASH Seven wait states

FLASH_LATENCY_8

FLASH Eight wait states

FLASH_LATENCY_9

FLASH Nine wait states

FLASH_LATENCY_10

FLASH Ten wait state

FLASH_LATENCY_11

FLASH Eleven wait state

FLASH_LATENCY_12

FLASH Twelve wait states

FLASH_LATENCY_13

FLASH Thirteen wait states

FLASH_LATENCY_14

FLASH Fourteen wait states

FLASH_LATENCY_15

FLASH Fifteen wait states

FLASH Option Bytes PCROP On RDP Level Type

OB_PCROP_RDP_NOT_ERASE

PCROP area is not erased when the RDP level is decreased from Level 1 to Level 0

OB_PCROP_RDP_ERASE

PCROP area is erased when the RDP level is decreased from Level 1 to Level 0 (full mass erase)

FLASH Option Bytes Read Protection

OB_RDP_LEVEL_0

OB_RDP_LEVEL_1

OB_RDP_LEVEL_2

Warning: When enabling read protection level 2 it's no more possible to go back to level 1 or 0

FLASH Option Bytes Type

OPTIONBYTE_WRP

WRP option byte configuration

OPTIONBYTE_RDP

RDP option byte configuration

OPTIONBYTE_USER

USER option byte configuration

OPTIONBYTE_PCROP

PCROP option byte configuration

FLASH Option Bytes User BFB2 Mode

OB_BFB2_DISABLE

Dual-bank boot disable

OB_BFB2_ENABLE

Dual-bank boot enable

FLASH Option Bytes User BOR Level

OB_BOR_LEVEL_0

Reset level threshold is around 1.7V

OB_BOR_LEVEL_1

Reset level threshold is around 2.0V

OB_BOR_LEVEL_2

Reset level threshold is around 2.2V

OB_BOR_LEVEL_3

Reset level threshold is around 2.5V

OB_BOR_LEVEL_4

Reset level threshold is around 2.8V

FLASH Option Bytes User DBANK Type

OB_DBANK_128_BITS

Single-bank with 128-bits data

OB_DBANK_64_BITS

Dual-bank with 64-bits data

FLASH Option Bytes User Dual-bank Type

OB_DUALBANK_SINGLE

1 MB/512 kB Single-bank Flash

OB_DUALBANK_DUAL

1 MB/512 kB Dual-bank Flash

FLASH Option Bytes User IWDG Mode On Standby

OB_IWDG_STDBY_FREEZE

Independent watchdog counter is frozen in Standby mode

OB_IWDG_STDBY_RUN

Independent watchdog counter is running in Standby mode

FLASH Option Bytes User IWDG Mode On Stop

OB_IWDG_STOP_FREEZE

Independent watchdog counter is frozen in Stop mode

OB_IWDG_STOP_RUN

Independent watchdog counter is running in Stop mode

FLASH Option Bytes User IWDG Type

OB_IWDG_HW

Hardware independent watchdog

OB_IWDG_SW

Software independent watchdog

FLASH Option Bytes User BOOT1 Type

OB_BOOT1_SRAM

Embedded SRAM1 is selected as boot space (if BOOT0=1)

OB_BOOT1_SYSTEM

System memory is selected as boot space (if BOOT0=1)

FLASH Option Bytes User Reset On Shutdown

OB_SHUTDOWN_RST

Reset generated when entering the shutdown mode

OB_SHUTDOWN_NORST

No reset generated when entering the shutdown mode

FLASH Option Bytes User Reset On Standby

OB_STANDBY_RST

Reset generated when entering the standby mode

OB_STANDBY_NORST

No reset generated when entering the standby mode

FLASH Option Bytes User Reset On Stop

OB_STOP_RST

Reset generated when entering the stop mode

OB_STOP_NORST

No reset generated when entering the stop mode

FLASH Option Bytes User SRAM2 Parity Check Type

OB_SRAM2_PARITY_ENABLE

SRAM2 parity check enable

OB_SRAM2_PARITY_DISABLE

SRAM2 parity check disable

FLASH Option Bytes User SRAM2 Erase On Reset Type

OB_SRAM2_RST_ERASE

SRAM2 erased when a system reset occurs

OB_SRAM2_RST_NOT_ERASE

SRAM2 is not erased when a system reset occurs

FLASH Option Bytes User Type

OB_USER_BOR_LEV

BOR reset Level

OB_USER_nRST_STOP

Reset generated when entering the stop mode

OB_USER_nRST_STDBY

Reset generated when entering the standby mode

OB_USER_IWDG_SW

Independent watchdog selection

OB_USER_IWDG_STOP

Independent watchdog counter freeze in stop mode

OB_USER_IWDG_STDBY

Independent watchdog counter freeze in standby mode

OB_USER_WWDG_SW

Window watchdog selection

OB_USER_BFB2

Dual-bank boot

OB_USER_DUALBANK

Dual-Bank on 1MB or 512kB Flash memory devices

OB_USER_nBOOT1

Boot configuration

OB_USER_SRAM2_PE

SRAM2 parity check enable

OB_USER_SRAM2_RST

SRAM2 Erase when system reset

OB_USER_nRST_SHDW

Reset generated when entering the shutdown mode

OB_USER_nSWBOOT0

Software BOOT0

OB_USER_nBOOT0

nBOOT0 option bit

OB_USER_DBANK

Single bank with 128-bits data or two banks with 64-bits data

FLASH Option Bytes User WWDG Type

OB_WWDG_HW

Hardware window watchdog

OB_WWDG_SW

Software window watchdog

FLASH WRP Area

OB_WRPAREA_BANK1_AREAA

Flash Bank 1 Area A

OB_WRPAREA_BANK1_AREAB

Flash Bank 1 Area B

OB_WRPAREA_BANK2_AREAA

Flash Bank 2 Area A

OB_WRPAREA_BANK2_AREAB

Flash Bank 2 Area B

FLASH Erase Type

FLASH_TYPEERASE_PAGES

Pages erase only

FLASH_TYPEERASE_MASSERASE

Flash mass erase activation

FLASH Program Type

FLASH_TYPEPROGRAM_DOUBLEWORD

Program a double-word (64-bit) at a specified address.

FLASH_TYPEPROGRAM_FAST

Fast program a 32 row double-word (64-bit) at a specified address. And another 32 row double-word (64-bit) will be programmed

FLASH_TYPEPROGRAM_FAST_AND_LAST

Fast program a 32 row double-word (64-bit) at a specified address. And this is the last 32 row double-word (64-bit) programmed

28 HAL FLASH Extension Driver

28.1 FLASHEx Firmware driver API description

The following section lists the various functions of the FLASHEx library.

28.1.1 Flash Extended features

Comparing to other previous devices, the FLASH interface for STM32L4xx devices contains the following additional features

- Capacity up to 2 Mbyte with dual bank architecture supporting read-while-write capability (RWW)
- Dual bank memory organization
- PCROP protection for all banks

28.1.2 How to use this driver

This driver provides functions to configure and program the FLASH memory of all STM32L4xx devices. It includes

1. Flash Memory Erase functions:
   - Lock and Unlock the FLASH interface using HAL_FLASH_Unlock() and HAL_FLASH_Lock() functions
   - Erase function: Erase page, erase all sectors
   - There are two modes of erase :
     - Polling Mode using HAL_FLASHEx_Erase()
     - Interrupt Mode using HAL_FLASHEx_Erase_IT()
2. Option Bytes Programming function: Use HAL_FLASHEx_OBProgram() to :
   - Set/Reset the write protection
   - Set the Read protection Level
   - Program the user Option Bytes
   - Configure the PCROP protection
3. Get Option Bytes Configuration function: Use HAL_FLASHEx_OBGetConfig() to :
   - Get the value of a write protection area
   - Know if the read protection is activated
   - Get the value of the user Option Bytes
   - Get the value of a PCROP area

28.1.3 Extended programming operation functions

This subsection provides a set of functions allowing to manage the Extended FLASH programming operations Operations.

This section contains the following APIs:

- ***HAL_FLASHEx_Erase***
- ***HAL_FLASHEx_Erase_IT***
- ***HAL_FLASHEx_OBProgram***
- ***HAL_FLASHEx_OBGetConfig***

28.1.4 Extended specific configuration functions

This subsection provides a set of functions allowing to manage the Extended FLASH specific configurations.

This section contains the following APIs:

- ***HAL_FLASHEx_ConfigLVEPin***

28.1.5 Detailed description of functions

`HAL_FLASHEx_Erase`

Function name

HAL_StatusTypeDef HAL_FLASHEx_Erase (FLASH_EraseInitTypeDef * pEraseInit, uint32_t * PageError)

Function description

Perform a mass erase or erase the specified FLASH memory pages.

Parameters

- **pEraseInit:** pointer to an FLASH_EraseInitTypeDef structure that contains the configuration information for the erasing.
- **PageError:** : pointer to variable that contains the configuration information on faulty page in case of error (0xFFFFFFFF means that all the pages have been correctly erased)

Return values

- **HAL:** Status

`HAL_FLASHEx_Erase_IT`

Function name

HAL_StatusTypeDef HAL_FLASHEx_Erase_IT (FLASH_EraseInitTypeDef * pEraseInit)

Function description

Perform a mass erase or erase the specified FLASH memory pages with interrupt enabled.

Parameters

- **pEraseInit:** pointer to an FLASH_EraseInitTypeDef structure that contains the configuration information for the erasing.

Return values

- **HAL:** Status

`HAL_FLASHEx_OBProgram`

Function name

HAL_StatusTypeDef HAL_FLASHEx_OBProgram (FLASH_OBProgramInitTypeDef * pOBInit)

Function description

Program Option bytes.

Parameters

- **pOBInit:** pointer to an FLASH_OBInitStruct structure that contains the configuration information for the programming.

Return values

- **HAL:** Status

`HAL_FLASHEx_OBGetConfig`

Function name

void HAL_FLASHEx_OBGetConfig (FLASH_OBProgramInitTypeDef * pOBInit)

Function description

Get the Option bytes configuration.

Parameters

- **pOBInit:** pointer to an FLASH_OBInitStruct structure that contains the configuration information.

Return values

- **None:**

Notes

- The fields pOBInit->WRPArea and pOBInit->PCROPConfig should indicate which area is requested for the WRP and PCROP, else no information will be returned

`HAL_FLASHEx_ConfigLVEPin`

Function name

HAL_StatusTypeDef HAL_FLASHEx_ConfigLVEPin (uint32_t ConfigLVE)

Function description

Configuration of the LVE pin of the Flash (managed by power controller or forced to low in order to use an external SMPS)

Parameters

- **ConfigLVE:** Configuration of the LVE pin, This parameter can be one of the following values:
  - FLASH_LVE_PIN_CTRL: LVE FLASH pin controlled by power controller
  - FLASH_LVE_PIN_FORCED: LVE FLASH pin enforced to low (external SMPS used)

Return values

- **HAL:** Status

Notes

- Before enforcing the LVE pin to low, the SOC should be in low voltage range 2 and the voltage VDD12 should be higher than 1.08V and SMPS is ON.

`FLASH_PageErase`

Function name

void FLASH_PageErase (uint32_t Page, uint32_t Banks)

Function description

Erase the specified FLASH memory page.

Parameters

- **Page:** FLASH page to erase This parameter must be a value between 0 and (max number of pages in the bank - 1)
- **Banks:** Bank(s) where the page will be erased This parameter can be one of the following values:
  - FLASH_BANK_1: Page in bank 1 to be erased
  - FLASH_BANK_2: Page in bank 2 to be erased

Return values

- **None:**

`FLASH_FlushCaches`

Function name

void FLASH_FlushCaches (void)

Function description

Flush the instruction and data caches.

Return values

- **None:**

28.2 FLASHEx Firmware driver defines

The following section lists the various define and macros of the module.

28.2.1 FLASHEx

FLASHEx

FLASHEx LVE pin configuration

FLASH_LVE_PIN_CTRL

LVE FLASH pin controlled by power controller

FLASH_LVE_PIN_FORCED

LVE FLASH pin enforced to low (external SMPS used)

29 HAL FLASH__RAMFUNC Generic Driver

29.1 FLASH__RAMFUNC Firmware driver API description

The following section lists the various functions of the FLASH__RAMFUNC library.

29.1.1 Flash RAM functions

ARM Compiler

RAM functions are defined using the toolchain options. Functions that are executed in RAM should reside in a separate source module. Using the 'Options for File' dialog you can simply change the 'Code / Const' area of a module to a memory space in physical RAM. Available memory areas are declared in the 'Target' tab of the Options for Target' dialog.

ICCARM Compiler

RAM functions are defined using a specific toolchain keyword "__ramfunc".

GNU Compiler

RAM functions are defined using a specific toolchain attribute "__attribute__((section(".RamFunc")))".

29.1.2 ramfunc functions

This subsection provides a set of functions that should be executed from RAM.

This section contains the following APIs:

- ***HAL_FLASHEx_EnableRunPowerDown***
- ***HAL_FLASHEx_DisableRunPowerDown***
- ***HAL_FLASHEx_OB_DBankConfig***

29.1.3 Detailed description of functions

`HAL_FLASHEx_EnableRunPowerDown`

Function name

__RAM_FUNC HAL_StatusTypeDef HAL_FLASHEx_EnableRunPowerDown (void)

Function description

Enable the Power down in Run Mode.

Return values

- **HAL:** status

Notes

- This function should be called and executed from SRAM memory

`HAL_FLASHEx_DisableRunPowerDown`

Function name

__RAM_FUNC HAL_StatusTypeDef HAL_FLASHEx_DisableRunPowerDown (void)

Function description

Disable the Power down in Run Mode.

Return values

- **HAL:** status

Notes

- This function should be called and executed from SRAM memory

`HAL_FLASHEx_OB_DBankConfig`

Function name

__RAM_FUNC HAL_StatusTypeDef HAL_FLASHEx_OB_DBankConfig (uint32_t DBankConfig)

Function description

Program the FLASH DBANK User Option Byte.

Parameters

- **DBankConfig:** The FLASH DBANK User Option Byte value. This parameter can be one of the following values:
  - OB_DBANK_128_BITS: Single-bank with 128-bits data
  - OB_DBANK_64_BITS: Dual-bank with 64-bits data

Return values

- **HAL:** status

Notes

- To configure the user option bytes, the option lock bit OPTLOCK must be cleared with the call of the HAL_FLASH_OB_Unlock() function.
- To modify the DBANK option byte, no PCROP region should be defined. To deactivate PCROP, user should perform RDP changing

30 HAL GFXMMU Generic Driver

30.1 GFXMMU Firmware driver registers structures

30.1.1 GFXMMU_BuffersTypeDef

GFXMMU_BuffersTypeDef is defined in the stm32l4xx_hal_gfxmmu.h

Data Fields

- ***uint32_t Buf0Address***
- ***uint32_t Buf1Address***
- ***uint32_t Buf2Address***
- ***uint32_t Buf3Address***

Field Documentation

- ***uint32_t GFXMMU_BuffersTypeDef::Buf0Address***
  Physical address of buffer 0.
- ***uint32_t GFXMMU_BuffersTypeDef::Buf1Address***
  Physical address of buffer 1.
- ***uint32_t GFXMMU_BuffersTypeDef::Buf2Address***
  Physical address of buffer 2.
- ***uint32_t GFXMMU_BuffersTypeDef::Buf3Address***
  Physical address of buffer 3.

30.1.2 GFXMMU_InterruptsTypeDef

GFXMMU_InterruptsTypeDef is defined in the stm32l4xx_hal_gfxmmu.h

Data Fields

- ***FunctionalState Activation***
- ***uint32_t UsedInterrupts***

Field Documentation

- ***FunctionalState GFXMMU_InterruptsTypeDef::Activation***
  Interrupts enable/disable
- ***uint32_t GFXMMU_InterruptsTypeDef::UsedInterrupts***
  Interrupts used. This parameter can be a values combination of ***GFXMMU_Interrupts***.
  Note:
  – : Usefull only when interrupts are enabled.

30.1.3 GFXMMU_InitTypeDef

GFXMMU_InitTypeDef is defined in the stm32l4xx_hal_gfxmmu.h

Data Fields

- ***uint32_t BlocksPerLine***
- ***uint32_t DefaultValue***
- ***GFXMMU_BuffersTypeDef Buffers***
- ***GFXMMU_InterruptsTypeDef Interrupts***

Field Documentation

- ***uint32_t GFXMMU_InitTypeDef::BlocksPerLine***
  Number of blocks of 16 bytes per line. This parameter can be a value of ***GFXMMU_BlocksPerLine***.
- ***uint32_t GFXMMU_InitTypeDef::DefaultValue***
  Value returned when virtual memory location not physically mapped.

- ***GFXMMU_BuffersTypeDef GFXMMU_InitTypeDef::Buffers***
  Physical buffers addresses.
- ***GFXMMU_InterruptsTypeDef GFXMMU_InitTypeDef::Interrupts***
  Interrupts parameters.

30.1.4 GFXMMU_HandleTypeDef

GFXMMU_HandleTypeDef is defined in the stm32l4xx_hal_gfxmmu.h

Data Fields

- ***GFXMMU_TypeDef * Instance***
- ***GFXMMU_InitTypeDef Init***
- ***HAL_GFXMMU_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***GFXMMU_TypeDef* GFXMMU_HandleTypeDef::Instance***
  GFXMMU instance
- ***GFXMMU_InitTypeDef GFXMMU_HandleTypeDef::Init***
  GFXMMU init parameters
- ***HAL_GFXMMU_StateTypeDef GFXMMU_HandleTypeDef::State***
  GFXMMU state
- ***__IO uint32_t GFXMMU_HandleTypeDef::ErrorCode***
  GFXMMU error code

30.1.5 GFXMMU_LutLineTypeDef

GFXMMU_LutLineTypeDef is defined in the stm32l4xx_hal_gfxmmu.h

Data Fields

- ***uint32_t LineNumber***
- ***uint32_t LineStatus***
- ***uint32_t FirstVisibleBlock***
- ***uint32_t LastVisibleBlock***
- ***int32_t LineOffset***

Field Documentation

- ***uint32_t GFXMMU_LutLineTypeDef::LineNumber***
  LUT line number. This parameter must be a number between Min_Data = 0 and Max_Data = 1023.
- ***uint32_t GFXMMU_LutLineTypeDef::LineStatus***
  LUT line enable/disable. This parameter can be a value of ***GFXMMU_LutLineStatus***.
- ***uint32_t GFXMMU_LutLineTypeDef::FirstVisibleBlock***
  First visible block on this line. This parameter must be a number between Min_Data = 0 and Max_Data = 255.
- ***uint32_t GFXMMU_LutLineTypeDef::LastVisibleBlock***
  Last visible block on this line. This parameter must be a number between Min_Data = 0 and Max_Data = 255.
- ***int32_t GFXMMU_LutLineTypeDef::LineOffset***
  Offset of block 0 of the current line in physical buffer. This parameter must be a number between Min_Data = -4080 and Max_Data = 4190208.

  Note:

  – : Line offset has to be computed with the following formula: LineOffset = [(Blocks already used) - (1st visible block)]*BlockSize.

30.2 GFXMMU Firmware driver API description

The following section lists the various functions of the GFXMMU library.

30.2.1 How to use this driver

Initialization

1. As prerequisite, fill in the HAL_GFXMMU_MspInit() :
   – Enable GFXMMU clock interface with __HAL_RCC_GFXMMU_CLK_ENABLE().
   – If interrupts are used, enable and configure GFXMMU global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
2. Configure the number of blocks per line, default value, physical buffer addresses and interrupts using the HAL_GFXMMU_Init() function.

LUT configuration

1. Use HAL_GFXMMU_DisableLutLines() to deactivate all LUT lines (or a range of lines).
2. Use HAL_GFXMMU_ConfigLut() to copy LUT from flash to look up RAM.
3. Use HAL_GFXMMU_ConfigLutLine() to configure one line of LUT.

Modify physical buffer adresses

1. Use HAL_GFXMMU_ModifyBuffers() to modify physical buffer addresses.

Error management

1. If interrupts are used, HAL_GFXMMU_IRQHandler() will be called when an error occurs. This function will call HAL_GFXMMU_ErrorCallback(). Use HAL_GFXMMU_GetError() to get the error code.

De-initialization

1. As prerequisite, fill in the HAL_GFXMMU_MspDeInit() :
   – Disable GFXMMU clock interface with __HAL_RCC_GFXMMU_CLK_ENABLE().
   – If interrupts has been used, disable GFXMMU global interrupt with HAL_NVIC_DisableIRQ().
2. De-initialize GFXMMU using the HAL_GFXMMU_DeInit() function.

Callback registration

The compilation define USE_HAL_GFXMMU_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use functions HAL_GFXMMU_RegisterCallback() to register a user callback.

Function HAL_GFXMMU_RegisterCallback() allows to register following callbacks:

- ErrorCallback : GFXMMU error.
- MspInitCallback : GFXMMU MspInit.
- MspDeInitCallback : GFXMMU MspDeInit.

This function takes as parameters the HAL peripheral handle, the callback ID and a pointer to the user callback function.

Use function HAL_GFXMMU_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. HAL_GFXMMU_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the callback ID.

This function allows to reset following callbacks:

- ErrorCallback : GFXMMU error.
- MspInitCallback : GFXMMU MspInit.
- MspDeInitCallback : GFXMMU MspDeInit.

By default, after the HAL_GFXMMU_Init and if the state is HAL_GFXMMU_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions: examples HAL_GFXMMU_ErrorCallback(). Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the HAL_GFXMMU_Init and HAL_GFXMMU_DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the HAL_GFXMMU_Init and HAL_GFXMMU_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using HAL_GFXMMU_RegisterCallback before calling HAL_GFXMMU_DeInit or HAL_GFXMMU_Init function.

When the compilation define USE_HAL_GFXMMU_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

30.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the GFXMMU.
- De-initialize the GFXMMU.

This section contains the following APIs:

- ***HAL_GFXMMU_Init***
- ***HAL_GFXMMU_DeInit***
- ***HAL_GFXMMU_MspInit***
- ***HAL_GFXMMU_MspDeInit***

30.2.3 Operation functions

This section provides functions allowing to:

- Configure LUT.
- Modify physical buffer adresses.
- Manage error.

This section contains the following APIs:

- ***HAL_GFXMMU_ConfigLut***
- ***HAL_GFXMMU_DisableLutLines***
- ***HAL_GFXMMU_ConfigLutLine***
- ***HAL_GFXMMU_ModifyBuffers***
- ***HAL_GFXMMU_IRQHandler***
- ***HAL_GFXMMU_ErrorCallback***

30.2.4 State functions

This section provides functions allowing to:

- Get GFXMMU handle state.
- Get GFXMMU error code.

This section contains the following APIs:

- ***HAL_GFXMMU_GetState***
- ***HAL_GFXMMU_GetError***

30.2.5 Detailed description of functions

`HAL_GFXMMU_Init`

Function name

HAL_StatusTypeDef HAL_GFXMMU_Init (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

Initialize the GFXMMU according to the specified parameters in the GFXMMU_InitTypeDef structure and initialize the associated handle.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **HAL:** status.

`HAL_GFXMMU_DeInit`

Function name

HAL_StatusTypeDef HAL_GFXMMU_DeInit (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

De-initialize the GFXMMU.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **HAL:** status.

`HAL_GFXMMU_MspInit`

Function name

void HAL_GFXMMU_MspInit (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

Initialize the GFXMMU MSP.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **None.:**

`HAL_GFXMMU_MspDeInit`

Function name

void HAL_GFXMMU_MspDeInit (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

De-initialize the GFXMMU MSP.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **None.:**

`HAL_GFXMMU_ConfigLut`

Function name

HAL_StatusTypeDef HAL_GFXMMU_ConfigLut (GFXMMU_HandleTypeDef * hgfxmmu, uint32_t FirstLine, uint32_t LinesNumber, uint32_t Address)

Function description

This function allows to copy LUT from flash to look up RAM.

Parameters

- **hgfxmmu:** GFXMMU handle.
- **FirstLine:** First line enabled on LUT. This parameter must be a number between Min_Data = 0 and Max_Data = 1023.
- **LinesNumber:** Number of lines enabled on LUT. This parameter must be a number between Min_Data = 1 and Max_Data = 1024.
- **Address:** Start address of LUT in flash.

Return values

- **HAL:** status.

`HAL_GFXMMU_DisableLutLines`

Function name

HAL_StatusTypeDef HAL_GFXMMU_DisableLutLines (GFXMMU_HandleTypeDef * hgfxmmu, uint32_t FirstLine, uint32_t LinesNumber)

Function description

This function allows to disable a range of LUT lines.

Parameters

- **hgfxmmu:** GFXMMU handle.
- **FirstLine:** First line to disable on LUT. This parameter must be a number between Min_Data = 0 and Max_Data = 1023.
- **LinesNumber:** Number of lines to disable on LUT. This parameter must be a number between Min_Data = 1 and Max_Data = 1024.

Return values

- **HAL:** status.

`HAL_GFXMMU_ConfigLutLine`

Function name

HAL_StatusTypeDef HAL_GFXMMU_ConfigLutLine (GFXMMU_HandleTypeDef * hgfxmmu, GFXMMU_LutLineTypeDef * lutLine)

Function description

This function allows to configure one line of LUT.

Parameters

- **hgfxmmu:** GFXMMU handle.
- **lutLine:** LUT line parameters.

Return values

- **HAL:** status.

`HAL_GFXMMU_ModifyBuffers`

Function name

HAL_StatusTypeDef HAL_GFXMMU_ModifyBuffers (GFXMMU_HandleTypeDef * hgfxmmu, GFXMMU_BuffersTypeDef * Buffers)

Function description

This function allows to modify physical buffer addresses.

Parameters

- **hgfxmmu:** GFXMMU handle.
- **Buffers:** Buffers parameters.

Return values

- **HAL:** status.

`HAL_GFXMMU_IRQHandler`

Function name

void HAL_GFXMMU_IRQHandler (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

This function handles the GFXMMU interrupts.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **None.:**

`HAL_GFXMMU_ErrorCallback`

Function name

void HAL_GFXMMU_ErrorCallback (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

Error callback.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **None.:**

`HAL_GFXMMU_GetState`

Function name

HAL_GFXMMU_StateTypeDef HAL_GFXMMU_GetState (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

This function allows to get the current GFXMMU handle state.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **GFXMMU:** state.

`HAL_GFXMMU_GetError`

Function name

uint32_t HAL_GFXMMU_GetError (GFXMMU_HandleTypeDef * hgfxmmu)

Function description

This function allows to get the current GFXMMU error code.

Parameters

- **hgfxmmu:** GFXMMU handle.

Return values

- **GFXMMU:** error code.

30.3 GFXMMU Firmware driver defines

The following section lists the various define and macros of the module.

30.3.1 GFXMMU

GFXMMU

GFXMMU blocks per line

GFXMMU_256BLOCKS

256 blocks of 16 bytes per line

GFXMMU_192BLOCKS

192 blocks of 16 bytes per line

GFXMMU Error Code

GFXMMU_ERROR_NONE

No error

GFXMMU_ERROR_BUFFER0_OVERFLOW

Buffer 0 overflow

GFXMMU_ERROR_BUFFER1_OVERFLOW

Buffer 1 overflow

GFXMMU_ERROR_BUFFER2_OVERFLOW

Buffer 2 overflow

GFXMMU_ERROR_BUFFER3_OVERFLOW

Buffer 3 overflow

GFXMMU_ERROR_AHB_MASTER

AHB master error

GFXMMU Exported Macros

__HAL_GFXMMU_RESET_HANDLE_STATE

Description:

- Reset GFXMMU handle state.

Parameters:

- __HANDLE__: GFXMMU handle.

Return value:

- None

GFXMMU interrupts

GFXMMU_AHB_MASTER_ERROR_IT

AHB master error interrupt

GFXMMU_BUFFER0_OVERFLOW_IT

Buffer 0 overflow interrupt

GFXMMU_BUFFER1_OVERFLOW_IT

Buffer 1 overflow interrupt

GFXMMU_BUFFER2_OVERFLOW_IT

Buffer 2 overflow interrupt

GFXMMU_BUFFER3_OVERFLOW_IT

Buffer 3 overflow interrupt

GFXMMU LUT line status

GFXMMU_LUT_LINE_DISABLE

LUT line disabled

GFXMMU_LUT_LINE_ENABLE

LUT line enabled

31 HAL GPIO Generic Driver

31.1 GPIO Firmware driver registers structures

31.1.1 GPIO_InitTypeDef

GPIO_InitTypeDef is defined in the stm32l4xx_hal_gpio.h

Data Fields

- ***uint32_t Pin***
- ***uint32_t Mode***
- ***uint32_t Pull***
- ***uint32_t Speed***
- ***uint32_t Alternate***

Field Documentation

- ***uint32_t GPIO_InitTypeDef::Pin***
  Specifies the GPIO pins to be configured. This parameter can be any value of ***GPIO_pins***
- ***uint32_t GPIO_InitTypeDef::Mode***
  Specifies the operating mode for the selected pins. This parameter can be a value of ***GPIO_mode***
- ***uint32_t GPIO_InitTypeDef::Pull***
  Specifies the Pull-up or Pull-Down activation for the selected pins. This parameter can be a value of ***GPIO_pull***
- ***uint32_t GPIO_InitTypeDef::Speed***
  Specifies the speed for the selected pins. This parameter can be a value of ***GPIO_speed***
- ***uint32_t GPIO_InitTypeDef::Alternate***
  Peripheral to be connected to the selected pins This parameter can be a value of ***GPIOEx_Alternate_function_selection***

31.2 GPIO Firmware driver API description

The following section lists the various functions of the GPIO library.

31.2.1 GPIO Peripheral features

- Each port bit of the general-purpose I/O (GPIO) ports can be individually configured by software in several modes:
  - Input mode
  - Analog mode
  - Output mode
  - Alternate function mode
  - External interrupt/event lines
- During and just after reset, the alternate functions and external interrupt lines are not active and the I/O ports are configured in input floating mode.
- All GPIO pins have weak internal pull-up and pull-down resistors, which can be activated or not.
- In Output or Alternate mode, each IO can be configured on open-drain or push-pull type and the IO speed can be selected depending on the VDD value.
- The microcontroller IO pins are connected to onboard peripherals/modules through a multiplexer that allows only one peripheral alternate function (AF) connected to an IO pin at a time. In this way, there can be no conflict between peripherals sharing the same IO pin.
- All ports have external interrupt/event capability. To use external interrupt lines, the port must be configured in input mode. All available GPIO pins are connected to the 16 external interrupt/event lines from EXTI0 to EXTI15.

- The external interrupt/event controller consists of up to 39 edge detectors (16 lines are connected to GPIO) for generating event/interrupt requests (each input line can be independently configured to select the type (interrupt or event) and the corresponding trigger event (rising or falling or both). Each line can also be masked independently.

31.2.2 How to use this driver

1. Enable the GPIO AHB clock using the following function: __HAL_RCC_GPIOx_CLK_ENABLE().
2. Configure the GPIO pin(s) using HAL_GPIO_Init().
   - Configure the IO mode using "Mode" member from GPIO_InitTypeDef structure
   - Activate Pull-up, Pull-down resistor using "Pull" member from GPIO_InitTypeDef structure.
   - In case of Output or alternate function mode selection: the speed is configured through "Speed" member from GPIO_InitTypeDef structure.
   - In alternate mode is selection, the alternate function connected to the IO is configured through "Alternate" member from GPIO_InitTypeDef structure.
   - Analog mode is required when a pin is to be used as ADC channel or DAC output.
   - In case of external interrupt/event selection the "Mode" member from GPIO_InitTypeDef structure select the type (interrupt or event) and the corresponding trigger event (rising or falling or both).
3. In case of external interrupt/event mode selection, configure NVIC IRQ priority mapped to the EXTI line using HAL_NVIC_SetPriority() and enable it using HAL_NVIC_EnableIRQ().
4. To get the level of a pin configured in input mode use HAL_GPIO_ReadPin().
5. To set/reset the level of a pin configured in output mode use HAL_GPIO_WritePin()/HAL_GPIO_TogglePin().
6. To lock pin configuration until next reset use HAL_GPIO_LockPin().
7. During and just after reset, the alternate functions are not active and the GPIO pins are configured in input floating mode (except JTAG pins).
8. The LSE oscillator pins OSC32_IN and OSC32_OUT can be used as general purpose (PC14 and PC15, respectively) when the LSE oscillator is off. The LSE has priority over the GPIO function.
9. The HSE oscillator pins OSC_IN/OSC_OUT can be used as general purpose PH0 and PH1, respectively, when the HSE oscillator is off. The HSE has priority over the GPIO function.

31.2.3 Initialization and de-initialization functions

This section contains the following APIs:

- ***HAL_GPIO_Init***
- ***HAL_GPIO_DeInit***

31.2.4 IO operation functions

This section contains the following APIs:

- ***HAL_GPIO_ReadPin***
- ***HAL_GPIO_WritePin***
- ***HAL_GPIO_TogglePin***
- ***HAL_GPIO_LockPin***
- ***HAL_GPIO_EXTI_IRQHandler***
- ***HAL_GPIO_EXTI_Callback***

31.2.5 Detailed description of functions

HAL_GPIO_Init

Function name

void HAL_GPIO_Init (GPIO_TypeDef * GPIOx, GPIO_InitTypeDef * GPIO_Init)

Function description

Initialize the GPIOx peripheral according to the specified parameters in the GPIO_Init.

Parameters

- **GPIOx:** where x can be (A..H) to select the GPIO peripheral for STM32L4 family
- **GPIO_Init:** pointer to a GPIO_InitTypeDef structure that contains the configuration information for the specified GPIO peripheral.

Return values

- **None:**

HAL_GPIO_DeInit

Function name

void HAL_GPIO_DeInit (GPIO_TypeDef * GPIOx, uint32_t GPIO_Pin)

Function description

De-initialize the GPIOx peripheral registers to their default reset values.

Parameters

- **GPIOx:** where x can be (A..H) to select the GPIO peripheral for STM32L4 family
- **GPIO_Pin:** specifies the port bit to be written. This parameter can be any combination of GPIO_Pin_x where x can be (0..15).

Return values

- **None:**

HAL_GPIO_ReadPin

Function name

GPIO_PinState HAL_GPIO_ReadPin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin)

Function description

Read the specified input port pin.

Parameters

- **GPIOx:** where x can be (A..H) to select the GPIO peripheral for STM32L4 family
- **GPIO_Pin:** specifies the port bit to read. This parameter can be any combination of GPIO_Pin_x where x can be (0..15).

Return values

- **The:** input port pin value.

HAL_GPIO_WritePin

Function name

void HAL_GPIO_WritePin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin, GPIO_PinState PinState)

Function description

Set or clear the selected data port bit.

Parameters

- **GPIOx:** where x can be (A..H) to select the GPIO peripheral for STM32L4 family
- **GPIO_Pin:** specifies the port bit to be written. This parameter can be any combination of GPIO_Pin_x where x can be (0..15).
- **PinState:** specifies the value to be written to the selected bit. This parameter can be one of the GPIO_PinState enum values:
  - GPIO_PIN_RESET: to clear the port pin
  - GPIO_PIN_SET: to set the port pin

Return values

- **None:**

Notes

- This function uses GPIOx_BSRR and GPIOx_BRR registers to allow atomic read/modify accesses. In this way, there is no risk of an IRQ occurring between the read and the modify access.

`HAL_GPIO_TogglePin`

Function name

void HAL_GPIO_TogglePin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin)

Function description

Toggle the specified GPIO pin.

Parameters

- **GPIOx:** where x can be (A..H) to select the GPIO peripheral for STM32L4 family
- **GPIO_Pin:** specifies the pin to be toggled.

Return values

- **None:**

`HAL_GPIO_LockPin`

Function name

HAL_StatusTypeDef HAL_GPIO_LockPin (GPIO_TypeDef * GPIOx, uint16_t GPIO_Pin)

Function description

Lock GPIO Pins configuration registers.

Parameters

- **GPIOx:** where x can be (A..H) to select the GPIO peripheral for STM32L4 family
- **GPIO_Pin:** specifies the port bits to be locked. This parameter can be any combination of GPIO_Pin_x where x can be (0..15).

Return values

- **None:**

Notes

- The locked registers are GPIOx_MODER, GPIOx_OTYPER, GPIOx_OSPEEDR, GPIOx_PUPDR, GPIOx_AFRL and GPIOx_AFRH.
- The configuration of the locked GPIO pins can no longer be modified until the next reset.

`HAL_GPIO_EXTI_IRQHandler`

Function name

void HAL_GPIO_EXTI_IRQHandler (uint16_t GPIO_Pin)

Function description

Handle EXTI interrupt request.

Parameters

- **GPIO_Pin:** Specifies the port pin connected to corresponding EXTI line.

Return values

- **None:**

`HAL_GPIO_EXTI_Callback`

Function name

void HAL_GPIO_EXTI_Callback (uint16_t GPIO_Pin)

Function description

EXTI line detection callback.

Parameters

- **GPIO_Pin:** Specifies the port pin connected to corresponding EXTI line.

Return values

- **None:**

31.3 GPIO Firmware driver defines

The following section lists the various define and macros of the module.

31.3.1 GPIO

GPIO

GPIO Exported Macros

__HAL_GPIO_EXTI_GET_FLAG

Description:

- Check whether the specified EXTI line flag is set or not.

Parameters:

- __EXTI_LINE__: specifies the EXTI line flag to check. This parameter can be GPIO_PIN_x where x can be(0..15)

Return value:

- The: new state of __EXTI_LINE__ (SET or RESET).

__HAL_GPIO_EXTI_CLEAR_FLAG

Description:

- Clear the EXTI's line pending flags.

Parameters:

- __EXTI_LINE__: specifies the EXTI lines flags to clear. This parameter can be any combination of GPIO_PIN_x where x can be (0..15)

Return value:

- None

__HAL_GPIO_EXTI_GET_IT

Description:

- Check whether the specified EXTI line is asserted or not.

Parameters:

- __EXTI_LINE__: specifies the EXTI line to check. This parameter can be GPIO_PIN_x where x can be(0..15)

Return value:

- The: new state of __EXTI_LINE__ (SET or RESET).

__HAL_GPIO_EXTI_CLEAR_IT

Description:

- Clear the EXTI's line pending bits.

Parameters:

- __EXTI_LINE__: specifies the EXTI lines to clear. This parameter can be any combination of GPIO_PIN_x where x can be (0..15)

Return value:

- None

__HAL_GPIO_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on selected EXTI line.

Parameters:

- __EXTI_LINE__: specifies the EXTI line to check. This parameter can be GPIO_PIN_x where x can be(0..15)

Return value:

- None

GPIO mode

GPIO_MODE_INPUT

Input Floating Mode

GPIO_MODE_OUTPUT_PP

Output Push Pull Mode

GPIO_MODE_OUTPUT_OD

Output Open Drain Mode

GPIO_MODE_AF_PP

Alternate Function Push Pull Mode

GPIO_MODE_AF_OD

Alternate Function Open Drain Mode

GPIO_MODE_ANALOG

Analog Mode

GPIO_MODE_ANALOG_ADC_CONTROL

Analog Mode for ADC conversion

GPIO_MODE_IT_RISING

External Interrupt Mode with Rising edge trigger detection

GPIO_MODE_IT_FALLING

External Interrupt Mode with Falling edge trigger detection

GPIO_MODE_IT_RISING_FALLING

External Interrupt Mode with Rising/Falling edge trigger detection

GPIO_MODE_EVT_RISING

External Event Mode with Rising edge trigger detection

GPIO_MODE_EVT_FALLING

External Event Mode with Falling edge trigger detection

GPIO_MODE_EVT_RISING_FALLING

External Event Mode with Rising/Falling edge trigger detection

GPIO pins

GPIO_PIN_0

GPIO_PIN_1

GPIO_PIN_2

GPIO_PIN_3

GPIO_PIN_4

GPIO_PIN_5

GPIO_PIN_6

GPIO_PIN_7

GPIO_PIN_8

GPIO_PIN_9

GPIO_PIN_10

GPIO_PIN_11

GPIO_PIN_12

GPIO_PIN_13

GPIO_PIN_14

GPIO_PIN_15

GPIO_PIN_All

GPIO_PIN_MASK

GPIO pull

GPIO_NOPULL

No Pull-up or Pull-down activation

GPIO_PULLUP

Pull-up activation

GPIO_PULLDOWN

Pull-down activation

GPIO speed

GPIO_SPEED_FREQ_LOW

range up to 5 MHz, please refer to the product datasheet

GPIO_SPEED_FREQ_MEDIUM

range 5 MHz to 25 MHz, please refer to the product datasheet

GPIO_SPEED_FREQ_HIGH

range 25 MHz to 50 MHz, please refer to the product datasheet

GPIO_SPEED_FREQ_VERY_HIGH

range 50 MHz to 80 MHz, please refer to the product datasheet

32 HAL GPIO Extension Driver

32.1 GPIOEx Firmware driver defines

The following section lists the various define and macros of the module.

32.1.1 GPIOEx

GPIOEx

GPIOEx Alternate function selection

GPIO_AF0_RTC_50Hz

GPIO_AF0_MCO

GPIO_AF0_SWJ

GPIO_AF0_TRACE

GPIO_AF1_TIM1

GPIO_AF1_TIM2

GPIO_AF1_TIM5

GPIO_AF1_TIM8

GPIO_AF1_LPTIM1

GPIO_AF1_IR

GPIO_AF2_TIM1

GPIO_AF2_TIM2

GPIO_AF2_TIM3

GPIO_AF2_TIM4

GPIO_AF2_TIM5

GPIO_AF3_I2C4

GPIO_AF3_OCTOSPIM_P1

GPIO_AF3_SAI1

GPIO_AF3_SPI2

GPIO_AF3_TIM1_COMP1

GPIO_AF3_TIM1_COMP2

GPIO_AF3_TIM8

GPIO_AF3_TIM8_COMP1

GPIO_AF3_TIM8_COMP2

GPIO_AF3_USART2

GPIO_AF4_I2C1

GPIO_AF4_I2C2

GPIO_AF4_I2C3

GPIO_AF4_I2C4

GPIO_AF4_DCMI

GPIO_AF5_DCMI

GPIO_AF5_DFSDM1

GPIO_AF5_I2C4

GPIO_AF5_OCTOSPIM_P1

GPIO_AF5_OCTOSPIM_P2

GPIO_AF5_SPI1

GPIO_AF5_SPI2

GPIO_AF5_SPI3

GPIO_AF6_DFSDM1

GPIO_AF6_I2C3

GPIO_AF6_SPI3

GPIO_AF7_USART1

GPIO_AF7_USART2

GPIO_AF7_USART3

GPIO_AF8_LPUART1

GPIO_AF8_SDMMC1

GPIO_AF8_UART4

GPIO_AF8_UART5

GPIO_AF9_CAN1

GPIO_AF9_LTDC

GPIO_AF9_TSC

GPIO_AF10_DCMI

GPIO_AF10_OCTOSPIM_P1

GPIO_AF10_OCTOSPIM_P2

GPIO_AF10_OTG_FS

GPIO_AF11_DSI

GPIO_AF11_LTDC

GPIO_AF12_COMP1

GPIO_AF12_COMP2

GPIO_AF12_DSI

GPIO_AF12_FMC

GPIO_AF12_SDMMC1

GPIO_AF12_TIM1_COMP1

GPIO_AF12_TIM1_COMP2

GPIO_AF12_TIM8_COMP2

GPIO_AF13_SAI1

GPIO_AF13_SAI2

GPIO_AF13_TIM8_COMP1

GPIO_AF14_TIM15

GPIO_AF14_TIM16

GPIO_AF14_TIM17

GPIO_AF14_LPTIM2

GPIO_AF14_TIM8_COMP2

GPIO_AF15_EVENTOUT

IS_GPIO_AF

GPIOEx_Get Port Index

GPIO_GET_INDEX

33 HAL HASH Generic Driver

33.1 HASH Firmware driver registers structures

33.1.1 HASH_InitTypeDef

HASH_InitTypeDef is defined in the stm32l4xx_hal_hash.h

Data Fields

- ***uint32_t DataType***
- ***uint32_t KeySize***
- ***uint8_t * pKey***

Field Documentation

- ***uint32_t HASH_InitTypeDef::DataType***
  32-bit data, 16-bit data, 8-bit data or 1-bit data. This parameter can be a value of ***HASH_Data_Type***.
- ***uint32_t HASH_InitTypeDef::KeySize***
  The key size is used only in HMAC operation.
- ***uint8_t* HASH_InitTypeDef::pKey***
  The key is used only in HMAC operation.

33.1.2 HASH_HandleTypeDef

HASH_HandleTypeDef is defined in the stm32l4xx_hal_hash.h

Data Fields

- ***HASH_InitTypeDef Init***
- ***uint8_t * pHashInBuffPtr***
- ***uint8_t * pHashOutBuffPtr***
- ***uint8_t * pHashKeyBuffPtr***
- ***uint8_t * pHashMsgBuffPtr***
- ***uint32_t HashBuffSize***
- ***__IO uint32_t HashInCount***
- ***__IO uint32_t HashITCounter***
- ***__IO uint32_t HashKeyCount***
- ***HAL_StatusTypeDef Status***
- ***HAL_HASH_PhaseTypeDef Phase***
- ***DMA_HandleTypeDef * hdmain***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_HASH_StateTypeDef State***
- ***HAL_HASH_SuspendTypeDef SuspendRequest***
- ***FlagStatus DigestCalculationDisable***
- ***__IO uint32_t NbWordsAlreadyPushed***
- ***__IO uint32_t ErrorCode***
- ***__IO uint32_t Accumulation***

Field Documentation

- ***HASH_InitTypeDef HASH_HandleTypeDef::Init***
  HASH required parameters
- ***uint8_t* HASH_HandleTypeDef::pHashInBuffPtr***
  Pointer to input buffer
- ***uint8_t* HASH_HandleTypeDef::pHashOutBuffPtr***
  Pointer to output buffer (digest)

- ***uint8_t* HASH_HandleTypeDef::pHashKeyBuffPtr***
  Pointer to key buffer (HMAC only)
- ***uint8_t* HASH_HandleTypeDef::pHashMsgBuffPtr***
  Pointer to message buffer (HMAC only)
- ***uint32_t HASH_HandleTypeDef::HashBuffSize***
  Size of buffer to be processed
- ***__IO uint32_t HASH_HandleTypeDef::HashInCount***
  Counter of inputted data
- ***__IO uint32_t HASH_HandleTypeDef::HashITCounter***
  Counter of issued interrupts
- ***__IO uint32_t HASH_HandleTypeDef::HashKeyCount***
  Counter for Key inputted data (HMAC only)
- ***HAL_StatusTypeDef HASH_HandleTypeDef::Status***
  HASH peripheral status
- ***HAL_HASH_PhaseTypeDef HASH_HandleTypeDef::Phase***
  HASH peripheral phase
- ***DMA_HandleTypeDef* HASH_HandleTypeDef::hdmain***
  HASH In DMA Handle parameters
- ***HAL_LockTypeDef HASH_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_HASH_StateTypeDef HASH_HandleTypeDef::State***
  HASH peripheral state
- ***HAL_HASH_SuspendTypeDef HASH_HandleTypeDef::SuspendRequest***
  HASH peripheral suspension request flag
- ***FlagStatus HASH_HandleTypeDef::DigestCalculationDisable***
  Digest calculation phase skip (MDMAT bit control) for multi-buffers DMA-based HMAC computation
- ***__IO uint32_t HASH_HandleTypeDef::NbWordsAlreadyPushed***
  Numbers of words already pushed in FIFO before inputting new block
- ***__IO uint32_t HASH_HandleTypeDef::ErrorCode***
  HASH Error code
- ***__IO uint32_t HASH_HandleTypeDef::Accumulation***
  HASH multi buffers accumulation flag

33.2 HASH Firmware driver API description

The following section lists the various functions of the HASH library.

33.2.1 How to use this driver

The HASH HAL driver can be used as follows:

1. Initialize the HASH low level resources by implementing the HAL_HASH_MspInit():
   a. Enable the HASH interface clock using __HASH_CLK_ENABLE()
   b. When resorting to interrupt-based APIs (e.g. HAL_HASH_xxx_Start_IT())
      - Configure the HASH interrupt priority using HAL_NVIC_SetPriority()
      - Enable the HASH IRQ handler using HAL_NVIC_EnableIRQ()
      - In HASH IRQ handler, call HAL_HASH_IRQHandler() API
   c. When resorting to DMA-based APIs (e.g. HAL_HASH_xxx_Start_DMA())
      - Enable the DMAx interface clock using __DMAx_CLK_ENABLE()
      - Configure and enable one DMA stream to manage data transfer from memory to peripheral (input stream). Managing data transfer from peripheral to memory can be performed only using CPU.
      - Associate the initialized DMA handle to the HASH DMA handle using __HAL_LINKDMA()
      - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Stream: use HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ()
2. Initialize the HASH HAL using HAL_HASH_Init(). This function:
   a. resorts to HAL_HASH_MspInit() for low-level initialization,
   b. configures the data type: 1-bit, 8-bit, 16-bit or 32-bit.
3. Three processing schemes are available:
   a. Polling mode: processing APIs are blocking functions i.e. they process the data and wait till the digest computation is finished, e.g. HAL_HASH_xxx_Start() for HASH or HAL_HMAC_xxx_Start() for HMAC
   b. Interrupt mode: processing APIs are not blocking functions i.e. they process the data under interrupt, e.g. HAL_HASH_xxx_Start_IT() for HASH or HAL_HMAC_xxx_Start_IT() for HMAC
   c. DMA mode: processing APIs are not blocking functions and the CPU is not used for data transfer i.e. the data transfer is ensured by DMA, e.g. HAL_HASH_xxx_Start_DMA() for HASH or HAL_HMAC_xxx_Start_DMA() for HMAC. Note that in DMA mode, a call to HAL_HASH_xxx_Finish() is then required to retrieve the digest.
4. When the processing function is called after HAL_HASH_Init(), the HASH peripheral is initialized and processes the buffer fed in input. When the input data have all been fed to the Peripheral, the digest computation can start.
5. Multi-buffer processing is possible in polling, interrupt and DMA modes.
   a. In polling mode, only multi-buffer HASH processing is possible. API HAL_HASH_xxx_Accumulate() must be called for each input buffer, except for the last one. User must resort to HAL_HASH_xxx_Accumulate_End() to enter the last one and retrieve as well the computed digest.
   b. In interrupt mode, API HAL_HASH_xxx_Accumulate_IT() must be called for each input buffer, except for the last one. User must resort to HAL_HASH_xxx_Accumulate_End_IT() to enter the last one and retrieve as well the computed digest.
   c. In DMA mode, multi-buffer HASH and HMAC processing are possible.
      - HASH processing: once initialization is done, MDMAT bit must be set thru __HAL_HASH_SET_MDMAT() macro. From that point, each buffer can be fed to the Peripheral thru HAL_HASH_xxx_Start_DMA() API. Before entering the last buffer, reset the MDMAT bit with __HAL_HASH_RESET_MDMAT() macro then wrap-up the HASH processing in feeding the last input buffer thru the same API HAL_HASH_xxx_Start_DMA(). The digest can then be retrieved with a call to API HAL_HASH_xxx_Finish().
      - HMAC processing (requires to resort to extended functions): after initialization, the key and the first input buffer are entered in the Peripheral with the API HAL_HMACEx_xxx_Step1_2_DMA(). This carries out HMAC step 1 and starts step 2. The following buffers are next entered with the API HAL_HMACEx_xxx_Step2_DMA(). At this point, the HMAC processing is still carrying out step 2. Then, step 2 for the last input buffer and step 3 are carried out by a single call to HAL_HMACEx_xxx_Step2_3_DMA(). The digest can finally be retrieved with a call to API HAL_HASH_xxx_Finish().

6. Context swapping.
   a. Two APIs are available to suspend HASH or HMAC processing:
      - HAL_HASH_SwFeed_ProcessSuspend() when data are entered by software (polling or IT mode),
      - HAL_HASH_DMAFeed_ProcessSuspend() when data are entered by DMA.
   b. When HASH or HMAC processing is suspended, HAL_HASH_ContextSaving() allows to save in memory the Peripheral context. This context can be restored afterwards to resume the HASH processing thanks to HAL_HASH_ContextRestoring().
   c. Once the HASH Peripheral has been restored to the same configuration as that at suspension time, processing can be restarted with the same API call (same API, same handle, same parameters) as done before the suspension. Relevant parameters to restart at the proper location are internally saved in the HASH handle.
7. Call HAL_HASH_DeInit() to deinitialize the HASH peripheral.

Remarks on message length

1. HAL in interruption mode (interruptions driven)
   a. Due to HASH peripheral hardware design, the peripheral interruption is triggered every 64 bytes. This is why, for driver implementation simplicity's sake, user is requested to enter a message the length of which is a multiple of 4 bytes.
   b. When the message length (in bytes) is not a multiple of words, a specific field exists in HASH_STR to specify which bits to discard at the end of the complete message to process only the message bits and not extra bits.
   c. If user needs to perform a hash computation of a large input buffer that is spread around various places in memory and where each piece of this input buffer is not necessarily a multiple of 4 bytes in size, it becomes necessary to use a temporary buffer to format the data accordingly before feeding them to the Peripheral. It is advised to the user to
      - achieve the first formatting operation by software then enter the data
      - while the Peripheral is processing the first input set, carry out the second formatting operation by software, to be ready when DINIS occurs.
      - repeat step 2 until the whole message is processed.

1. HAL in DMA mode
   a. Again, due to hardware design, the DMA transfer to feed the data can only be done on a word-basis. The same field described above in HASH_STR is used to specify which bits to discard at the end of the DMA transfer to process only the message bits and not extra bits. Due to hardware implementation, this is possible only at the end of the complete message. When several DMA transfers are needed to enter the message, this is not applicable at the end of the intermediary transfers.
   b. Similarly to the interruption-driven mode, it is suggested to the user to format the consecutive chunks of data by software while the DMA transfer and processing is on-going for the first parts of the message. Due to the 32-bit alignment required for the DMA transfer, it is underlined that the software formatting operation is more complex than in the IT mode.

Callback registration

1. The compilation define USE_HAL_HASH_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use function @ref HAL_HASH_RegisterCallback() to register a user callback.
2. Function @ref HAL_HASH_RegisterCallback() allows to register following callbacks: (+) InCpltCallback : callback for input completion. (+) DgstCpltCallback : callback for digest computation completion. (+) ErrorCallback : callback for error. (+) MspInitCallback : HASH MspInit. (+) MspDeInitCallback : HASH MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.
3. Use function @ref HAL_HASH_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_HASH_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks: (+) InCpltCallback : callback for input completion. (+) DgstCpltCallback : callback for digest computation completion. (+) ErrorCallback : callback for error. (+) MspInitCallback : HASH MspInit. (+) MspDeInitCallback : HASH MspDeInit.

4. By default, after the @ref HAL_HASH_Init and if the state is HAL_HASH_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions: examples @ref HAL_HASH_InCpltCallback(), @ref HAL_HASH_DgstCpltCallback() Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_HASH_Init and @ref HAL_HASH_DeInit only when these callbacks are null (not registered beforehand) If not, MspInit or MspDeInit are not null, the @ref HAL_HASH_Init and @ref HAL_HASH_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand). Callbacks can be registered/ unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/ unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_HASH_RegisterCallback before calling @ref HAL_HASH_DeInit or @ref HAL_HASH_Init function. When The compilation define USE_HAL_HASH_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

(#) The compilation define USE_HAL_HASH_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use function @ref HAL_HASH_RegisterCallback() to register a user callback. (#) Function @ref HAL_HASH_RegisterCallback() allows to register following callbacks:

- InCpltCallback : callback for input completion.
- DgstCpltCallback : callback for digest computation completion.
- ErrorCallback : callback for error.
- MspInitCallback : HASH MspInit.
- MspDeInitCallback : HASH MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. (#) Use function @ref HAL_HASH_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_HASH_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:
- InCpltCallback : callback for input completion.
- DgstCpltCallback : callback for digest computation completion.
- ErrorCallback : callback for error.
- MspInitCallback : HASH MspInit.
- MspDeInitCallback : HASH MspDeInit. (#) By default, after the @ref HAL_HASH_Init and if the state is HAL_HASH_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions: examples @ref HAL_HASH_InCpltCallback(), @ref HAL_HASH_DgstCpltCallback() Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_HASH_Init and @ref HAL_HASH_DeInit only when these callbacks are null (not registered beforehand) If not, MspInit or MspDeInit are not null, the @ref HAL_HASH_Init and @ref HAL_HASH_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand). Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_HASH_RegisterCallback before calling @ref HAL_HASH_DeInit or @ref HAL_HASH_Init function. When The compilation define USE_HAL_HASH_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

33.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the HASH according to the specified parameters in the HASH_InitTypeDef and create the associated handle
- DeInitialize the HASH peripheral
- Initialize the HASH MCU Specific Package (MSP)
- DeInitialize the HASH MSP

This section provides as well call back functions definitions for user code to manage:

- Input data transfer to Peripheral completion
- Calculated digest retrieval completion
- Error management

This section contains the following APIs:

- ***HAL_HASH_Init***
- ***HAL_HASH_DeInit***
- ***HAL_HASH_MspInit***
- ***HAL_HASH_MspDeInit***
- ***HAL_HASH_InCpltCallback***
- ***HAL_HASH_DgstCpltCallback***
- ***HAL_HASH_ErrorCallback***

33.2.3 Polling mode HASH processing functions

This section provides functions allowing to calculate in polling mode the hash value using one of the following algorithms:

- MD5
  - HAL_HASH_MD5_Start()
  - HAL_HASH_MD5_Accumulate()
  - HAL_HASH_MD5_Accumulate_End()
- SHA1
  - HAL_HASH_SHA1_Start()
  - HAL_HASH_SHA1_Accumulate()
  - HAL_HASH_SHA1_Accumulate_End()

For a single buffer to be hashed, user can resort to HAL_HASH_xxx_Start().

In case of multi-buffer HASH processing (a single digest is computed while several buffers are fed to the Peripheral), the user can resort to successive calls to HAL_HASH_xxx_Accumulate() and wrap-up the digest computation by a call to HAL_HASH_xxx_Accumulate_End().

This section contains the following APIs:

- ***HAL_HASH_MD5_Start***
- ***HAL_HASH_MD5_Accumulate***
- ***HAL_HASH_MD5_Accumulate_End***
- ***HAL_HASH_SHA1_Start***
- ***HAL_HASH_SHA1_Accumulate***
- ***HAL_HASH_SHA1_Accumulate_End***

33.2.4 Interruption mode HASH processing functions

This section provides functions allowing to calculate in interrupt mode the hash value using one of the following algorithms:

- MD5
  - HAL_HASH_MD5_Start_IT()
  - HAL_HASH_MD5_Accumulate_IT()
  - HAL_HASH_MD5_Accumulate_End_IT()
- SHA1
  - HAL_HASH_SHA1_Start_IT()
  - HAL_HASH_SHA1_Accumulate_IT()
  - HAL_HASH_SHA1_Accumulate_End_IT()

API HAL_HASH_IRQHandler() manages each HASH interruption.

Note that HAL_HASH_IRQHandler() manages as well HASH Peripheral interruptions when in HMAC processing mode.

This section contains the following APIs:

- ***HAL_HASH_MD5_Start_IT***
- ***HAL_HASH_MD5_Accumulate_IT***
- ***HAL_HASH_MD5_Accumulate_End_IT***

- ***HAL_HASH_SHA1_Start_IT***
- ***HAL_HASH_SHA1_Accumulate_IT***
- ***HAL_HASH_SHA1_Accumulate_End_IT***
- ***HAL_HASH_IRQHandler***

33.2.5 DMA mode HASH processing functions

This section provides functions allowing to calculate in DMA mode the hash value using one of the following algorithms:

- MD5
  - HAL_HASH_MD5_Start_DMA()
  - HAL_HASH_MD5_Finish()
- SHA1
  - HAL_HASH_SHA1_Start_DMA()
  - HAL_HASH_SHA1_Finish()

When resorting to DMA mode to enter the data in the Peripheral, user must resort to HAL_HASH_xxx_Start_DMA() then read the resulting digest with HAL_HASH_xxx_Finish().

In case of multi-buffer HASH processing, MDMAT bit must first be set before the successive calls to HAL_HASH_xxx_Start_DMA(). Then, MDMAT bit needs to be reset before the last call to HAL_HASH_xxx_Start_DMA(). Digest is finally retrieved thanks to HAL_HASH_xxx_Finish().

This section contains the following APIs:

- ***HAL_HASH_MD5_Start_DMA***
- ***HAL_HASH_MD5_Finish***
- ***HAL_HASH_SHA1_Start_DMA***
- ***HAL_HASH_SHA1_Finish***

33.2.6 Polling mode HMAC processing functions

This section provides functions allowing to calculate in polling mode the HMAC value using one of the following algorithms:

- MD5
  - HAL_HMAC_MD5_Start()
- SHA1
  - HAL_HMAC_SHA1_Start()

This section contains the following APIs:

- ***HAL_HMAC_MD5_Start***
- ***HAL_HMAC_SHA1_Start***

33.2.7 Interrupt mode HMAC processing functions

This section provides functions allowing to calculate in interrupt mode the HMAC value using one of the following algorithms:

- MD5
  - HAL_HMAC_MD5_Start_IT()
- SHA1
  - HAL_HMAC_SHA1_Start_IT()

This section contains the following APIs:

- ***HAL_HMAC_MD5_Start_IT***
- ***HAL_HMAC_SHA1_Start_IT***

33.2.8 DMA mode HMAC processing functions

This section provides functions allowing to calculate in DMA mode the HMAC value using one of the following algorithms:

- MD5
  - HAL_HMAC_MD5_Start_DMA()
- SHA1
  - HAL_HMAC_SHA1_Start_DMA()

When resorting to DMA mode to enter the data in the Peripheral for HMAC processing, user must resort to HAL_HMAC_xxx_Start_DMA() then read the resulting digest with HAL_HASH_xxx_Finish().

This section contains the following APIs:

- ***HAL_HMAC_MD5_Start_DMA***
- ***HAL_HMAC_SHA1_Start_DMA***

33.2.9 Peripheral State methods

This section permits to get in run-time the state and the peripheral handle status of the peripheral:

- HAL_HASH_GetState()
- HAL_HASH_GetStatus()

Additionally, this subsection provides functions allowing to save and restore the HASH or HMAC processing context in case of calculation suspension:

- HAL_HASH_ContextSaving()
- HAL_HASH_ContextRestoring()

This subsection provides functions allowing to suspend the HASH processing

- when input are fed to the Peripheral by software
  - HAL_HASH_SwFeed_ProcessSuspend()
- when input are fed to the Peripheral by DMA
  - HAL_HASH_DMAFeed_ProcessSuspend()

This section contains the following APIs:

- ***HAL_HASH_GetState***
- ***HAL_HASH_GetStatus***
- ***HAL_HASH_ContextSaving***
- ***HAL_HASH_ContextRestoring***
- ***HAL_HASH_SwFeed_ProcessSuspend***
- ***HAL_HASH_DMAFeed_ProcessSuspend***
- ***HAL_HASH_GetError***

33.2.10 Detailed description of functions

`HAL_HASH_Init`

Function name

HAL_StatusTypeDef HAL_HASH_Init (HASH_HandleTypeDef * hhash)

Function description

Initialize the HASH according to the specified parameters in the HASH_HandleTypeDef and create the associated handle.

Parameters

- **hhash:** HASH handle

Return values

- **HAL:** status

Notes

- Only MDMAT and DATATYPE bits of HASH Peripheral are set by HAL_HASH_Init(), other configuration bits are set by HASH or HMAC processing APIs.
- MDMAT bit is systematically reset by HAL_HASH_Init(). To set it for multi-buffer HASH processing, user needs to resort to __HAL_HASH_SET_MDMAT() macro. For HMAC multi-buffer processing, the relevant APIs manage themselves the MDMAT bit.

`HAL_HASH_DeInit`

Function name

HAL_StatusTypeDef HAL_HASH_DeInit (HASH_HandleTypeDef * hhash)

Function description

DeInitialize the HASH peripheral.

Parameters

- **hhash:** HASH handle.

Return values

- **HAL:** status

`HAL_HASH_MspInit`

Function name

void HAL_HASH_MspInit (HASH_HandleTypeDef * hhash)

Function description

Initialize the HASH MSP.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

`HAL_HASH_MspDeInit`

Function name

void HAL_HASH_MspDeInit (HASH_HandleTypeDef * hhash)

Function description

DeInitialize the HASH MSP.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

`HAL_HASH_InCpltCallback`

Function name

void HAL_HASH_InCpltCallback (HASH_HandleTypeDef * hhash)

Function description

Input data transfer complete call back.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

Notes

- HAL_HASH_InCpltCallback() is called when the complete input message has been fed to the Peripheral. This API is invoked only when input data are entered under interruption or thru DMA.
- In case of HASH or HMAC multi-buffer DMA feeding case (MDMAT bit set), HAL_HASH_InCpltCallback() is called at the end of each buffer feeding to the Peripheral.

`HAL_HASH_DgstCpltCallback`

Function name

void HAL_HASH_DgstCpltCallback (HASH_HandleTypeDef * hhash)

Function description

Digest computation complete call back.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

Notes

- HAL_HASH_DgstCpltCallback() is used under interruption, is not relevant with DMA.

`HAL_HASH_ErrorCallback`

Function name

void HAL_HASH_ErrorCallback (HASH_HandleTypeDef * hhash)

Function description

Error callback.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

Notes

- Code user can resort to hhash->Status (HAL_ERROR, HAL_TIMEOUT,...) to retrieve the error type.

`HAL_HASH_SHA1_Start`

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in SHA1 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

`HAL_HASH_MD5_Start`

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in MD5 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

`HAL_HASH_MD5_Accumulate`

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in MD5 mode then processes pInBuffer.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASH_MD5_Accumulate() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASH_MD5_Accumulate_End().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- Digest is not retrieved by this API, user must resort to HAL_HASH_MD5_Accumulate_End() to read it, feeding at the same time the last input buffer to the Peripheral.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASH_MD5_Accumulate_End() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASH_SHA1_Accumulate

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in SHA1 mode then processes pInBuffer.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASH_SHA1_Accumulate() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASH_SHA1_Accumulate_End().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- Digest is not retrieved by this API, user must resort to HAL_HASH_SHA1_Accumulate_End() to read it, feeding at the same time the last input buffer to the Peripheral.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASH_SHA1_Accumulate_End() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASH_MD5_Accumulate_End

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Accumulate_End (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

End computation of a single HASH signature after several calls to HAL_HASH_MD5_Accumulate() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASH_SHA1_Accumulate_End

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Accumulate_End (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

End computation of a single HASH signature after several calls to HAL_HASH_SHA1_Accumulate() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASH_SHA1_Start_IT

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in SHA1 mode, next process pInBuffer then read the computed digest in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASH_SHA1_Accumulate_IT

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Accumulate_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in SHA1 mode then processes pInBuffer in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASH_SHA1_Accumulate_IT() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASH_SHA1_Accumulate_End_IT().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASH_SHA1_Accumulate_End_IT() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASH_SHA1_Accumulate_End_IT

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Accumulate_End_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

End computation of a single HASH signature after several calls to HAL_HASH_SHA1_Accumulate_IT() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASH_MD5_Start_IT

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in MD5 mode, next process pInBuffer then read the computed digest in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASH_MD5_Accumulate_IT

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Accumulate_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in MD5 mode then processes pInBuffer in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASH_MD5_Accumulate_IT() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASH_MD5_Accumulate_End_IT().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASH_MD5_Accumulate_End_IT() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASH_MD5_Accumulate_End_IT

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Accumulate_End_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

End computation of a single HASH signature after several calls to HAL_HASH_MD5_Accumulate_IT() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASH_IRQHandler

Function name

void HAL_HASH_IRQHandler (HASH_HandleTypeDef * hhash)

Function description

Handle HASH interrupt request.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

Notes

- HAL_HASH_IRQHandler() handles interrupts in HMAC processing as well.
- In case of error reported during the HASH interruption processing, HAL_HASH_ErrorCallback() API is called so that user code can manage the error. The error type is available in hhash->Status field.

HAL_HASH_SHA1_Start_DMA

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in SHA1 mode then initiate a DMA transfer to feed the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfer is finished, HAL_HASH_SHA1_Finish() API must be called to retrieve the computed digest.

HAL_HASH_SHA1_Finish

Function name

HAL_StatusTypeDef HAL_HASH_SHA1_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Return the computed digest in SHA1 mode.

Parameters

- **hhash:** HASH handle.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- The API waits for DCIS to be set then reads the computed digest.
- HAL_HASH_SHA1_Finish() can be used as well to retrieve the digest in HMAC SHA1 mode.

HAL_HASH_MD5_Start_DMA

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in MD5 mode then initiate a DMA transfer to feed the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfer is finished, HAL_HASH_MD5_Finish() API must be called to retrieve the computed digest.

HAL_HASH_MD5_Finish

Function name

HAL_StatusTypeDef HAL_HASH_MD5_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Return the computed digest in MD5 mode.

Parameters

- **hhash:** HASH handle.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- The API waits for DCIS to be set then reads the computed digest.
- HAL_HASH_MD5_Finish() can be used as well to retrieve the digest in HMAC MD5 mode.

HAL_HMAC_SHA1_Start

Function name

HAL_StatusTypeDef HAL_HMAC_SHA1_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in HMAC SHA1 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMAC_MD5_Start

Function name

HAL_StatusTypeDef HAL_HMAC_MD5_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in HMAC MD5 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMAC_MD5_Start_IT

Function name

HAL_StatusTypeDef HAL_HMAC_MD5_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in HMAC MD5 mode, next process pInBuffer then read the computed digest in interrupt mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 16 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMAC_SHA1_Start_IT

Function name

HAL_StatusTypeDef HAL_HMAC_SHA1_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in HMAC SHA1 mode, next process pInBuffer then read the computed digest in interrupt mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 20 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMAC_SHA1_Start_DMA

Function name

HAL_StatusTypeDef HAL_HMAC_SHA1_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in HMAC SHA1 mode then initiate the required DMA transfers to feed the key and the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASH_SHA1_Finish() API must be called to retrieve the computed digest.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- If MDMAT bit is set before calling this function (multi-buffer HASH processing case), the input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. For the processing of the last buffer of the thread, MDMAT bit must be reset and the buffer length (in bytes) doesn't have to be a multiple of 4.

HAL_HMAC_MD5_Start_DMA

Function name

HAL_StatusTypeDef HAL_HMAC_MD5_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in HMAC MD5 mode then initiate the required DMA transfers to feed the key and the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASH_MD5_Finish() API must be called to retrieve the computed digest.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- If MDMAT bit is set before calling this function (multi-buffer HASH processing case), the input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. For the processing of the last buffer of the thread, MDMAT bit must be reset and the buffer length (in bytes) doesn't have to be a multiple of 4.

HAL_HASH_GetState

Function name

HAL_HASH_StateTypeDef HAL_HASH_GetState (HASH_HandleTypeDef * hhash)

Function description

Return the HASH handle state.

Parameters

- **hhash:** HASH handle.

Return values

- **HAL:** HASH state

Notes

- The API yields the current state of the handle (BUSY, READY,...).

HAL_HASH_GetStatus

Function name

HAL_StatusTypeDef HAL_HASH_GetStatus (HASH_HandleTypeDef * hhash)

Function description

Return the HASH HAL status.

Parameters

- **hhash:** HASH handle.

Return values

- **HAL:** status

Notes

- The API yields the HAL status of the handle: it is the result of the latest HASH processing and allows to report any issue (e.g. HAL_TIMEOUT).

HAL_HASH_ContextSaving

Function name

void HAL_HASH_ContextSaving (HASH_HandleTypeDef * hhash, uint8_t * pMemBuffer)

Function description

Save the HASH context in case of processing suspension.

Parameters

- **hhash:** HASH handle.
- **pMemBuffer:** pointer to the memory buffer where the HASH context is saved.

Return values

- **None:**

Notes

- The IMR, STR, CR then all the CSR registers are saved in that order. Only the r/w bits are read to be restored later on.
- By default, all the context swap registers (there are HASH_NUMBER_OF_CSR_REGISTERS of those) are saved.
- pMemBuffer points to a buffer allocated by the user. The buffer size must be at least (HASH_NUMBER_OF_CSR_REGISTERS + 3) * 4 uint8 long.

HAL_HASH_ContextRestoring

Function name

void HAL_HASH_ContextRestoring (HASH_HandleTypeDef * hhash, uint8_t * pMemBuffer)

Function description

Restore the HASH context in case of processing resumption.

Parameters

- **hhash:** HASH handle.
- **pMemBuffer:** pointer to the memory buffer where the HASH context is stored.

Return values

- **None:**

Notes

- The IMR, STR, CR then all the CSR registers are restored in that order. Only the r/w bits are restored.
- By default, all the context swap registers (HASH_NUMBER_OF_CSR_REGISTERS of those) are restored (all of them have been saved by default beforehand).

`HAL_HASH_SwFeed_ProcessSuspend`

Function name

void HAL_HASH_SwFeed_ProcessSuspend (HASH_HandleTypeDef * hhash)

Function description

Initiate HASH processing suspension when in polling or interruption mode.

Parameters

- **hhash:** HASH handle.

Return values

- **None:**

Notes

- Set the handle field SuspendRequest to the appropriate value so that the on-going HASH processing is suspended as soon as the required conditions are met. Note that the actual suspension is carried out by the functions HASH_WriteData() in polling mode and HASH_IT() in interruption mode.

`HAL_HASH_DMAFeed_ProcessSuspend`

Function name

HAL_StatusTypeDef HAL_HASH_DMAFeed_ProcessSuspend (HASH_HandleTypeDef * hhash)

Function description

Suspend the HASH processing when in DMA mode.

Parameters

- **hhash:** HASH handle.

Return values

- **HAL:** status

Notes

- When suspension attempt occurs at the very end of a DMA transfer and all the data have already been entered in the Peripheral, hhash->State is set to HAL_HASH_STATE_READY and the API returns HAL_ERROR. It is recommended to wrap-up the processing in reading the digest as usual.

`HAL_HASH_GetError`

Function name

uint32_t HAL_HASH_GetError (HASH_HandleTypeDef * hhash)

Function description

Return the HASH handle error code.

Parameters

- **hhash:** pointer to a HASH_HandleTypeDef structure.

Return values

- **HASH:** Error Code

HASH_Start

Function name

HAL_StatusTypeDef HASH_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout, uint32_t Algorithm)

Function description

Initialize the HASH peripheral, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest.
- **Timeout:** Timeout value.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HASH_Accumulate

Function name

HAL_StatusTypeDef HASH_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint32_t Algorithm)

Function description

If not already done, initialize the HASH peripheral then processes pInBuffer.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

HASH_Accumulate_IT

Function name

HAL_StatusTypeDef HASH_Accumulate_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint32_t Algorithm)

Function description

If not already done, initialize the HASH peripheral then processes pInBuffer in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HASH_Start_IT`

Function name

HAL_StatusTypeDef HASH_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Algorithm)

Function description

Initialize the HASH peripheral, next process pInBuffer then read the computed digest in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

`HASH_Start_DMA`

Function name

HAL_StatusTypeDef HASH_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint32_t Algorithm)

Function description

Initialize the HASH peripheral then initiate a DMA transfer to feed the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- If MDMAT bit is set before calling this function (multi-buffer HASH processing case), the input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. For the processing of the last buffer of the thread, MDMAT bit must be reset and the buffer length (in bytes) doesn't have to be a multiple of 4.

`HASH_Finish`

Function name

HAL_StatusTypeDef HASH_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Return the computed digest.

Parameters

- **hhash:** HASH handle.
- **pOutBuffer:** pointer to the computed digest.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- The API waits for DCIS to be set then reads the computed digest.

`HMAC_Start`

Function name

HAL_StatusTypeDef HMAC_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout, uint32_t Algorithm)

Function description

Initialize the HASH peripheral in HMAC mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest.
- **Timeout:** Timeout value.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

`HMAC_Start_IT`

Function name

HAL_StatusTypeDef HMAC_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Algorithm)

Function description

Initialize the HASH peripheral in HMAC mode, next process pInBuffer then read the computed digest in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

`HMAC_Start_DMA`

Function name

HAL_StatusTypeDef HMAC_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint32_t Algorithm)

Function description

Initialize the HASH peripheral in HMAC mode then initiate the required DMA transfers to feed the key and the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **Algorithm:** HASH algorithm.

Return values

- **HAL:** status

Notes

- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- In case of multi-buffer HMAC processing, the input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only the length of the last buffer of the thread doesn't have to be a multiple of 4.

33.3 HASH Firmware driver defines

The following section lists the various define and macros of the module.

33.3.1 HASH

HASH

HASH algorithm mode

HASH_ALGOMODE_HASH

Algorithm is HASH

HASH_ALGOMODE_HMAC

Algorithm is HMAC

HASH algorithm selection

HASH_ALGOSELECTION_SHA1

HASH function is SHA1

HASH_ALGOSELECTION_MD5

HASH function is MD5

HASH_ALGOSELECTION_SHA224

HASH function is SHA224

HASH_ALGOSELECTION_SHA256

HASH function is SHA256

HASH API alias

HAL_HASHEx_IRQHandler

is re-directed to

HASH input data type

HASH_DATATYPE_32B

32-bit data. No swapping

HASH_DATATYPE_16B

16-bit data. Each half word is swapped

HASH_DATATYPE_8B

8-bit data. All bytes are swapped

HASH_DATATYPE_1B

1-bit data. In the word all bits are swapped

HASH Digest Calculation Status

HASH_DIGEST_CALCULATION_NOT_STARTED

DCAL not set after input data written in DIN register

HASH_DIGEST_CALCULATION_STARTED

DCAL set after input data written in DIN register

HASH DMA suspension words limit

HASH_DMA_SUSPENSION_WORDS_LIMIT

Number of words below which DMA suspension is aborted

HASH Error Definition

HAL_HASH_ERROR_NONE

No error

HAL_HASH_ERROR_IT

IT-based process error

HAL_HASH_ERROR_DMA

DMA-based process error

HASH Exported Macros

__HAL_HASH_GET_FLAG

Description:

- Check whether or not the specified HASH flag is set.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - HASH_FLAG_DINIS A new block can be entered into the input buffer.
  - HASH_FLAG_DCIS Digest calculation complete.
  - HASH_FLAG_DMAS DMA interface is enabled (DMAE=1) or a transfer is ongoing.
  - HASH_FLAG_BUSY The hash core is Busy : processing a block of data.
  - HASH_FLAG_DINNE DIN not empty : the input buffer contains at least one word of data.

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_HASH_CLEAR_FLAG

Description:

- Clear the specified HASH flag.

Parameters:

- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - HASH_FLAG_DINIS A new block can be entered into the input buffer.
  - HASH_FLAG_DCIS Digest calculation complete

Return value:

- None

__HAL_HASH_ENABLE_IT

Description:

- Enable the specified HASH interrupt.

Parameters:

- __INTERRUPT__: specifies the HASH interrupt source to enable. This parameter can be one of the following values:
  - HASH_IT_DINI A new block can be entered into the input buffer (DIN)
  - HASH_IT_DCI Digest calculation complete

Return value:

- None

__HAL_HASH_DISABLE_IT

Description:

- Disable the specified HASH interrupt.

Parameters:

- __INTERRUPT__: specifies the HASH interrupt source to disable. This parameter can be one of the following values:
  - HASH_IT_DINI A new block can be entered into the input buffer (DIN)
  - HASH_IT_DCI Digest calculation complete

Return value:

- None

__HAL_HASH_RESET_HANDLE_STATE

Description:

- Reset HASH handle state.

Parameters:

- __HANDLE__: HASH handle.

Return value:

- None

__HAL_HASH_RESET_HANDLE_STATUS

Description:

- Reset HASH handle status.

Parameters:

- __HANDLE__: HASH handle.

Return value:

- None

__HAL_HASH_SET_MDMAT

Description:

- Enable the multi-buffer DMA transfer mode.

Return value:

- None

Notes:

- This bit is set when hashing large files when multiple DMA transfers are needed.

__HAL_HASH_RESET_MDMAT

Description:

- Disable the multi-buffer DMA transfer mode.

Return value:

- None

__HAL_HASH_START_DIGEST

Description:

- Start the digest computation.

Return value:

- None

__HAL_HASH_SET_NBVALIDBITS

Description:

- Set the number of valid bits in the last word written in data register DIN.

Parameters:

- __SIZE__: size in bytes of last data written in Data register.

Return value:

- None

__HAL_HASH_INIT

Description:

- Reset the HASH core.

Return value:

- None

HASH flags definitions

HASH_FLAG_DINIS

16 locations are free in the DIN : a new block can be entered in the Peripheral

HASH_FLAG_DCIS

Digest calculation complete

HASH_FLAG_DMAS

DMA interface is enabled (DMAE=1) or a transfer is ongoing

HASH_FLAG_BUSY

The hash core is Busy, processing a block of data

HASH_FLAG_DINNE

DIN not empty : the input buffer contains at least one word of data

HMAC key length type

HASH_HMAC_KEYTYPE_SHORTKEY

HMAC Key size is ≤ 64 bytes

HASH_HMAC_KEYTYPE_LONGKEY

HMAC Key size is > 64 bytes

HASH interrupts definitions

HASH_IT_DINI

A new block can be entered into the input buffer (DIN)

HASH_IT_DCI

Digest calculation complete

HASH Number of Context Swap Registers

HASH_NUMBER_OF_CSR_REGISTERS

Number of Context Swap Registers

HASH TimeOut Value

HASH_TIMEOUTVALUE

Time-out value

34 HAL HASH Extension Driver

34.1 HASHEx Firmware driver API description

The following section lists the various functions of the HASHEx library.

34.1.1 HASH peripheral extended features

The SHA-224 and SHA-256 HASH and HMAC processing can be carried out exactly the same way as for SHA-1 or MD-5 algorithms.

1. Three modes are available.
   a. Polling mode: processing APIs are blocking functions i.e. they process the data and wait till the digest computation is finished, e.g. HAL_HASHEx_xxx_Start()
   b. Interrupt mode: processing APIs are not blocking functions i.e. they process the data under interrupt, e.g. HAL_HASHEx_xxx_Start_IT()
   c. DMA mode: processing APIs are not blocking functions and the CPU is not used for data transfer i.e. the data transfer is ensured by DMA, e.g. HAL_HASHEx_xxx_Start_DMA(). Note that in DMA mode, a call to HAL_HASHEx_xxx_Finish() is then required to retrieve the digest.
2. Multi-buffer processing is possible in polling, interrupt and DMA modes.
   a. In polling mode, only multi-buffer HASH processing is possible. API HAL_HASHEx_xxx_Accumulate() must be called for each input buffer, except for the last one. User must resort to HAL_HASHEx_xxx_Accumulate_End() to enter the last one and retrieve as well the computed digest.
   b. In interrupt mode, API HAL_HASHEx_xxx_Accumulate_IT() must be called for each input buffer, except for the last one. User must resort to HAL_HASHEx_xxx_Accumulate_End_IT() to enter the last one and retrieve as well the computed digest.
   c. In DMA mode, multi-buffer HASH and HMAC processing are possible.
      - HASH processing: once initialization is done, MDMAT bit must be set thru __HAL_HASH_SET_MDMAT() macro. From that point, each buffer can be fed to the Peripheral thru HAL_HASHEx_xxx_Start_DMA() API. Before entering the last buffer, reset the MDMAT bit with __HAL_HASH_RESET_MDMAT() macro then wrap-up the HASH processing in feeding the last input buffer thru the same API HAL_HASHEx_xxx_Start_DMA(). The digest can then be retrieved with a call to API HAL_HASHEx_xxx_Finish().
      - HMAC processing (MD-5, SHA-1, SHA-224 and SHA-256 must all resort to extended functions): after initialization, the key and the first input buffer are entered in the Peripheral with the API HAL_HMACEx_xxx_Step1_2_DMA(). This carries out HMAC step 1 and starts step 2. The following buffers are next entered with the API HAL_HMACEx_xxx_Step2_DMA(). At this point, the HMAC processing is still carrying out step 2. Then, step 2 for the last input buffer and step 3 are carried out by a single call to HAL_HMACEx_xxx_Step2_3_DMA(). The digest can finally be retrieved with a call to API HAL_HASH_xxx_Finish() for MD-5 and SHA-1, to HAL_HASHEx_xxx_Finish() for SHA-224 and SHA-256.

34.1.2 Polling mode HASH extended processing functions

This section provides functions allowing to calculate in polling mode the hash value using one of the following algorithms:

- SHA224
  - HAL_HASHEx_SHA224_Start()
  - HAL_HASHEx_SHA224_Accumulate()
  - HAL_HASHEx_SHA224_Accumulate_End()
- SHA256
  - HAL_HASHEx_SHA256_Start()
  - HAL_HASHEx_SHA256_Accumulate()
  - HAL_HASHEx_SHA256_Accumulate_End()

For a single buffer to be hashed, user can resort to HAL_HASH_xxx_Start().

In case of multi-buffer HASH processing (a single digest is computed while several buffers are fed to the Peripheral), the user can resort to successive calls to HAL_HASHEx_xxx_Accumulate() and wrap-up the digest computation by a call to HAL_HASHEx_xxx_Accumulate_End().

This section contains the following APIs:

- ***HAL_HASHEx_SHA224_Start***
- ***HAL_HASHEx_SHA224_Accumulate***
- ***HAL_HASHEx_SHA224_Accumulate_End***
- ***HAL_HASHEx_SHA256_Start***
- ***HAL_HASHEx_SHA256_Accumulate***
- ***HAL_HASHEx_SHA256_Accumulate_End***

34.1.3 Interruption mode HASH extended processing functions

This section provides functions allowing to calculate in interrupt mode the hash value using one of the following algorithms:

- SHA224
  - HAL_HASHEx_SHA224_Start_IT()
  - HAL_HASHEx_SHA224_Accumulate_IT()
  - HAL_HASHEx_SHA224_Accumulate_End_IT()
- SHA256
  - HAL_HASHEx_SHA256_Start_IT()
  - HAL_HASHEx_SHA256_Accumulate_IT()
  - HAL_HASHEx_SHA256_Accumulate_End_IT()

This section contains the following APIs:

- ***HAL_HASHEx_SHA224_Start_IT***
- ***HAL_HASHEx_SHA224_Accumulate_IT***
- ***HAL_HASHEx_SHA224_Accumulate_End_IT***
- ***HAL_HASHEx_SHA256_Start_IT***
- ***HAL_HASHEx_SHA256_Accumulate_IT***
- ***HAL_HASHEx_SHA256_Accumulate_End_IT***

34.1.4 DMA mode HASH extended processing functionss

This section provides functions allowing to calculate in DMA mode the hash value using one of the following algorithms:

- SHA224
  - HAL_HASHEx_SHA224_Start_DMA()
  - HAL_HASHEx_SHA224_Finish()
- SHA256
  - HAL_HASHEx_SHA256_Start_DMA()
  - HAL_HASHEx_SHA256_Finish()

When resorting to DMA mode to enter the data in the Peripheral, user must resort to HAL_HASHEx_xxx_Start_DMA() then read the resulting digest with HAL_HASHEx_xxx_Finish().

In case of multi-buffer HASH processing, MDMAT bit must first be set before the successive calls to HAL_HASHEx_xxx_Start_DMA(). Then, MDMAT bit needs to be reset before the last call to HAL_HASHEx_xxx_Start_DMA(). Digest is finally retrieved thanks to HAL_HASHEx_xxx_Finish().

This section contains the following APIs:

- ***HAL_HASHEx_SHA224_Start_DMA***
- ***HAL_HASHEx_SHA224_Finish***
- ***HAL_HASHEx_SHA256_Start_DMA***
- ***HAL_HASHEx_SHA256_Finish***

34.1.5 Polling mode HMAC extended processing functions

This section provides functions allowing to calculate in polling mode the HMAC value using one of the following algorithms:

- SHA224
  - HAL_HMACEx_SHA224_Start()
- SHA256
  - HAL_HMACEx_SHA256_Start()

This section contains the following APIs:

- ***HAL_HMACEx_SHA224_Start***
- ***HAL_HMACEx_SHA256_Start***

34.1.6 Interrupt mode HMAC extended processing functions

This section provides functions allowing to calculate in interrupt mode the HMAC value using one of the following algorithms:

- SHA224
  - HAL_HMACEx_SHA224_Start_IT()
- SHA256
  - HAL_HMACEx_SHA256_Start_IT()

This section contains the following APIs:

- ***HAL_HMACEx_SHA224_Start_IT***
- ***HAL_HMACEx_SHA256_Start_IT***

34.1.7 DMA mode HMAC extended processing functions

This section provides functions allowing to calculate in DMA mode the HMAC value using one of the following algorithms:

- SHA224
  - HAL_HMACEx_SHA224_Start_DMA()
- SHA256
  - HAL_HMACEx_SHA256_Start_DMA()

When resorting to DMA mode to enter the data in the Peripheral for HMAC processing, user must resort to HAL_HMACEx_xxx_Start_DMA() then read the resulting digest with HAL_HASHEx_xxx_Finish().

This section contains the following APIs:

- ***HAL_HMACEx_SHA224_Start_DMA***
- ***HAL_HMACEx_SHA256_Start_DMA***

34.1.8 Multi-buffer DMA mode HMAC extended processing functions

This section provides functions to manage HMAC multi-buffer DMA-based processing for MD5, SHA1, SHA224 and SHA256 algorithms.

- MD5
  - HAL_HMACEx_MD5_Step1_2_DMA()
  - HAL_HMACEx_MD5_Step2_DMA()
  - HAL_HMACEx_MD5_Step2_3_DMA()
- SHA1
  - HAL_HMACEx_SHA1_Step1_2_DMA()
  - HAL_HMACEx_SHA1_Step2_DMA()
  - HAL_HMACEx_SHA1_Step2_3_DMA()
- SHA256
  - HAL_HMACEx_SHA224_Step1_2_DMA()
  - HAL_HMACEx_SHA224_Step2_DMA()
  - HAL_HMACEx_SHA224_Step2_3_DMA()

- SHA256
  - HAL_HMACEx_SHA256_Step1_2_DMA()
  - HAL_HMACEx_SHA256_Step2_DMA()
  - HAL_HMACEx_SHA256_Step2_3_DMA()

User must first start-up the multi-buffer DMA-based HMAC computation in calling HAL_HMACEx_xxx_Step1_2_DMA(). This carries out HMAC step 1 and intiates step 2 with the first input buffer.

The following buffers are next fed to the Peripheral with a call to the API HAL_HMACEx_xxx_Step2_DMA(). There may be several consecutive calls to this API.

Multi-buffer DMA-based HMAC computation is wrapped up by a call to HAL_HMACEx_xxx_Step2_3_DMA(). This finishes step 2 in feeding the last input buffer to the Peripheral then carries out step 3.

Digest is retrieved by a call to HAL_HASH_xxx_Finish() for MD-5 or SHA-1, to HAL_HASHEx_xxx_Finish() for SHA-224 or SHA-256.

If only two buffers need to be consecutively processed, a call to HAL_HMACEx_xxx_Step1_2_DMA() followed by a call to HAL_HMACEx_xxx_Step2_3_DMA() is sufficient.

This section contains the following APIs:

- ***HAL_HMACEx_MD5_Step1_2_DMA***
- ***HAL_HMACEx_MD5_Step2_DMA***
- ***HAL_HMACEx_MD5_Step2_3_DMA***
- ***HAL_HMACEx_SHA1_Step1_2_DMA***
- ***HAL_HMACEx_SHA1_Step2_DMA***
- ***HAL_HMACEx_SHA1_Step2_3_DMA***
- ***HAL_HMACEx_SHA224_Step1_2_DMA***
- ***HAL_HMACEx_SHA224_Step2_DMA***
- ***HAL_HMACEx_SHA224_Step2_3_DMA***
- ***HAL_HMACEx_SHA256_Step1_2_DMA***
- ***HAL_HMACEx_SHA256_Step2_DMA***
- ***HAL_HMACEx_SHA256_Step2_3_DMA***

34.1.9 Detailed description of functions

`HAL_HASHEx_SHA224_Start`

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in SHA224 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA224_Accumulate

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in SHA224 mode then processes pInBuffer.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASHEx_SHA224_Accumulate() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASHEx_SHA224_Accumulate_End().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- Digest is not retrieved by this API, user must resort to HAL_HASHEx_SHA224_Accumulate_End() to read it, feeding at the same time the last input buffer to the Peripheral.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASHEx_SHA224_Accumulate_End() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASHEx_SHA224_Accumulate_End

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Accumulate_End (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

End computation of a single HASH signature after several calls to HAL_HASHEx_SHA224_Accumulate() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA256_Start

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in SHA256 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA256_Accumulate

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Accumulate (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in SHA256 mode then processes pInBuffer.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASHEx_SHA256_Accumulate() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASHEx_SHA256_Accumulate_End().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- Digest is not retrieved by this API, user must resort to HAL_HASHEx_SHA256_Accumulate_End() to read it, feeding at the same time the last input buffer to the Peripheral.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASHEx_SHA256_Accumulate_End() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASHEx_SHA256_Accumulate_End

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Accumulate_End (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

End computation of a single HASH signature after several calls to HAL_HASHEx_SHA256_Accumulate() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.
- **Timeout:** Timeout value

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA224_Start_IT

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in SHA224 mode, next process pInBuffer then read the computed digest in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA224_Accumulate_IT

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Accumulate_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in SHA224 mode then processes pInBuffer in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASHEx_SHA224_Accumulate_IT() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASHEx_SHA224_Accumulate_End_IT().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASHEx_SHA224_Accumulate_End_IT() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASHEx_SHA224_Accumulate_End_IT

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Accumulate_End_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

End computation of a single HASH signature after several calls to HAL_HASHEx_SHA224_Accumulate_IT() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA256_Start_IT

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in SHA256 mode, next process pInBuffer then read the computed digest in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA256_Accumulate_IT

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Accumulate_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

If not already done, initialize the HASH peripheral in SHA256 mode then processes pInBuffer in interruption mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes, must be a multiple of 4.

Return values

- **HAL:** status

Notes

- Consecutive calls to HAL_HASHEx_SHA256_Accumulate_IT() can be used to feed several input buffers back-to-back to the Peripheral that will yield a single HASH signature once all buffers have been entered. Wrap-up of input buffers feeding and retrieval of digest is done by a call to HAL_HASHEx_SHA256_Accumulate_End_IT().
- Field hhash->Phase of HASH handle is tested to check whether or not the Peripheral has already been initialized.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. Only HAL_HASHEx_SHA256_Accumulate_End_IT() is able to manage the ending buffer with a length in bytes not a multiple of 4.

HAL_HASHEx_SHA256_Accumulate_End_IT

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Accumulate_End_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

End computation of a single HASH signature after several calls to HAL_HASHEx_SHA256_Accumulate_IT() API.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.

HAL_HASHEx_SHA224_Start_DMA

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in SHA224 mode then initiate a DMA transfer to feed the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfer is finished, HAL_HASHEx_SHA224_Finish() API must be called to retrieve the computed digest.

HAL_HASHEx_SHA224_Finish

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA224_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Return the computed digest in SHA224 mode.

Parameters

- **hhash:** HASH handle.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- The API waits for DCIS to be set then reads the computed digest.
- HAL_HASHEx_SHA224_Finish() can be used as well to retrieve the digest in HMAC SHA224 mode.

HAL_HASHEx_SHA256_Start_DMA

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in SHA256 mode then initiate a DMA transfer to feed the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfer is finished, HAL_HASHEx_SHA256_Finish() API must be called to retrieve the computed digest.

HAL_HASHEx_SHA256_Finish

Function name

HAL_StatusTypeDef HAL_HASHEx_SHA256_Finish (HASH_HandleTypeDef * hhash, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Return the computed digest in SHA256 mode.

Parameters

- **hhash:** HASH handle.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- The API waits for DCIS to be set then reads the computed digest.
- HAL_HASHEx_SHA256_Finish() can be used as well to retrieve the digest in HMAC SHA256 mode.

HAL_HMACEx_SHA224_Start

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA224_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in HMAC SHA224 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMACEx_SHA256_Start

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA256_Start (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer, uint32_t Timeout)

Function description

Initialize the HASH peripheral in HMAC SHA256 mode, next process pInBuffer then read the computed digest.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.
- **Timeout:** Timeout value.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMACEx_SHA224_Start_IT

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA224_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in HMAC SHA224 mode, next process pInBuffer then read the computed digest in interrupt mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 28 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMACEx_SHA256_Start_IT

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA256_Start_IT (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size, uint8_t * pOutBuffer)

Function description

Initialize the HASH peripheral in HMAC SHA256 mode, next process pInBuffer then read the computed digest in interrupt mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.
- **pOutBuffer:** pointer to the computed digest. Digest size is 32 bytes.

Return values

- **HAL:** status

Notes

- Digest is available in pOutBuffer.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.

HAL_HMACEx_SHA224_Start_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA224_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in HMAC SHA224 mode then initiate the required DMA transfers to feed the key and the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASHEx_SHA224_Finish() API must be called to retrieve the computed digest.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- If MDMAT bit is set before calling this function (multi-buffer HASH processing case), the input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. For the processing of the last buffer of the thread, MDMAT bit must be reset and the buffer length (in bytes) doesn't have to be a multiple of 4.

HAL_HMACEx_SHA256_Start_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA256_Start_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

Initialize the HASH peripheral in HMAC SHA224 mode then initiate the required DMA transfers to feed the key and the input buffer to the Peripheral.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (buffer to be hashed).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASHEx_SHA256_Finish() API must be called to retrieve the computed digest.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- If MDMAT bit is set before calling this function (multi-buffer HASH processing case), the input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted. For the processing of the last buffer of the thread, MDMAT bit must be reset and the buffer length (in bytes) doesn't have to be a multiple of 4.

HAL_HMACEx_MD5_Step1_2_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_MD5_Step1_2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

MD5 HMAC step 1 completion and step 2 start in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 1 consists in writing the inner hash function key in the Peripheral, step 2 consists in writing the message text.
- The API carries out the HMAC step 1 then starts step 2 with the first buffer entered to the Peripheral. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HAL_HMACEx_MD5_Step2_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_MD5_Step2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

MD5 HMAC step 2 in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral.
- The API carries on the HMAC step 2, applied to the buffer entered as input parameter. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HAL_HMACEx_MD5_Step2_3_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_MD5_Step2_3_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

MD5 HMAC step 2 wrap-up and step 3 completion in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral, step 3 consists in writing the outer hash function key.
- The API wraps up the HMAC step 2 in processing the buffer entered as input parameter (the input buffer must be the last one of the multi-buffer thread) then carries out HMAC step 3.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASHEx_SHA256_Finish() API must be called to retrieve the computed digest.

HAL_HMACEx_SHA1_Step1_2_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA1_Step1_2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA1 HMAC step 1 completion and step 2 start in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 1 consists in writing the inner hash function key in the Peripheral, step 2 consists in writing the message text.
- The API carries out the HMAC step 1 then starts step 2 with the first buffer entered to the Peripheral. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

HAL_HMACEx_SHA1_Step2_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA1_Step2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA1 HMAC step 2 in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral.
- The API carries on the HMAC step 2, applied to the buffer entered as input parameter. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

HAL_HMACEx_SHA1_Step2_3_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA1_Step2_3_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA1 HMAC step 2 wrap-up and step 3 completion in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral, step 3 consists in writing the outer hash function key.
- The API wraps up the HMAC step 2 in processing the buffer entered as input parameter (the input buffer must be the last one of the multi-buffer thread) then carries out HMAC step 3.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASHEx_SHA256_Finish() API must be called to retrieve the computed digest.

HAL_HMACEx_SHA224_Step1_2_DMA

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA224_Step1_2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA224 HMAC step 1 completion and step 2 start in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 1 consists in writing the inner hash function key in the Peripheral, step 2 consists in writing the message text.
- The API carries out the HMAC step 1 then starts step 2 with the first buffer entered to the Peripheral. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HAL_HMACEx_SHA224_Step2_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA224_Step2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA224 HMAC step 2 in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral.
- The API carries on the HMAC step 2, applied to the buffer entered as input parameter. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HAL_HMACEx_SHA224_Step2_3_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA224_Step2_3_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA224 HMAC step 2 wrap-up and step 3 completion in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral, step 3 consists in writing the outer hash function key.
- The API wraps up the HMAC step 2 in processing the buffer entered as input parameter (the input buffer must be the last one of the multi-buffer thread) then carries out HMAC step 3.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASHEx_SHA256_Finish() API must be called to retrieve the computed digest.

`HAL_HMACEx_SHA256_Step1_2_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA256_Step1_2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA256 HMAC step 1 completion and step 2 start in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 1 consists in writing the inner hash function key in the Peripheral, step 2 consists in writing the message text.
- The API carries out the HMAC step 1 then starts step 2 with the first buffer entered to the Peripheral. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HAL_HMACEx_SHA256_Step2_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA256_Step2_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA256 HMAC step 2 in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral.
- The API carries on the HMAC step 2, applied to the buffer entered as input parameter. DCAL bit is not automatically set after the message buffer feeding, allowing other messages DMA transfers to occur.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- The input buffer size (in bytes) must be a multiple of 4 otherwise, the HASH digest computation is corrupted.

`HAL_HMACEx_SHA256_Step2_3_DMA`

Function name

HAL_StatusTypeDef HAL_HMACEx_SHA256_Step2_3_DMA (HASH_HandleTypeDef * hhash, uint8_t * pInBuffer, uint32_t Size)

Function description

SHA256 HMAC step 2 wrap-up and step 3 completion in multi-buffer DMA mode.

Parameters

- **hhash:** HASH handle.
- **pInBuffer:** pointer to the input buffer (message buffer).
- **Size:** length of the input buffer in bytes.

Return values

- **HAL:** status

Notes

- Step 2 consists in writing the message text in the Peripheral, step 3 consists in writing the outer hash function key.
- The API wraps up the HMAC step 2 in processing the buffer entered as input parameter (the input buffer must be the last one of the multi-buffer thread) then carries out HMAC step 3.
- Same key is used for the inner and the outer hash functions; pointer to key and key size are respectively stored in hhash->Init.pKey and hhash->Init.KeySize.
- Once the DMA transfers are finished (indicated by hhash->State set back to HAL_HASH_STATE_READY), HAL_HASHEx_SHA256_Finish() API must be called to retrieve the computed digest.

35 HAL HCD Generic Driver

35.1 HCD Firmware driver registers structures

35.1.1 HCD_HandleTypeDef

HCD_HandleTypeDef is defined in the stm32l4xx_hal_hcd.h

Data Fields

- ***HCD_TypeDef * Instance***
- ***HCD_InitTypeDef Init***
- ***HCD_HCTypeDef hc***
- ***HAL_LockTypeDef Lock***
- ***__IO HCD_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***void * pData***

Field Documentation

- ***HCD_TypeDef* HCD_HandleTypeDef::Instance***
  Register base address
- ***HCD_InitTypeDef HCD_HandleTypeDef::Init***
  HCD required parameters
- ***HCD_HCTypeDef HCD_HandleTypeDef::hc[16]***
  Host channels parameters
- ***HAL_LockTypeDef HCD_HandleTypeDef::Lock***
  HCD peripheral status
- ***__IO HCD_StateTypeDef HCD_HandleTypeDef::State***
  HCD communication state
- ***__IO uint32_t HCD_HandleTypeDef::ErrorCode***
  HCD Error code
- ***void* HCD_HandleTypeDef::pData***
  Pointer Stack Handler

35.2 HCD Firmware driver API description

The following section lists the various functions of the HCD library.

35.2.1 How to use this driver

1. Declare a HCD_HandleTypeDef handle structure, for example: HCD_HandleTypeDef hhcd;
2. Fill parameters of Init structure in HCD handle
3. Call HAL_HCD_Init() API to initialize the HCD peripheral (Core, Host core, ...)
4. Initialize the HCD low level resources through the HAL_HCD_MspInit() API:
   a. Enable the HCD/USB Low Level interface clock using the following macros
      ◦ __HAL_RCC_USB_OTG_FS_CLK_ENABLE();
   b. Initialize the related GPIO clocks
   c. Configure HCD pin-out
   d. Configure HCD NVIC interrupt
5. Associate the Upper USB Host stack to the HAL HCD Driver:
   a. hhcd.pData = phost;
6. Enable HCD transmission and reception:
   a. HAL_HCD_Start();

35.2.2 Initialization and de-initialization functions

This section provides functions allowing to:
This section contains the following APIs:

- *HAL_HCD_Init*
- *HAL_HCD_HC_Init*
- *HAL_HCD_HC_Halt*
- *HAL_HCD_DeInit*
- *HAL_HCD_MspInit*
- *HAL_HCD_MspDeInit*

35.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the USB Host Data Transfer
This section contains the following APIs:

- *HAL_HCD_HC_SubmitRequest*
- *HAL_HCD_IRQHandler*
- *HAL_HCD_SOF_Callback*
- *HAL_HCD_Connect_Callback*
- *HAL_HCD_Disconnect_Callback*
- *HAL_HCD_PortEnabled_Callback*
- *HAL_HCD_PortDisabled_Callback*
- *HAL_HCD_HC_NotifyURBChange_Callback*

35.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the HCD data transfers.
This section contains the following APIs:

- *HAL_HCD_Start*
- *HAL_HCD_Stop*
- *HAL_HCD_ResetPort*

35.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.
This section contains the following APIs:

- *HAL_HCD_GetState*
- *HAL_HCD_HC_GetURBState*
- *HAL_HCD_HC_GetXferCount*
- *HAL_HCD_HC_GetState*
- *HAL_HCD_GetCurrentFrame*
- *HAL_HCD_GetCurrentSpeed*

35.2.6 Detailed description of functions

`HAL_HCD_Init`

Function name

HAL_StatusTypeDef HAL_HCD_Init (HCD_HandleTypeDef * hhcd)

Function description

Initialize the host driver.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** status

`HAL_HCD_DeInit`

Function name

HAL_StatusTypeDef HAL_HCD_DeInit (HCD_HandleTypeDef * hhcd)

Function description

DeInitialize the host driver.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** status

`HAL_HCD_HC_Init`

Function name

HAL_StatusTypeDef HAL_HCD_HC_Init (HCD_HandleTypeDef * hhcd, uint8_t ch_num, uint8_t epnum, uint8_t dev_address, uint8_t speed, uint8_t ep_type, uint16_t mps)

Function description

Initialize a host channel.

Parameters

- **hhcd:** HCD handle
- **ch_num:** Channel number. This parameter can be a value from 1 to 15
- **epnum:** Endpoint number. This parameter can be a value from 1 to 15
- **dev_address:** Current device address This parameter can be a value from 0 to 255
- **speed:** Current device speed. This parameter can be one of these values: HCD_SPEED_FULL: Full speed mode, HCD_SPEED_LOW: Low speed mode
- **ep_type:** Endpoint Type. This parameter can be one of these values: EP_TYPE_CTRL: Control type, EP_TYPE_ISOC: Isochronous type, EP_TYPE_BULK: Bulk type, EP_TYPE_INTR: Interrupt type
- **mps:** Max Packet Size. This parameter can be a value from 0 to32K

Return values

- **HAL:** status

`HAL_HCD_HC_Halt`

Function name

HAL_StatusTypeDef HAL_HCD_HC_Halt (HCD_HandleTypeDef * hhcd, uint8_t ch_num)

Function description

Halt a host channel.

Parameters

- **hhcd:** HCD handle
- **ch_num:** Channel number. This parameter can be a value from 1 to 15

Return values

- **HAL:** status

HAL_HCD_MspInit

Function name

void HAL_HCD_MspInit (HCD_HandleTypeDef * hhcd)

Function description

Initialize the HCD MSP.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_MspDeInit

Function name

void HAL_HCD_MspDeInit (HCD_HandleTypeDef * hhcd)

Function description

DeInitialize the HCD MSP.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_HC_SubmitRequest

Function name

HAL_StatusTypeDef HAL_HCD_HC_SubmitRequest (HCD_HandleTypeDef * hhcd, uint8_t ch_num, uint8_t direction, uint8_t ep_type, uint8_t token, uint8_t * pbuff, uint16_t length, uint8_t do_ping)

Function description

Submit a new URB for processing.

Parameters

- **hhcd:** HCD handle
- **ch_num:** Channel number. This parameter can be a value from 1 to 15
- **direction:** Channel number. This parameter can be one of these values: 0 : Output / 1 : Input
- **ep_type:** Endpoint Type. This parameter can be one of these values: EP_TYPE_CTRL: Control type/ EP_TYPE_ISOC: Isochronous type/ EP_TYPE_BULK: Bulk type/ EP_TYPE_INTR: Interrupt type/
- **token:** Endpoint Type. This parameter can be one of these values: 0: HC_PID_SETUP / 1: HC_PID_DATA1
- **pbuff:** pointer to URB data
- **length:** Length of URB data
- **do_ping:** activate do ping protocol (for high speed only). This parameter can be one of these values: 0 : do ping inactive / 1 : do ping active

Return values

- **HAL:** status

HAL_HCD_IRQHandler

Function name

void HAL_HCD_IRQHandler (HCD_HandleTypeDef * hhcd)

Function description

Handle HCD interrupt request.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_SOF_Callback

Function name

void HAL_HCD_SOF_Callback (HCD_HandleTypeDef * hhcd)

Function description

SOF callback.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_Connect_Callback

Function name

void HAL_HCD_Connect_Callback (HCD_HandleTypeDef * hhcd)

Function description

Connection Event callback.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_Disconnect_Callback

Function name

void HAL_HCD_Disconnect_Callback (HCD_HandleTypeDef * hhcd)

Function description

Disconnection Event callback.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_PortEnabled_Callback

Function name

void HAL_HCD_PortEnabled_Callback (HCD_HandleTypeDef * hhcd)

Function description

Port Enabled Event callback.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_PortDisabled_Callback

Function name

void HAL_HCD_PortDisabled_Callback (HCD_HandleTypeDef * hhcd)

Function description

Port Disabled Event callback.

Parameters

- **hhcd:** HCD handle

Return values

- **None:**

HAL_HCD_HC_NotifyURBChange_Callback

Function name

void HAL_HCD_HC_NotifyURBChange_Callback (HCD_HandleTypeDef * hhcd, uint8_t chnum, HCD_URBStateTypeDef urb_state)

Function description

Notify URB state change callback.

Parameters

- **hhcd:** HCD handle
- **chnum:** Channel number. This parameter can be a value from 1 to 15
- **urb_state:** This parameter can be one of these values: URB_IDLE/ URB_DONE/ URB_NOTREADY/ URB_NYET/ URB_ERROR/ URB_STALL/

Return values

- **None:**

HAL_HCD_ResetPort

Function name

HAL_StatusTypeDef HAL_HCD_ResetPort (HCD_HandleTypeDef * hhcd)

Function description

Reset the host port.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** status

`HAL_HCD_Start`

Function name

HAL_StatusTypeDef HAL_HCD_Start (HCD_HandleTypeDef * hhcd)

Function description

Start the host driver.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** status

`HAL_HCD_Stop`

Function name

HAL_StatusTypeDef HAL_HCD_Stop (HCD_HandleTypeDef * hhcd)

Function description

Stop the host driver.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** status

`HAL_HCD_GetState`

Function name

HCD_StateTypeDef HAL_HCD_GetState (HCD_HandleTypeDef * hhcd)

Function description

Return the HCD handle state.

Parameters

- **hhcd:** HCD handle

Return values

- **HAL:** state

`HAL_HCD_HC_GetURBState`

Function name

HCD_URBStateTypeDef HAL_HCD_HC_GetURBState (HCD_HandleTypeDef * hhcd, uint8_t chnum)

Function description

Return URB state for a channel.

Parameters

- **hhcd:** HCD handle
- **chnum:** Channel number. This parameter can be a value from 1 to 15

Return values

- **URB:** state. This parameter can be one of these values: URB_IDLE/ URB_DONE/ URB_NOTREADY/ URB_NYET/ URB_ERROR/ URB_STALL

`HAL_HCD_HC_GetXferCount`

Function name

uint32_t HAL_HCD_HC_GetXferCount (HCD_HandleTypeDef * hhcd, uint8_t chnum)

Function description

Return the last host transfer size.

Parameters

- **hhcd:** HCD handle
- **chnum:** Channel number. This parameter can be a value from 1 to 15

Return values

- **last:** transfer size in byte

`HAL_HCD_HC_GetState`

Function name

HCD_HCStateTypeDef HAL_HCD_HC_GetState (HCD_HandleTypeDef * hhcd, uint8_t chnum)

Function description

Return the Host Channel state.

Parameters

- **hhcd:** HCD handle
- **chnum:** Channel number. This parameter can be a value from 1 to 15

Return values

- **Host:** channel state This parameter can be one of these values: HC_IDLE/ HC_XFRC/ HC_HALTED/ HC_NYET/ HC_NAK/ HC_STALL/ HC_XACTERR/ HC_BBLERR/ HC_DATATGLERR

`HAL_HCD_GetCurrentFrame`

Function name

uint32_t HAL_HCD_GetCurrentFrame (HCD_HandleTypeDef * hhcd)

Function description

Return the current Host frame number.

Parameters

- **hhcd:** HCD handle

Return values

- **Current:** Host frame number

`HAL_HCD_GetCurrentSpeed`

Function name

uint32_t HAL_HCD_GetCurrentSpeed (HCD_HandleTypeDef * hhcd)

Function description

Return the Host enumeration speed.

Parameters

- **hhcd:** HCD handle

Return values

- **Enumeration:** speed

35.3 HCD Firmware driver defines

The following section lists the various define and macros of the module.

35.3.1 HCD

HCD

HCD Exported Macros

__HAL_HCD_ENABLE

__HAL_HCD_DISABLE

__HAL_HCD_GET_FLAG

__HAL_HCD_CLEAR_FLAG

__HAL_HCD_IS_INVALID_INTERRUPT

__HAL_HCD_CLEAR_HC_INT

__HAL_HCD_MASK_HALT_HC_INT

__HAL_HCD_UNMASK_HALT_HC_INT

__HAL_HCD_MASK_ACK_HC_INT

__HAL_HCD_UNMASK_ACK_HC_INT

HCD PHY Module

HCD_PHY_ULPI

HCD_PHY_EMBEDDED

HCD Speed

HCD_SPEED_FULL

HCD_SPEED_LOW

36 HAL I2C Generic Driver

36.1 I2C Firmware driver registers structures

36.1.1 I2C_InitTypeDef

I2C_InitTypeDef is defined in the stm32l4xx_hal_i2c.h

Data Fields

- ***uint32_t Timing***
- ***uint32_t OwnAddress1***
- ***uint32_t AddressingMode***
- ***uint32_t DualAddressMode***
- ***uint32_t OwnAddress2***
- ***uint32_t OwnAddress2Masks***
- ***uint32_t GeneralCallMode***
- ***uint32_t NoStretchMode***

Field Documentation

- ***uint32_t I2C_InitTypeDef::Timing***

  Specifies the I2C_TIMINGR_register value. This parameter calculated by referring to I2C initialization section in Reference manual
- ***uint32_t I2C_InitTypeDef::OwnAddress1***

  Specifies the first device own address. This parameter can be a 7-bit or 10-bit address.
- ***uint32_t I2C_InitTypeDef::AddressingMode***

  Specifies if 7-bit or 10-bit addressing mode is selected. This parameter can be a value of *I2C_ADDRESSING_MODE*
- ***uint32_t I2C_InitTypeDef::DualAddressMode***

  Specifies if dual addressing mode is selected. This parameter can be a value of *I2C_DUAL_ADDRESSING_MODE*
- ***uint32_t I2C_InitTypeDef::OwnAddress2***

  Specifies the second device own address if dual addressing mode is selected This parameter can be a 7-bit address.
- ***uint32_t I2C_InitTypeDef::OwnAddress2Masks***

  Specifies the acknowledge mask address second device own address if dual addressing mode is selected This parameter can be a value of *I2C_OWN_ADDRESS2_MASKS*
- ***uint32_t I2C_InitTypeDef::GeneralCallMode***

  Specifies if general call mode is selected. This parameter can be a value of *I2C_GENERAL_CALL_ADDRESSING_MODE*
- ***uint32_t I2C_InitTypeDef::NoStretchMode***

  Specifies if nostretch mode is selected. This parameter can be a value of *I2C_NOSTRETCH_MODE*

36.1.2 __I2C_HandleTypeDef

__I2C_HandleTypeDef is defined in the stm32l4xx_hal_i2c.h

Data Fields

- ***I2C_TypeDef * Instance***
- ***I2C_InitTypeDef Init***
- ***uint8_t * pBuffPtr***
- ***uint16_t XferSize***
- ***__IO uint16_t XferCount***
- ***__IO uint32_t XferOptions***

- ***__IO uint32_t PreviousState***
- ***HAL_StatusTypeDef(* XferISR***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_I2C_StateTypeDef State***
- ***__IO HAL_I2C_ModeTypeDef Mode***
- ***__IO uint32_t ErrorCode***
- ***__IO uint32_t AddrEventCount***

Field Documentation

- ***I2C_TypeDef* __I2C_HandleTypeDef::Instance***
  I2C registers base address
- ***I2C_InitTypeDef __I2C_HandleTypeDef::Init***
  I2C communication parameters
- ***uint8_t* __I2C_HandleTypeDef::pBuffPtr***
  Pointer to I2C transfer buffer
- ***uint16_t __I2C_HandleTypeDef::XferSize***
  I2C transfer size
- ***__IO uint16_t __I2C_HandleTypeDef::XferCount***
  I2C transfer counter
- ***__IO uint32_t __I2C_HandleTypeDef::XferOptions***
  I2C sequantial transfer options, this parameter can be a value of *I2C_XFEROPTIONS*
- ***__IO uint32_t __I2C_HandleTypeDef::PreviousState***
  I2C communication Previous state
- ***HAL_StatusTypeDef(* __I2C_HandleTypeDef::XferISR)(struct __I2C_HandleTypeDef *hi2c, uint32_t ITFlags, uint32_t ITSources)***
  I2C transfer IRQ handler function pointer
- ***DMA_HandleTypeDef* __I2C_HandleTypeDef::hdmatx***
  I2C Tx DMA handle parameters
- ***DMA_HandleTypeDef* __I2C_HandleTypeDef::hdmarx***
  I2C Rx DMA handle parameters
- ***HAL_LockTypeDef __I2C_HandleTypeDef::Lock***
  I2C locking object
- ***__IO HAL_I2C_StateTypeDef __I2C_HandleTypeDef::State***
  I2C communication state
- ***__IO HAL_I2C_ModeTypeDef __I2C_HandleTypeDef::Mode***
  I2C communication mode
- ***__IO uint32_t __I2C_HandleTypeDef::ErrorCode***
  I2C Error code
- ***__IO uint32_t __I2C_HandleTypeDef::AddrEventCount***
  I2C Address Event counter

36.2 I2C Firmware driver API description

The following section lists the various functions of the I2C library.

36.2.1 How to use this driver

The I2C HAL driver can be used as follows:

1. Declare a I2C_HandleTypeDef handle structure, for example: I2C_HandleTypeDef hi2c;

2. Initialize the I2C low level resources by implementing the @ref HAL_I2C_MspInit() API:
   a. Enable the I2Cx interface clock
   b. I2C pins configuration
      - Enable the clock for the I2C GPIOs
      - Configure I2C pins as alternate function open-drain
   c. NVIC configuration if you need to use interrupt process
      - Configure the I2Cx interrupt priority
      - Enable the NVIC I2C IRQ Channel
   d. DMA Configuration if you need to use DMA process
      - Declare a DMA_HandleTypeDef handle structure for the transmit or receive channel
      - Enable the DMAx interface clock using
      - Configure the DMA handle parameters
      - Configure the DMA Tx or Rx channel
      - Associate the initialized DMA handle to the hi2c DMA Tx or Rx handle
      - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx or Rx channel
3. Configure the Communication Clock Timing, Own Address1, Master Addressing mode, Dual Addressing mode, Own Address2, Own Address2 Mask, General call and Nostretch mode in the hi2c Init structure.
4. Initialize the I2C registers by calling the @ref HAL_I2C_Init(), configures also the low level Hardware (GPIO, CLOCK, NVIC...etc) by calling the customized @ref HAL_I2C_MspInit(&hi2c) API.
5. To check if target device is ready for communication, use the function @ref HAL_I2C_IsDeviceReady()
6. For I2C IO and IO MEM operations, three operation modes are available within this driver :

Polling mode IO operation

- Transmit in master mode an amount of data in blocking mode using @ref HAL_I2C_Master_Transmit()
- Receive in master mode an amount of data in blocking mode using @ref HAL_I2C_Master_Receive()
- Transmit in slave mode an amount of data in blocking mode using @ref HAL_I2C_Slave_Transmit()
- Receive in slave mode an amount of data in blocking mode using @ref HAL_I2C_Slave_Receive()

Polling mode IO MEM operation

- Write an amount of data in blocking mode to a specific memory address using @ref HAL_I2C_Mem_Write()
- Read an amount of data in blocking mode from a specific memory address using @ref HAL_I2C_Mem_Read()

Interrupt mode IO operation

- Transmit in master mode an amount of data in non-blocking mode using @ref HAL_I2C_Master_Transmit_IT()
- At transmission end of transfer, @ref HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MasterTxCpltCallback()
- Receive in master mode an amount of data in non-blocking mode using @ref HAL_I2C_Master_Receive_IT()
- At reception end of transfer, @ref HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MasterRxCpltCallback()
- Transmit in slave mode an amount of data in non-blocking mode using @ref HAL_I2C_Slave_Transmit_IT()
- At transmission end of transfer, @ref HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_SlaveTxCpltCallback()
- Receive in slave mode an amount of data in non-blocking mode using @ref HAL_I2C_Slave_Receive_IT()
- At reception end of transfer, @ref HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, @ref HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_I2C_ErrorCallback()

- Abort a master I2C process communication with Interrupt using @ref HAL_I2C_Master_Abort_IT()
- End of abort process, @ref HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using @ref __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

Interrupt mode or DMA mode IO sequential operation

Note: These interfaces allow to manage a sequential transfer with a repeated start condition when a direction change during transfer

- A specific option field manage the different steps of a sequential transfer
- Option field values are defined through @ref I2C_XFEROPTIONS and are listed below:
  - I2C_FIRST_AND_LAST_FRAME: No sequential usage, functionnal is same as associated interfaces in no sequential mode
  - I2C_FIRST_FRAME: Sequential usage, this option allow to manage a sequence with start condition, address and data to transfer without a final stop condition
  - I2C_FIRST_AND_NEXT_FRAME: Sequential usage (Master only), this option allow to manage a sequence with start condition, address and data to transfer without a final stop condition, an then permit a call the same master sequential interface several times (like @ref HAL_I2C_Master_Seq_Transmit_IT() then @ref HAL_I2C_Master_Seq_Transmit_IT() or @ref HAL_I2C_Master_Seq_Transmit_DMA() then @ref HAL_I2C_Master_Seq_Transmit_DMA())
  - I2C_NEXT_FRAME: Sequential usage, this option allow to manage a sequence with a restart condition, address and with new data to transfer if the direction change or manage only the new data to transfer if no direction change and without a final stop condition in both cases
  - I2C_LAST_FRAME: Sequential usage, this option allow to manage a sequance with a restart condition, address and with new data to transfer if the direction change or manage only the new data to transfer if no direction change and with a final stop condition in both cases
  - I2C_LAST_FRAME_NO_STOP: Sequential usage (Master only), this option allow to manage a restart condition after several call of the same master sequential interface several times (link with option I2C_FIRST_AND_NEXT_FRAME). Usage can, transfer several bytes one by one using HAL_I2C_Master_Seq_Transmit_IT(option I2C_FIRST_AND_NEXT_FRAME then I2C_NEXT_FRAME) or HAL_I2C_Master_Seq_Receive_IT(option I2C_FIRST_AND_NEXT_FRAME then I2C_NEXT_FRAME) or HAL_I2C_Master_Seq_Transmit_DMA(option I2C_FIRST_AND_NEXT_FRAME then I2C_NEXT_FRAME) or HAL_I2C_Master_Seq_Receive_DMA(option I2C_FIRST_AND_NEXT_FRAME then I2C_NEXT_FRAME). Then usage of this option I2C_LAST_FRAME_NO_STOP at the last Transmit or Receive sequence permit to call the oposite interface Receive or Transmit without stopping the communication and so generate a restart condition.
  - I2C_OTHER_FRAME: Sequential usage (Master only), this option allow to manage a restart condition after each call of the same master sequential interface. Usage can, transfer several bytes one by one with a restart with slave address between each bytes using HAL_I2C_Master_Seq_Transmit_IT(option I2C_FIRST_FRAME then I2C_OTHER_FRAME) or HAL_I2C_Master_Seq_Receive_IT(option I2C_FIRST_FRAME then I2C_OTHER_FRAME) or HAL_I2C_Master_Seq_Transmit_DMA(option I2C_FIRST_FRAME then I2C_OTHER_FRAME) or HAL_I2C_Master_Seq_Receive_DMA(option I2C_FIRST_FRAME then I2C_OTHER_FRAME). Then usage of this option I2C_OTHER_AND_LAST_FRAME at the last frame to help automatic generation of STOP condition.

- Differents sequential I2C interfaces are listed below:
  - Sequential transmit in master I2C mode an amount of data in non-blocking mode using @ref HAL_I2C_Master_Seq_Transmit_IT() or using @ref HAL_I2C_Master_Seq_Transmit_DMA()
    - At transmission end of current frame transfer, @ref HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MasterTxCpltCallback()
  - Sequential receive in master I2C mode an amount of data in non-blocking mode using @ref HAL_I2C_Master_Seq_Receive_IT() or using @ref HAL_I2C_Master_Seq_Receive_DMA()
    - At reception end of current frame transfer, @ref HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MasterRxCpltCallback()
  - Abort a master IT or DMA I2C process communication with Interrupt using @ref HAL_I2C_Master_Abort_IT()
    - End of abort process, @ref HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_AbortCpltCallback()
  - Enable/disable the Address listen mode in slave I2C mode using @ref HAL_I2C_EnableListen_IT() @ref HAL_I2C_DisableListen_IT()
    - When address slave I2C match, @ref HAL_I2C_AddrCallback() is executed and user can add his own code to check the Address Match Code and the transmission direction request by master (Write/Read).
    - At Listen mode end @ref HAL_I2C_ListenCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_ListenCpltCallback()
  - Sequential transmit in slave I2C mode an amount of data in non-blocking mode using @ref HAL_I2C_Slave_Seq_Transmit_IT() or using @ref HAL_I2C_Slave_Seq_Transmit_DMA()
    - At transmission end of current frame transfer, @ref HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_SlaveTxCpltCallback()
  - Sequential receive in slave I2C mode an amount of data in non-blocking mode using @ref HAL_I2C_Slave_Seq_Receive_IT() or using @ref HAL_I2C_Slave_Seq_Receive_DMA()
    - At reception end of current frame transfer, @ref HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_SlaveRxCpltCallback()
  - In case of transfer Error, @ref HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_I2C_ErrorCallback()
  - Discard a slave I2C process communication using @ref __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

Interrupt mode IO MEM operation

- Write an amount of data in non-blocking mode with Interrupt to a specific memory address using @ref HAL_I2C_Mem_Write_IT()
- At Memory end of write transfer, @ref HAL_I2C_MemTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MemTxCpltCallback()
- Read an amount of data in non-blocking mode with Interrupt from a specific memory address using @ref HAL_I2C_Mem_Read_IT()
- At Memory end of read transfer, @ref HAL_I2C_MemRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MemRxCpltCallback()
- In case of transfer Error, @ref HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_I2C_ErrorCallback()

DMA mode IO operation

- Transmit in master mode an amount of data in non-blocking mode (DMA) using @ref HAL_I2C_Master_Transmit_DMA()
- At transmission end of transfer, @ref HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MasterTxCpltCallback()

- Receive in master mode an amount of data in non-blocking mode (DMA) using @ref HAL_I2C_Master_Receive_DMA()
- At reception end of transfer, @ref HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MasterRxCpltCallback()
- Transmit in slave mode an amount of data in non-blocking mode (DMA) using @ref HAL_I2C_Slave_Transmit_DMA()
- At transmission end of transfer, @ref HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_SlaveTxCpltCallback()
- Receive in slave mode an amount of data in non-blocking mode (DMA) using @ref HAL_I2C_Slave_Receive_DMA()
- At reception end of transfer, @ref HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, @ref HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using @ref HAL_I2C_Master_Abort_IT()
- End of abort process, @ref HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using @ref __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

DMA mode IO MEM operation

- Write an amount of data in non-blocking mode with DMA to a specific memory address using @ref HAL_I2C_Mem_Write_DMA()
- At Memory end of write transfer, @ref HAL_I2C_MemTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MemTxCpltCallback()
- Read an amount of data in non-blocking mode with DMA from a specific memory address using @ref HAL_I2C_Mem_Read_DMA()
- At Memory end of read transfer, @ref HAL_I2C_MemRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_I2C_MemRxCpltCallback()
- In case of transfer Error, @ref HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_I2C_ErrorCallback()

I2C HAL driver macros list

Below the list of most used macros in I2C HAL driver.

- @ref __HAL_I2C_ENABLE: Enable the I2C peripheral
- @ref __HAL_I2C_DISABLE: Disable the I2C peripheral
- @ref __HAL_I2C_GENERATE_NACK: Generate a Non-Acknowledge I2C peripheral in Slave mode
- @ref __HAL_I2C_GET_FLAG: Check whether the specified I2C flag is set or not
- @ref __HAL_I2C_CLEAR_FLAG: Clear the specified I2C pending flag
- @ref __HAL_I2C_ENABLE_IT: Enable the specified I2C interrupt
- @ref __HAL_I2C_DISABLE_IT: Disable the specified I2C interrupt

Callback registration

The compilation flag USE_HAL_I2C_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_I2C_RegisterCallback() or @ref HAL_I2C_RegisterAddrCallback() to register an interrupt callback.

Function @ref HAL_I2C_RegisterCallback() allows to register following callbacks:

- MasterTxCpltCallback : callback for Master transmission end of transfer.
- MasterRxCpltCallback : callback for Master reception end of transfer.
- SlaveTxCpltCallback : callback for Slave transmission end of transfer.
- SlaveRxCpltCallback : callback for Slave reception end of transfer.
- ListenCpltCallback : callback for end of listen mode.

- MemTxCpltCallback : callback for Memory transmission end of transfer.
- MemRxCpltCallback : callback for Memory reception end of transfer.
- ErrorCallback : callback for error detection.
- AbortCpltCallback : callback for abort completion process.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

For specific callback AddrCallback use dedicated register callbacks : @ref HAL_I2C_RegisterAddrCallback().

Use function @ref HAL_I2C_UnRegisterCallback to reset a callback to the default weak function. @ref HAL_I2C_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- MasterTxCpltCallback : callback for Master transmission end of transfer.
- MasterRxCpltCallback : callback for Master reception end of transfer.
- SlaveTxCpltCallback : callback for Slave transmission end of transfer.
- SlaveRxCpltCallback : callback for Slave reception end of transfer.
- ListenCpltCallback : callback for end of listen mode.
- MemTxCpltCallback : callback for Memory transmission end of transfer.
- MemRxCpltCallback : callback for Memory reception end of transfer.
- ErrorCallback : callback for error detection.
- AbortCpltCallback : callback for abort completion process.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit.

For callback AddrCallback use dedicated register callbacks : @ref HAL_I2C_UnRegisterAddrCallback().

By default, after the @ref HAL_I2C_Init() and when the state is @ref HAL_I2C_STATE_RESET all callbacks are set to the corresponding weak functions: examples @ref HAL_I2C_MasterTxCpltCallback(), @ref HAL_I2C_MasterRxCpltCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the @ref HAL_I2C_Init()/ @ref HAL_I2C_DeInit() only when these callbacks are null (not registered beforehand). If MspInit or MspDeInit are not null, the @ref HAL_I2C_Init()/ @ref HAL_I2C_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state.

Callbacks can be registered/unregistered in @ref HAL_I2C_STATE_READY state only. Exception done MspInit/ MspDeInit functions that can be registered/unregistered in @ref HAL_I2C_STATE_READY or @ref HAL_I2C_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. Then, the user first registers the MspInit/MspDeInit user callbacks using @ref HAL_I2C_RegisterCallback() before calling @ref HAL_I2C_DeInit() or @ref HAL_I2C_Init() function.

When the compilation flag USE_HAL_I2C_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

Note: You can refer to the I2C HAL driver header file for more useful macros

36.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and deinitialize the I2Cx peripheral:

- User must Implement HAL_I2C_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_I2C_Init() to configure the selected device with the selected configuration:
  - Clock Timing
  - Own Address 1
  - Addressing mode (Master, Slave)
  - Dual Addressing mode
  - Own Address 2
  - Own Address 2 Mask
  - General call mode
  - Nostretch mode

- Call the function HAL_I2C_DeInit() to restore the default configuration of the selected I2Cx peripheral.

This section contains the following APIs:

- ***HAL_I2C_Init***
- ***HAL_I2C_DeInit***
- ***HAL_I2C_MspInit***
- ***HAL_I2C_MspDeInit***

36.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the I2C data transfers.

1. There are two modes of transfer:
   - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
   - No-Blocking mode : The communication is performed using Interrupts or DMA. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated I2C IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
2. Blocking mode functions are :
   - HAL_I2C_Master_Transmit()
   - HAL_I2C_Master_Receive()
   - HAL_I2C_Slave_Transmit()
   - HAL_I2C_Slave_Receive()
   - HAL_I2C_Mem_Write()
   - HAL_I2C_Mem_Read()
   - HAL_I2C_IsDeviceReady()
3. No-Blocking mode functions with Interrupt are :
   - HAL_I2C_Master_Transmit_IT()
   - HAL_I2C_Master_Receive_IT()
   - HAL_I2C_Slave_Transmit_IT()
   - HAL_I2C_Slave_Receive_IT()
   - HAL_I2C_Mem_Write_IT()
   - HAL_I2C_Mem_Read_IT()
   - HAL_I2C_Master_Seq_Transmit_IT()
   - HAL_I2C_Master_Seq_Receive_IT()
   - HAL_I2C_Slave_Seq_Transmit_IT()
   - HAL_I2C_Slave_Seq_Receive_IT()
   - HAL_I2C_EnableListen_IT()
   - HAL_I2C_DisableListen_IT()
   - HAL_I2C_Master_Abort_IT()
4. No-Blocking mode functions with DMA are :
   - HAL_I2C_Master_Transmit_DMA()
   - HAL_I2C_Master_Receive_DMA()
   - HAL_I2C_Slave_Transmit_DMA()
   - HAL_I2C_Slave_Receive_DMA()
   - HAL_I2C_Mem_Write_DMA()
   - HAL_I2C_Mem_Read_DMA()
   - HAL_I2C_Master_Seq_Transmit_DMA()
   - HAL_I2C_Master_Seq_Receive_DMA()
   - HAL_I2C_Slave_Seq_Transmit_DMA()
   - HAL_I2C_Slave_Seq_Receive_DMA()

5. A set of Transfer Complete Callbacks are provided in non Blocking mode:
   - HAL_I2C_MasterTxCpltCallback()
   - HAL_I2C_MasterRxCpltCallback()
   - HAL_I2C_SlaveTxCpltCallback()
   - HAL_I2C_SlaveRxCpltCallback()
   - HAL_I2C_MemTxCpltCallback()
   - HAL_I2C_MemRxCpltCallback()
   - HAL_I2C_AddrCallback()
   - HAL_I2C_ListenCpltCallback()
   - HAL_I2C_ErrorCallback()
   - HAL_I2C_AbortCpltCallback()

This section contains the following APIs:

- ***HAL_I2C_Master_Transmit***
- ***HAL_I2C_Master_Receive***
- ***HAL_I2C_Slave_Transmit***
- ***HAL_I2C_Slave_Receive***
- ***HAL_I2C_Master_Transmit_IT***
- ***HAL_I2C_Master_Receive_IT***
- ***HAL_I2C_Slave_Transmit_IT***
- ***HAL_I2C_Slave_Receive_IT***
- ***HAL_I2C_Master_Transmit_DMA***
- ***HAL_I2C_Master_Receive_DMA***
- ***HAL_I2C_Slave_Transmit_DMA***
- ***HAL_I2C_Slave_Receive_DMA***
- ***HAL_I2C_Mem_Write***
- ***HAL_I2C_Mem_Read***
- ***HAL_I2C_Mem_Write_IT***
- ***HAL_I2C_Mem_Read_IT***
- ***HAL_I2C_Mem_Write_DMA***
- ***HAL_I2C_Mem_Read_DMA***
- ***HAL_I2C_IsDeviceReady***
- ***HAL_I2C_Master_Seq_Transmit_IT***
- ***HAL_I2C_Master_Seq_Transmit_DMA***
- ***HAL_I2C_Master_Seq_Receive_IT***
- ***HAL_I2C_Master_Seq_Receive_DMA***
- ***HAL_I2C_Slave_Seq_Transmit_IT***
- ***HAL_I2C_Slave_Seq_Transmit_DMA***
- ***HAL_I2C_Slave_Seq_Receive_IT***
- ***HAL_I2C_Slave_Seq_Receive_DMA***
- ***HAL_I2C_EnableListen_IT***
- ***HAL_I2C_DisableListen_IT***
- ***HAL_I2C_Master_Abort_IT***

36.2.4 Peripheral State, Mode and Error functions

This subsection permit to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- ***HAL_I2C_GetState***
- ***HAL_I2C_GetMode***

- *HAL_I2C_GetError*

36.2.5 Detailed description of functions

`HAL_I2C_Init`

Function name

HAL_StatusTypeDef HAL_I2C_Init (I2C_HandleTypeDef * hi2c)

Function description

Initializes the I2C according to the specified parameters in the I2C_InitTypeDef and initialize the associated handle.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **HAL:** status

`HAL_I2C_DeInit`

Function name

HAL_StatusTypeDef HAL_I2C_DeInit (I2C_HandleTypeDef * hi2c)

Function description

DeInitialize the I2C peripheral.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **HAL:** status

`HAL_I2C_MspInit`

Function name

void HAL_I2C_MspInit (I2C_HandleTypeDef * hi2c)

Function description

Initialize the I2C MSP.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

`HAL_I2C_MspDeInit`

Function name

void HAL_I2C_MspDeInit (I2C_HandleTypeDef * hi2c)

Function description

DeInitialize the I2C MSP.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

`HAL_I2C_Master_Transmit`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Transmit (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Transmits in master mode an amount of data in blocking mode.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_I2C_Master_Receive`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Receive (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receives in master mode an amount of data in blocking mode.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_I2C_Slave_Transmit`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Transmit (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Transmits in slave mode an amount of data in blocking mode.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_I2C_Slave_Receive`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Receive (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receive in slave mode an amount of data in blocking mode.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_I2C_Mem_Write`

Function name

HAL_StatusTypeDef HAL_I2C_Mem_Write (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Write an amount of data in blocking mode to a specific memory address.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **MemAddress:** Internal memory address
- **MemAddSize:** Size of internal memory address
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_I2C_Mem_Read

Function name

HAL_StatusTypeDef HAL_I2C_Mem_Read (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Read an amount of data in blocking mode from a specific memory address.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **MemAddress:** Internal memory address
- **MemAddSize:** Size of internal memory address
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_I2C_IsDeviceReady

Function name

HAL_StatusTypeDef HAL_I2C_IsDeviceReady (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint32_t Trials, uint32_t Timeout)

Function description

Checks if target device is ready for communication.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **Trials:** Number of trials
- **Timeout:** Timeout duration

Return values

- **HAL:** status

Notes

- This function is used with Memory devices

HAL_I2C_Master_Transmit_IT

Function name

HAL_StatusTypeDef HAL_I2C_Master_Transmit_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)

Function description

Transmit in master mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

`HAL_I2C_Master_Receive_IT`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Receive_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)

Function description

Receive in master mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

`HAL_I2C_Slave_Transmit_IT`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Transmit_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)

Function description

Transmit in slave mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

`HAL_I2C_Slave_Receive_IT`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Receive_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)

Function description

Receive in slave mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_I2C_Mem_Write_IT

Function name

HAL_StatusTypeDef HAL_I2C_Mem_Write_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)

Function description

Write an amount of data in non-blocking mode with Interrupt to a specific memory address.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **MemAddress:** Internal memory address
- **MemAddSize:** Size of internal memory address
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_I2C_Mem_Read_IT

Function name

HAL_StatusTypeDef HAL_I2C_Mem_Read_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)

Function description

Read an amount of data in non-blocking mode with Interrupt from a specific memory address.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **MemAddress:** Internal memory address
- **MemAddSize:** Size of internal memory address
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_I2C_Master_Seq_Transmit_IT

Function name

HAL_StatusTypeDef HAL_I2C_Master_Seq_Transmit_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential transmit in master I2C mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Master_Seq_Receive_IT

Function name

HAL_StatusTypeDef HAL_I2C_Master_Seq_Receive_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential receive in master I2C mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Slave_Seq_Transmit_IT

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Seq_Transmit_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential transmit in slave/device I2C mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Slave_Seq_Receive_IT

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Seq_Receive_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential receive in slave/device I2C mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_EnableListen_IT

Function name

HAL_StatusTypeDef HAL_I2C_EnableListen_IT (I2C_HandleTypeDef * hi2c)

Function description

Enable the Address listen mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **HAL:** status

`HAL_I2C_DisableListen_IT`

Function name

HAL_StatusTypeDef HAL_I2C_DisableListen_IT (I2C_HandleTypeDef * hi2c)

Function description

Disable the Address listen mode with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C

Return values

- **HAL:** status

`HAL_I2C_Master_Abort_IT`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Abort_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress)

Function description

Abort a master I2C IT or DMA process communication with Interrupt.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface

Return values

- **HAL:** status

`HAL_I2C_Master_Transmit_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Transmit_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)

Function description

Transmit in master mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

`HAL_I2C_Master_Receive_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Receive_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size)

Function description

Receive in master mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

`HAL_I2C_Slave_Transmit_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Transmit_DMA (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)

Function description

Transmit in slave mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

`HAL_I2C_Slave_Receive_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Receive_DMA (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size)

Function description

Receive in slave mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_I2C_Mem_Write_DMA

Function name

HAL_StatusTypeDef HAL_I2C_Mem_Write_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)

Function description

Write an amount of data in non-blocking mode with DMA to a specific memory address.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **MemAddress:** Internal memory address
- **MemAddSize:** Size of internal memory address
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_I2C_Mem_Read_DMA

Function name

HAL_StatusTypeDef HAL_I2C_Mem_Read_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint16_t MemAddress, uint16_t MemAddSize, uint8_t * pData, uint16_t Size)

Function description

Reads an amount of data in non-blocking mode with DMA from a specific memory address.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **MemAddress:** Internal memory address
- **MemAddSize:** Size of internal memory address
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be read

Return values

- **HAL:** status

HAL_I2C_Master_Seq_Transmit_DMA

Function name

HAL_StatusTypeDef HAL_I2C_Master_Seq_Transmit_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential transmit in master I2C mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

`HAL_I2C_Master_Seq_Receive_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Master_Seq_Receive_DMA (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential receive in master I2C mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

`HAL_I2C_Slave_Seq_Transmit_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Seq_Transmit_DMA (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential transmit in slave/device I2C mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

`HAL_I2C_Slave_Seq_Receive_DMA`

Function name

HAL_StatusTypeDef HAL_I2C_Slave_Seq_Receive_DMA (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Sequential receive in slave/device I2C mode an amount of data in non-blocking mode with DMA.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C Sequential Transfer Options

Return values

- **HAL:** status

Notes

- This interface allow to manage repeated start condition when a direction change during transfer

`HAL_I2C_EV_IRQHandler`

Function name

void HAL_I2C_EV_IRQHandler (I2C_HandleTypeDef * hi2c)

Function description

This function handles I2C event interrupt request.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

`HAL_I2C_ER_IRQHandler`

Function name

void HAL_I2C_ER_IRQHandler (I2C_HandleTypeDef * hi2c)

Function description

This function handles I2C error interrupt request.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_MasterTxCpltCallback

Function name

void HAL_I2C_MasterTxCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Master Tx Transfer completed callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_MasterRxCpltCallback

Function name

void HAL_I2C_MasterRxCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Master Rx Transfer completed callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_SlaveTxCpltCallback

Function name

void HAL_I2C_SlaveTxCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Slave Tx Transfer completed callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_SlaveRxCpltCallback

Function name

void HAL_I2C_SlaveRxCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Slave Rx Transfer completed callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_AddrCallback

Function name

void HAL_I2C_AddrCallback (I2C_HandleTypeDef * hi2c, uint8_t TransferDirection, uint16_t AddrMatchCode)

Function description

Slave Address Match callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.
- **TransferDirection:** Master request Transfer Direction (Write/Read), value of I2C Transfer Direction Master Point of View
- **AddrMatchCode:** Address Match Code

Return values

- **None:**

HAL_I2C_ListenCpltCallback

Function name

void HAL_I2C_ListenCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Listen Complete callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_MemTxCpltCallback

Function name

void HAL_I2C_MemTxCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Memory Tx Transfer completed callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_MemRxCpltCallback

Function name

void HAL_I2C_MemRxCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

Memory Rx Transfer completed callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_ErrorCallback

Function name

void HAL_I2C_ErrorCallback (I2C_HandleTypeDef * hi2c)

Function description

I2C error callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_AbortCpltCallback

Function name

void HAL_I2C_AbortCpltCallback (I2C_HandleTypeDef * hi2c)

Function description

I2C abort callback.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **None:**

HAL_I2C_GetState

Function name

HAL_I2C_StateTypeDef HAL_I2C_GetState (I2C_HandleTypeDef * hi2c)

Function description

Return the I2C handle state.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **HAL:** state

`HAL_I2C_GetMode`

Function name

HAL_I2C_ModeTypeDef HAL_I2C_GetMode (I2C_HandleTypeDef * hi2c)

Function description

Returns the I2C Master, Slave, Memory or no mode.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for I2C module

Return values

- **HAL:** mode

`HAL_I2C_GetError`

Function name

uint32_t HAL_I2C_GetError (I2C_HandleTypeDef * hi2c)

Function description

Return the I2C error code.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2C.

Return values

- **I2C:** Error Code

36.3 I2C Firmware driver defines

The following section lists the various define and macros of the module.

36.3.1 I2C

I2C

I2C Addressing Mode

I2C_ADDRESSINGMODE_7BIT

I2C_ADDRESSINGMODE_10BIT

I2C Dual Addressing Mode

I2C_DUALADDRESS_DISABLE

I2C_DUALADDRESS_ENABLE

I2C Error Code definition

HAL_I2C_ERROR_NONE

No error

HAL_I2C_ERROR_BERR

BERR error

HAL_I2C_ERROR_ARLO

ARLO error

HAL_I2C_ERROR_AF

ACKF error

HAL_I2C_ERROR_OVR

OVR error

HAL_I2C_ERROR_DMA

DMA transfer error

HAL_I2C_ERROR_TIMEOUT

Timeout error

HAL_I2C_ERROR_SIZE

Size Management error

HAL_I2C_ERROR_DMA_PARAM

DMA Parameter Error

HAL_I2C_ERROR_INVALID_PARAM

Invalid Parameters error

I2C Exported Macros

__HAL_I2C_RESET_HANDLE_STATE

Description:

- Reset I2C handle state.

Parameters:

- __HANDLE__: specifies the I2C Handle.

Return value:

- None

__HAL_I2C_ENABLE_IT

Description:

- Enable the specified I2C interrupt.

Parameters:

- __HANDLE__: specifies the I2C Handle.
- __INTERRUPT__: specifies the interrupt source to enable. This parameter can be one of the following values:
  - I2C_IT_ERRI Errors interrupt enable
  - I2C_IT_TCI Transfer complete interrupt enable
  - I2C_IT_STOPI STOP detection interrupt enable
  - I2C_IT_NACKI NACK received interrupt enable
  - I2C_IT_ADDRI Address match interrupt enable
  - I2C_IT_RXI RX interrupt enable
  - I2C_IT_TXI TX interrupt enable

Return value:

- None

__HAL_I2C_DISABLE_IT

Description:

- Disable the specified I2C interrupt.

Parameters:

- __HANDLE__: specifies the I2C Handle.
- __INTERRUPT__: specifies the interrupt source to disable. This parameter can be one of the following values:
  - I2C_IT_ERRI Errors interrupt enable
  - I2C_IT_TCI Transfer complete interrupt enable
  - I2C_IT_STOPI STOP detection interrupt enable
  - I2C_IT_NACKI NACK received interrupt enable
  - I2C_IT_ADDRI Address match interrupt enable
  - I2C_IT_RXI RX interrupt enable
  - I2C_IT_TXI TX interrupt enable

Return value:

- None

__HAL_I2C_GET_IT_SOURCE

Description:

- Check whether the specified I2C interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the I2C Handle.
- __INTERRUPT__: specifies the I2C interrupt source to check. This parameter can be one of the following values:
  - I2C_IT_ERRI Errors interrupt enable
  - I2C_IT_TCI Transfer complete interrupt enable
  - I2C_IT_STOPI STOP detection interrupt enable
  - I2C_IT_NACKI NACK received interrupt enable
  - I2C_IT_ADDRI Address match interrupt enable
  - I2C_IT_RXI RX interrupt enable
  - I2C_IT_TXI TX interrupt enable

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

I2C_FLAG_MASK

Description:

- Check whether the specified I2C flag is set or not.

Parameters:

- __HANDLE__: specifies the I2C Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - I2C_FLAG_TXE Transmit data register empty
  - I2C_FLAG_TXIS Transmit interrupt status
  - I2C_FLAG_RXNE Receive data register not empty
  - I2C_FLAG_ADDR Address matched (slave mode)
  - I2C_FLAG_AF Acknowledge failure received flag
  - I2C_FLAG_STOPF STOP detection flag
  - I2C_FLAG_TC Transfer complete (master mode)
  - I2C_FLAG_TCR Transfer complete reload
  - I2C_FLAG_BERR Bus error
  - I2C_FLAG_ARLO Arbitration lost
  - I2C_FLAG_OVR Overrun/Underrun
  - I2C_FLAG_PECERR PEC error in reception
  - I2C_FLAG_TIMEOUT Timeout or Tlow detection flag
  - I2C_FLAG_ALERT SMBus alert
  - I2C_FLAG_BUSY Bus busy
  - I2C_FLAG_DIR Transfer direction (slave mode)

Return value:

- The: new state of __FLAG__ (SET or RESET).

__HAL_I2C_GET_FLAG

__HAL_I2C_CLEAR_FLAG

Description:

- Clear the I2C pending flags which are cleared by writing 1 in a specific bit.

Parameters:

- __HANDLE__: specifies the I2C Handle.
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - I2C_FLAG_TXE Transmit data register empty
  - I2C_FLAG_ADDR Address matched (slave mode)
  - I2C_FLAG_AF Acknowledge failure received flag
  - I2C_FLAG_STOPF STOP detection flag
  - I2C_FLAG_BERR Bus error
  - I2C_FLAG_ARLO Arbitration lost
  - I2C_FLAG_OVR Overrun/Underrun
  - I2C_FLAG_PECERR PEC error in reception
  - I2C_FLAG_TIMEOUT Timeout or Tlow detection flag
  - I2C_FLAG_ALERT SMBus alert

Return value:

- None

__HAL_I2C_ENABLE

Description:

- Enable the specified I2C peripheral.

Parameters:

- __HANDLE__: specifies the I2C Handle.

Return value:

- None

__HAL_I2C_DISABLE

Description:

- Disable the specified I2C peripheral.

Parameters:

- __HANDLE__: specifies the I2C Handle.

Return value:

- None

__HAL_I2C_GENERATE_NACK

Description:

- Generate a Non-Acknowledge I2C peripheral in Slave mode.

Parameters:

- __HANDLE__: specifies the I2C Handle.

Return value:

- None

I2C Flag definition

I2C_FLAG_TXE

I2C_FLAG_TXIS

I2C_FLAG_RXNE

I2C_FLAG_ADDR

I2C_FLAG_AF

I2C_FLAG_STOPF

I2C_FLAG_TC

I2C_FLAG_TCR

I2C_FLAG_BERR

I2C_FLAG_ARLO

I2C_FLAG_OVR

I2C_FLAG_PECERR

I2C_FLAG_TIMEOUT

I2C_FLAG_ALERT

I2C_FLAG_BUSY

I2C_FLAG_DIR

I2C General Call Addressing Mode

I2C_GENERALCALL_DISABLE

I2C_GENERALCALL_ENABLE

I2C Interrupt configuration definition

I2C_IT_ERRI

I2C_IT_TCI

I2C_IT_STOPI

I2C_IT_NACKI

I2C_IT_ADDRI

I2C_IT_RXI

I2C_IT_TXI

I2C Memory Address Size

I2C_MEMADD_SIZE_8BIT

I2C_MEMADD_SIZE_16BIT

I2C No-Stretch Mode

I2C_NOSTRETCH_DISABLE

I2C_NOSTRETCH_ENABLE

I2C Own Address2 Masks

I2C_OA2_NOMASK

I2C_OA2_MASK01

I2C_OA2_MASK02

I2C_OA2_MASK03

I2C_OA2_MASK04

I2C_OA2_MASK05

I2C_OA2_MASK06

I2C_OA2_MASK07

I2C Reload End Mode

I2C_RELOAD_MODE

I2C_AUTOEND_MODE

I2C_SOFTEND_MODE

I2C Start or Stop Mode

I2C_NO_STARTSTOP

I2C_GENERATE_STOP

I2C_GENERATE_START_READ

I2C_GENERATE_START_WRITE

I2C Transfer Direction Master Point of View

I2C_DIRECTION_TRANSMIT

I2C_DIRECTION_RECEIVE

I2C Sequential Transfer Options

I2C_FIRST_FRAME

I2C_FIRST_AND_NEXT_FRAME

I2C_NEXT_FRAME

I2C_FIRST_AND_LAST_FRAME

I2C_LAST_FRAME

I2C_LAST_FRAME_NO_STOP

I2C_OTHER_FRAME

I2C_OTHER_AND_LAST_FRAME

37 HAL I2C Extension Driver

37.1 I2CEx Firmware driver API description

The following section lists the various functions of the I2CEx library.

37.1.1 I2C peripheral Extended features

Comparing to other previous devices, the I2C interface for STM32L4xx devices contains the following additional features

- Possibility to disable or enable Analog Noise Filter
- Use of a configured Digital Noise Filter
- Disable or enable wakeup from Stop mode(s)
- Disable or enable Fast Mode Plus

37.1.2 How to use this driver

This driver provides functions to configure Noise Filter and Wake Up Feature

1. Configure I2C Analog noise filter using the function HAL_I2CEx_ConfigAnalogFilter()
2. Configure I2C Digital noise filter using the function HAL_I2CEx_ConfigDigitalFilter()
3. Configure the enable or disable of I2C Wake Up Mode using the functions :
   - HAL_I2CEx_EnableWakeUp()
   - HAL_I2CEx_DisableWakeUp()
4. Configure the enable or disable of fast mode plus driving capability using the functions :
   - HAL_I2CEx_EnableFastModePlus()
   - HAL_I2CEx_DisableFastModePlus()

37.1.3 Extended features functions

This section provides functions allowing to:

- Configure Noise Filters
- Configure Wake Up Feature
- Configure Fast Mode Plus

This section contains the following APIs:

- ***HAL_I2CEx_ConfigAnalogFilter***
- ***HAL_I2CEx_ConfigDigitalFilter***
- ***HAL_I2CEx_EnableWakeUp***
- ***HAL_I2CEx_DisableWakeUp***
- ***HAL_I2CEx_EnableFastModePlus***
- ***HAL_I2CEx_DisableFastModePlus***

37.1.4 Detailed description of functions

`HAL_I2CEx_ConfigAnalogFilter`

Function name

HAL_StatusTypeDef HAL_I2CEx_ConfigAnalogFilter (I2C_HandleTypeDef * hi2c, uint32_t AnalogFilter)

Function description

Configure I2C Analog noise filter.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2Cx peripheral.
- **AnalogFilter:** New state of the Analog filter.

Return values

- **HAL:** status

`HAL_I2CEx_ConfigDigitalFilter`

Function name

HAL_StatusTypeDef HAL_I2CEx_ConfigDigitalFilter (I2C_HandleTypeDef * hi2c, uint32_t DigitalFilter)

Function description

Configure I2C Digital noise filter.

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2Cx peripheral.
- **DigitalFilter:** Coefficient of digital noise filter between Min_Data=0x00 and Max_Data=0x0F.

Return values

- **HAL:** status

`HAL_I2CEx_EnableWakeUp`

Function name

HAL_StatusTypeDef HAL_I2CEx_EnableWakeUp (I2C_HandleTypeDef * hi2c)

Function description

Enable I2C wakeup from Stop mode(s).

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2Cx peripheral.

Return values

- **HAL:** status

`HAL_I2CEx_DisableWakeUp`

Function name

HAL_StatusTypeDef HAL_I2CEx_DisableWakeUp (I2C_HandleTypeDef * hi2c)

Function description

Disable I2C wakeup from Stop mode(s).

Parameters

- **hi2c:** Pointer to a I2C_HandleTypeDef structure that contains the configuration information for the specified I2Cx peripheral.

Return values

- **HAL:** status

HAL_I2CEx_EnableFastModePlus

Function name

void HAL_I2CEx_EnableFastModePlus (uint32_t ConfigFastModePlus)

Function description

Enable the I2C fast mode plus driving capability.

Parameters

- **ConfigFastModePlus:** Selects the pin. This parameter can be one of the I2C Extended Fast Mode Plus values

Return values

- **None:**

Notes

- For I2C1, fast mode plus driving capability can be enabled on all selected I2C1 pins using I2C_FASTMODEPLUS_I2C1 parameter or independently on each one of the following pins PB6, PB7, PB8 and PB9.
- For remaining I2C1 pins (PA14, PA15...) fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C1 parameter.
- For all I2C2 pins fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C2 parameter.
- For all I2C3 pins fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C3 parameter.
- For all I2C4 pins fast mode plus driving capability can be enabled only by using I2C_FASTMODEPLUS_I2C4 parameter.

HAL_I2CEx_DisableFastModePlus

Function name

void HAL_I2CEx_DisableFastModePlus (uint32_t ConfigFastModePlus)

Function description

Disable the I2C fast mode plus driving capability.

Parameters

- **ConfigFastModePlus:** Selects the pin. This parameter can be one of the I2C Extended Fast Mode Plus values

Return values

- **None:**

Notes

- For I2C1, fast mode plus driving capability can be disabled on all selected I2C1 pins using I2C_FASTMODEPLUS_I2C1 parameter or independently on each one of the following pins PB6, PB7, PB8 and PB9.
- For remaining I2C1 pins (PA14, PA15...) fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C1 parameter.
- For all I2C2 pins fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C2 parameter.
- For all I2C3 pins fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C3 parameter.
- For all I2C4 pins fast mode plus driving capability can be disabled only by using I2C_FASTMODEPLUS_I2C4 parameter.

37.2 I2CEx Firmware driver defines

The following section lists the various define and macros of the module.

37.2.1 I2CEx

I2CEx

I2C Extended Analog Filter

I2C_ANALOGFILTER_ENABLE

I2C_ANALOGFILTER_DISABLE

I2C Extended Fast Mode Plus

I2C_FMP_NOT_SUPPORTED

Fast Mode Plus not supported

I2C_FASTMODEPLUS_PB6

Enable Fast Mode Plus on PB6

I2C_FASTMODEPLUS_PB7

Enable Fast Mode Plus on PB7

I2C_FASTMODEPLUS_PB8

Enable Fast Mode Plus on PB8

I2C_FASTMODEPLUS_PB9

Enable Fast Mode Plus on PB9

I2C_FASTMODEPLUS_I2C1

Enable Fast Mode Plus on I2C1 pins

I2C_FASTMODEPLUS_I2C2

Enable Fast Mode Plus on I2C2 pins

I2C_FASTMODEPLUS_I2C3

Enable Fast Mode Plus on I2C3 pins

I2C_FASTMODEPLUS_I2C4

Enable Fast Mode Plus on I2C4 pins

38 HAL IRDA Generic Driver

38.1 IRDA Firmware driver registers structures

38.1.1 IRDA_InitTypeDef

IRDA_InitTypeDef is defined in the stm32l4xx_hal_irda.h

Data Fields

- ***uint32_t BaudRate***
- ***uint32_t WordLength***
- ***uint32_t Parity***
- ***uint32_t Mode***
- ***uint8_t Prescaler***
- ***uint16_t PowerMode***
- ***uint32_t ClockPrescaler***

Field Documentation

- ***uint32_t IRDA_InitTypeDef::BaudRate***

  This member configures the IRDA communication baud rate. The baud rate register is computed using the following formula: Baud Rate Register = ((usart_ker_ckpres) / ((hirda->Init.BaudRate))) where usart_ker_ckpres is the IRDA input clock divided by a prescaler
- ***uint32_t IRDA_InitTypeDef::WordLength***

  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of *IRDAEx_Word_Length*
- ***uint32_t IRDA_InitTypeDef::Parity***

  Specifies the parity mode. This parameter can be a value of *IRDA_Parity*

  Note:

  – When parity is enabled, the computed parity is inserted at the MSB position of the transmitted data (9th bit when the word length is set to 9 data bits; 8th bit when the word length is set to 8 data bits).
- ***uint32_t IRDA_InitTypeDef::Mode***

  Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of *IRDA_Transfer_Mode*
- ***uint8_t IRDA_InitTypeDef::Prescaler***

  Specifies the Prescaler value for dividing the UART/USART source clock to achieve low-power frequency.

  Note:

  – Prescaler value 0 is forbidden
- ***uint16_t IRDA_InitTypeDef::PowerMode***

  Specifies the IRDA power mode. This parameter can be a value of *IRDA_Low_Power*
- ***uint32_t IRDA_InitTypeDef::ClockPrescaler***

  Specifies the prescaler value used to divide the IRDA clock source. This parameter can be a value of *IRDA_ClockPrescaler*.

38.1.2 IRDA_HandleTypeDef

IRDA_HandleTypeDef is defined in the stm32l4xx_hal_irda.h

Data Fields

- ***USART_TypeDef * Instance***
- ***IRDA_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***

- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint16_t Mask***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_IRDA_StateTypeDef gState***
- ***__IO HAL_IRDA_StateTypeDef RxState***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* IRDA_HandleTypeDef::Instance***
  USART registers base address
- ***IRDA_InitTypeDef IRDA_HandleTypeDef::Init***
  IRDA communication parameters
- ***uint8_t* IRDA_HandleTypeDef::pTxBuffPtr***
  Pointer to IRDA Tx transfer Buffer
- ***uint16_t IRDA_HandleTypeDef::TxXferSize***
  IRDA Tx Transfer size
- ***__IO uint16_t IRDA_HandleTypeDef::TxXferCount***
  IRDA Tx Transfer Counter
- ***uint8_t* IRDA_HandleTypeDef::pRxBuffPtr***
  Pointer to IRDA Rx transfer Buffer
- ***uint16_t IRDA_HandleTypeDef::RxXferSize***
  IRDA Rx Transfer size
- ***__IO uint16_t IRDA_HandleTypeDef::RxXferCount***
  IRDA Rx Transfer Counter
- ***uint16_t IRDA_HandleTypeDef::Mask***
  USART RX RDR register mask
- ***DMA_HandleTypeDef* IRDA_HandleTypeDef::hdmatx***
  IRDA Tx DMA Handle parameters
- ***DMA_HandleTypeDef* IRDA_HandleTypeDef::hdmarx***
  IRDA Rx DMA Handle parameters
- ***HAL_LockTypeDef IRDA_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_IRDA_StateTypeDef IRDA_HandleTypeDef::gState***
  IRDA state information related to global Handle management and also related to Tx operations. This parameter can be a value of **HAL_IRDA_StateTypeDef**
- ***__IO HAL_IRDA_StateTypeDef IRDA_HandleTypeDef::RxState***
  IRDA state information related to Rx operations. This parameter can be a value of **HAL_IRDA_StateTypeDef**
- ***__IO uint32_t IRDA_HandleTypeDef::ErrorCode***
  IRDA Error code

38.2 IRDA Firmware driver API description

The following section lists the various functions of the IRDA library.

38.2.1 How to use this driver

The IRDA HAL driver can be used as follows:

1. Declare a IRDA_HandleTypeDef handle structure (eg. IRDA_HandleTypeDef hirda).
2. Initialize the IRDA low level resources by implementing the HAL_IRDA_MspInit() API in setting the associated USART or UART in IRDA mode:
   - Enable the USARTx/UARTx interface clock.
   - USARTx/UARTx pins configuration:
     - Enable the clock for the USARTx/UARTx GPIOs.
     - Configure these USARTx/UARTx pins (TX as alternate function pull-up, RX as alternate function Input).
   - NVIC configuration if you need to use interrupt process (HAL_IRDA_Transmit_IT() and HAL_IRDA_Receive_IT() APIs):
     - Configure the USARTx/UARTx interrupt priority.
     - Enable the NVIC USARTx/UARTx IRQ handle.
     - The specific IRDA interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_IRDA_ENABLE_IT() and __HAL_IRDA_DISABLE_IT() inside the transmit and receive process.
   - DMA Configuration if you need to use DMA process (HAL_IRDA_Transmit_DMA() and HAL_IRDA_Receive_DMA() APIs):
     - Declare a DMA handle structure for the Tx/Rx channel.
     - Enable the DMAx interface clock.
     - Configure the declared DMA handle structure with the required Tx/Rx parameters.
     - Configure the DMA Tx/Rx channel.
     - Associate the initialized DMA handle to the IRDA DMA Tx/Rx handle.
     - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx channel.
3. Program the Baud Rate, Word Length and Parity and Mode(Receiver/Transmitter), the normal or low power mode and the clock prescaler in the hirda handle Init structure.
4. Initialize the IRDA registers by calling the HAL_IRDA_Init() API:
   - This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_IRDA_MspInit() API.

Note: The specific IRDA interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_IRDA_ENABLE_IT() and __HAL_IRDA_DISABLE_IT() inside the transmit and receive process.

5. Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_IRDA_Transmit()
- Receive an amount of data in blocking mode using HAL_IRDA_Receive()

Interrupt mode IO operation

- Send an amount of data in non-blocking mode using HAL_IRDA_Transmit_IT()
- At transmission end of transfer HAL_IRDA_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_IRDA_TxCpltCallback()
- Receive an amount of data in non-blocking mode using HAL_IRDA_Receive_IT()
- At reception end of transfer HAL_IRDA_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_IRDA_RxCpltCallback()
- In case of transfer Error, HAL_IRDA_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_IRDA_ErrorCallback()

DMA mode IO operation

- Send an amount of data in non-blocking mode (DMA) using HAL_IRDA_Transmit_DMA()
- At transmission half of transfer HAL_IRDA_TxHalfCpltCallback() is executed and user can add his own code by customization of function pointer HAL_IRDA_TxHalfCpltCallback()

- At transmission end of transfer HAL_IRDA_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_IRDA_TxCpltCallback()
- Receive an amount of data in non-blocking mode (DMA) using HAL_IRDA_Receive_DMA()
- At reception half of transfer HAL_IRDA_RxHalfCpltCallback() is executed and user can add his own code by customization of function pointer HAL_IRDA_RxHalfCpltCallback()
- At reception end of transfer HAL_IRDA_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_IRDA_RxCpltCallback()
- In case of transfer Error, HAL_IRDA_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_IRDA_ErrorCallback()

IRDA HAL driver macros list

Below the list of most used macros in IRDA HAL driver.

- __HAL_IRDA_ENABLE: Enable the IRDA peripheral
- __HAL_IRDA_DISABLE: Disable the IRDA peripheral
- __HAL_IRDA_GET_FLAG : Check whether the specified IRDA flag is set or not
- __HAL_IRDA_CLEAR_FLAG : Clear the specified IRDA pending flag
- __HAL_IRDA_ENABLE_IT: Enable the specified IRDA interrupt
- __HAL_IRDA_DISABLE_IT: Disable the specified IRDA interrupt
- __HAL_IRDA_GET_IT_SOURCE: Check whether or not the specified IRDA interrupt is enabled

Note: You can refer to the IRDA HAL driver header file for more useful macros

38.2.2 Callback registration

The compilation define USE_HAL_IRDA_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_IRDA_RegisterCallback() to register a user callback. Function @ref HAL_IRDA_RegisterCallback() allows to register following callbacks:

- TxHalfCpltCallback : Tx Half Complete Callback.
- TxCpltCallback : Tx Complete Callback.
- RxHalfCpltCallback : Rx Half Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- AbortTransmitCpltCallback : Abort Transmit Complete Callback.
- AbortReceiveCpltCallback : Abort Receive Complete Callback.
- MspInitCallback : IRDA MspInit.
- MspDeInitCallback : IRDA MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_IRDA_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_IRDA_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- TxHalfCpltCallback : Tx Half Complete Callback.
- TxCpltCallback : Tx Complete Callback.
- RxHalfCpltCallback : Rx Half Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- AbortTransmitCpltCallback : Abort Transmit Complete Callback.
- AbortReceiveCpltCallback : Abort Receive Complete Callback.
- MspInitCallback : IRDA MspInit.
- MspDeInitCallback : IRDA MspDeInit.

By default, after the @ref HAL_IRDA_Init() and when the state is HAL_IRDA_STATE_RESET all callbacks are set to the corresponding weak (surcharged) functions: examples @ref HAL_IRDA_TxCpltCallback(), @ref HAL_IRDA_RxHalfCpltCallback(). Exception done for MspInit and MspDeInit functions that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_IRDA_Init() and @ref HAL_IRDA_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_IRDA_Init() and @ref HAL_IRDA_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_IRDA_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_IRDA_STATE_READY or HAL_IRDA_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_IRDA_RegisterCallback() before calling @ref HAL_IRDA_DeInit() or @ref HAL_IRDA_Init() function.

When The compilation define USE_HAL_IRDA_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and weak (surcharged) callbacks are used.

38.2.3 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx in asynchronous IRDA mode.

- For the asynchronous mode only these parameters can be configured:
  - Baud Rate
  - Word Length
  - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit.
  - Power mode
  - Prescaler setting
  - Receiver/transmitter modes

The HAL_IRDA_Init() API follows the USART asynchronous configuration procedures (details for the procedures are available in reference manual).

This section contains the following APIs:

- ***HAL_IRDA_Init***
- ***HAL_IRDA_DeInit***
- ***HAL_IRDA_MspInit***
- ***HAL_IRDA_MspDeInit***

38.2.4 IO operation functions

This subsection provides a set of functions allowing to manage the IRDA data transfers.

IrDA is a half duplex communication protocol. If the Transmitter is busy, any data on the IrDA receive line will be ignored by the IrDA decoder and if the Receiver is busy, data on the TX from the USART to IrDA will not be encoded by IrDA. While receiving data, transmission should be avoided as the data to be transmitted could be corrupted.

1. There are two modes of transfer:
   - Blocking mode: the communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
   - Non-Blocking mode: the communication is performed using Interrupts or DMA, these API's return the HAL status. The end of the data processing will be indicated through the dedicated IRDA IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_IRDA_TxCpltCallback(), HAL_IRDA_RxCpltCallback() user callbacks will be executed respectively at the end of the Transmit or Receive process The HAL_IRDA_ErrorCallback() user callback will be executed when a communication error is detected
2. Blocking mode APIs are :
   - HAL_IRDA_Transmit()
   - HAL_IRDA_Receive()

3. Non Blocking mode APIs with Interrupt are :
   – HAL_IRDA_Transmit_IT()
   – HAL_IRDA_Receive_IT()
   – HAL_IRDA_IRQHandler()
4. Non Blocking mode functions with DMA are :
   – HAL_IRDA_Transmit_DMA()
   – HAL_IRDA_Receive_DMA()
   – HAL_IRDA_DMAPause()
   – HAL_IRDA_DMAResume()
   – HAL_IRDA_DMAStop()
5. A set of Transfer Complete Callbacks are provided in Non Blocking mode:
   – HAL_IRDA_TxHalfCpltCallback()
   – HAL_IRDA_TxCpltCallback()
   – HAL_IRDA_RxHalfCpltCallback()
   – HAL_IRDA_RxCpltCallback()
   – HAL_IRDA_ErrorCallback()
6. Non-Blocking mode transfers could be aborted using Abort API's : (+) HAL_IRDA_Abort() (+) HAL_IRDA_AbortTransmit() (+) HAL_IRDA_AbortReceive() (+) HAL_IRDA_Abort_IT() (+) HAL_IRDA_AbortTransmit_IT() (+) HAL_IRDA_AbortReceive_IT()
7. For Abort services based on interrupts (HAL_IRDA_Abortxxx_IT), a set of Abort Complete Callbacks are provided: (+) HAL_IRDA_AbortCpltCallback() (+) HAL_IRDA_AbortTransmitCpltCallback() (+) HAL_IRDA_AbortReceiveCpltCallback()
8. In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows : (+) Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_IRDA_ErrorCallback() user callback is executed. Transfer is kept ongoing on IRDA side. If user wants to abort it, Abort services should be called by user. (+) Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Overrun Error In Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_IRDA_ErrorCallback() user callback is executed.

IrDA is a half duplex communication protocol. If the Transmitter is busy, any data on the IrDA receive line will be ignored by the IrDA decoder and if the Receiver is busy, data on the TX from the USART to IrDA will not be encoded by IrDA. While receiving data, transmission should be avoided as the data to be transmitted could be corrupted. (#) There are two modes of transfer: (++) Blocking mode: the communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer. (++) Non-Blocking mode: the communication is performed using Interrupts or DMA, these API's return the HAL status. The end of the data processing will be indicated through the dedicated IRDA IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_IRDA_TxCpltCallback(), HAL_IRDA_RxCpltCallback() user callbacks will be executed respectively at the end of the Transmit or Receive process The HAL_IRDA_ErrorCallback() user callback will be executed when a communication error is detected (#) Blocking mode APIs are : (++) HAL_IRDA_Transmit() (++) HAL_IRDA_Receive() (#) Non Blocking mode APIs with Interrupt are : (++) HAL_IRDA_Transmit_IT() (++) HAL_IRDA_Receive_IT() (++) HAL_IRDA_IRQHandler() (#) Non Blocking mode functions with DMA are : (++) HAL_IRDA_Transmit_DMA() (++) HAL_IRDA_Receive_DMA() (++) HAL_IRDA_DMAPause() (++) HAL_IRDA_DMAResume() (++) HAL_IRDA_DMAStop() (#) A set of Transfer Complete Callbacks are provided in Non Blocking mode: (++) HAL_IRDA_TxHalfCpltCallback() (++) HAL_IRDA_TxCpltCallback() (++) HAL_IRDA_RxHalfCpltCallback() (++) HAL_IRDA_RxCpltCallback() (++) HAL_IRDA_ErrorCallback() (#) Non-Blocking mode transfers could be aborted using Abort API's :

- HAL_IRDA_Abort()
- HAL_IRDA_AbortTransmit()
- HAL_IRDA_AbortReceive()
- HAL_IRDA_Abort_IT()
- HAL_IRDA_AbortTransmit_IT()
- HAL_IRDA_AbortReceive_IT() (#) For Abort services based on interrupts (HAL_IRDA_Abortxxx_IT), a set of Abort Complete Callbacks are provided:

- HAL_IRDA_AbortCpltCallback()
- HAL_IRDA_AbortTransmitCpltCallback()
- HAL_IRDA_AbortReceiveCpltCallback() (#) In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows :
- Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_IRDA_ErrorCallback() user callback is executed. Transfer is kept ongoing on IRDA side. If user wants to abort it, Abort services should be called by user.
- Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Overrun Error In Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_IRDA_ErrorCallback() user callback is executed.

This section contains the following APIs:

- ***HAL_IRDA_Transmit***
- ***HAL_IRDA_Receive***
- ***HAL_IRDA_Transmit_IT***
- ***HAL_IRDA_Receive_IT***
- ***HAL_IRDA_Transmit_DMA***
- ***HAL_IRDA_Receive_DMA***
- ***HAL_IRDA_DMAPause***
- ***HAL_IRDA_DMAResume***
- ***HAL_IRDA_DMAStop***
- ***HAL_IRDA_Abort***
- ***HAL_IRDA_AbortTransmit***
- ***HAL_IRDA_AbortReceive***
- ***HAL_IRDA_Abort_IT***
- ***HAL_IRDA_AbortTransmit_IT***
- ***HAL_IRDA_AbortReceive_IT***
- ***HAL_IRDA_IRQHandler***
- ***HAL_IRDA_TxCpltCallback***
- ***HAL_IRDA_TxHalfCpltCallback***
- ***HAL_IRDA_RxCpltCallback***
- ***HAL_IRDA_RxHalfCpltCallback***
- ***HAL_IRDA_ErrorCallback***
- ***HAL_IRDA_AbortCpltCallback***
- ***HAL_IRDA_AbortTransmitCpltCallback***
- ***HAL_IRDA_AbortReceiveCpltCallback***

38.2.5 Peripheral State and Error functions

This subsection provides a set of functions allowing to return the State of IrDA communication process and also return Peripheral Errors occurred during communication process

- HAL_IRDA_GetState() API can be helpful to check in run-time the state of the IRDA peripheral handle.
- HAL_IRDA_GetError() checks in run-time errors that could occur during communication.

This section contains the following APIs:

- ***HAL_IRDA_GetState***
- ***HAL_IRDA_GetError***

38.2.6 Detailed description of functions

`HAL_IRDA_Init`

Function name

HAL_StatusTypeDef HAL_IRDA_Init (IRDA_HandleTypeDef * hirda)

Function description

Initialize the IRDA mode according to the specified parameters in the IRDA_InitTypeDef and initialize the associated handle.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **HAL:** status

`HAL_IRDA_DeInit`

Function name

HAL_StatusTypeDef HAL_IRDA_DeInit (IRDA_HandleTypeDef * hirda)

Function description

DeInitialize the IRDA peripheral.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **HAL:** status

`HAL_IRDA_MspInit`

Function name

void HAL_IRDA_MspInit (IRDA_HandleTypeDef * hirda)

Function description

Initialize the IRDA MSP.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

`HAL_IRDA_MspDeInit`

Function name

void HAL_IRDA_MspDeInit (IRDA_HandleTypeDef * hirda)

Function description

DeInitialize the IRDA MSP.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_Transmit

Function name

HAL_StatusTypeDef HAL_IRDA_Transmit (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Send an amount of data in blocking mode.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
- **pData:** Pointer to data buffer.
- **Size:** Amount of data to be sent.
- **Timeout:** Specify timeout value.

Return values

- **HAL:** status

HAL_IRDA_Receive

Function name

HAL_StatusTypeDef HAL_IRDA_Receive (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
- **pData:** Pointer to data buffer.
- **Size:** Amount of data to be received.
- **Timeout:** Specify timeout value.

Return values

- **HAL:** status

HAL_IRDA_Transmit_IT

Function name

HAL_StatusTypeDef HAL_IRDA_Transmit_IT (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)

Function description

Send an amount of data in interrupt mode.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
- **pData:** Pointer to data buffer.
- **Size:** Amount of data to be sent.

Return values

- **HAL:** status

HAL_IRDA_Receive_IT

Function name

HAL_StatusTypeDef HAL_IRDA_Receive_IT (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in interrupt mode.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
- **pData:** Pointer to data buffer.
- **Size:** Amount of data to be received.

Return values

- **HAL:** status

HAL_IRDA_Transmit_DMA

Function name

HAL_StatusTypeDef HAL_IRDA_Transmit_DMA (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)

Function description

Send an amount of data in DMA mode.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be sent.

Return values

- **HAL:** status

HAL_IRDA_Receive_DMA

Function name

HAL_StatusTypeDef HAL_IRDA_Receive_DMA (IRDA_HandleTypeDef * hirda, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in DMA mode.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.
- **pData:** Pointer to data buffer.
- **Size:** Amount of data to be received.

Return values

- **HAL:** status

Notes

- When the IRDA parity is enabled (PCE = 1), the received data contains the parity bit (MSB position).

`HAL_IRDA_DMAPause`

Function name

HAL_StatusTypeDef HAL_IRDA_DMAPause (IRDA_HandleTypeDef * hirda)

Function description

Pause the DMA Transfer.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **HAL:** status

`HAL_IRDA_DMAResume`

Function name

HAL_StatusTypeDef HAL_IRDA_DMAResume (IRDA_HandleTypeDef * hirda)

Function description

Resume the DMA Transfer.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

`HAL_IRDA_DMAStop`

Function name

HAL_StatusTypeDef HAL_IRDA_DMAStop (IRDA_HandleTypeDef * hirda)

Function description

Stop the DMA Transfer.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

`HAL_IRDA_Abort`

Function name

HAL_StatusTypeDef HAL_IRDA_Abort (IRDA_HandleTypeDef * hirda)

Function description

Abort ongoing transfers (blocking mode).

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_IRDA_AbortTransmit`

Function name

HAL_StatusTypeDef HAL_IRDA_AbortTransmit (IRDA_HandleTypeDef * hirda)

Function description

Abort ongoing Transmit transfer (blocking mode).

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_IRDA_AbortReceive`

Function name

HAL_StatusTypeDef HAL_IRDA_AbortReceive (IRDA_HandleTypeDef * hirda)

Function description

Abort ongoing Receive transfer (blocking mode).

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_IRDA_Abort_IT`

Function name

HAL_StatusTypeDef HAL_IRDA_Abort_IT (IRDA_HandleTypeDef * hirda)

Function description

Abort ongoing transfers (Interrupt mode).

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

`HAL_IRDA_AbortTransmit_IT`

Function name

HAL_StatusTypeDef HAL_IRDA_AbortTransmit_IT (IRDA_HandleTypeDef * hirda)

Function description

Abort ongoing Transmit transfer (Interrupt mode).

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_IRDA_AbortReceive_IT

Function name

HAL_StatusTypeDef HAL_IRDA_AbortReceive_IT (IRDA_HandleTypeDef * hirda)

Function description

Abort ongoing Receive transfer (Interrupt mode).

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable IRDA Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_IRDA_IRQHandler

Function name

void HAL_IRDA_IRQHandler (IRDA_HandleTypeDef * hirda)

Function description

Handle IRDA interrupt request.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_TxCpltCallback

Function name

void HAL_IRDA_TxCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

Tx Transfer completed callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_RxCpltCallback

Function name

void HAL_IRDA_RxCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

Rx Transfer completed callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_TxHalfCpltCallback

Function name

void HAL_IRDA_TxHalfCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

Tx Half Transfer completed callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values

- **None:**

HAL_IRDA_RxHalfCpltCallback

Function name

void HAL_IRDA_RxHalfCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

Rx Half Transfer complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_ErrorCallback

Function name

void HAL_IRDA_ErrorCallback (IRDA_HandleTypeDef * hirda)

Function description

IRDA error callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_AbortCpltCallback

Function name

void HAL_IRDA_AbortCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

IRDA Abort Complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_AbortTransmitCpltCallback

Function name

void HAL_IRDA_AbortTransmitCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

IRDA Abort Complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_AbortReceiveCpltCallback

Function name

void HAL_IRDA_AbortReceiveCpltCallback (IRDA_HandleTypeDef * hirda)

Function description

IRDA Abort Receive Complete callback.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **None:**

HAL_IRDA_GetState

Function name

HAL_IRDA_StateTypeDef HAL_IRDA_GetState (IRDA_HandleTypeDef * hirda)

Function description

Return the IRDA handle state.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **HAL:** state

`HAL_IRDA_GetError`

Function name

uint32_t HAL_IRDA_GetError (IRDA_HandleTypeDef * hirda)

Function description

Return the IRDA handle error code.

Parameters

- **hirda:** Pointer to a IRDA_HandleTypeDef structure that contains the configuration information for the specified IRDA module.

Return values

- **IRDA:** Error Code

38.3 IRDA Firmware driver defines

The following section lists the various define and macros of the module.

38.3.1 IRDA

IRDA

Clock Prescaler

IRDA_PRESCALER_DIV1

fclk_pres = fclk

IRDA_PRESCALER_DIV2

fclk_pres = fclk/2

IRDA_PRESCALER_DIV4

fclk_pres = fclk/4

IRDA_PRESCALER_DIV6

fclk_pres = fclk/6

IRDA_PRESCALER_DIV8

fclk_pres = fclk/8

IRDA_PRESCALER_DIV10

fclk_pres = fclk/10

IRDA_PRESCALER_DIV12

fclk_pres = fclk/12

IRDA_PRESCALER_DIV16

fclk_pres = fclk/16

IRDA_PRESCALER_DIV32

fclk_pres = fclk/32

IRDA_PRESCALER_DIV64

fclk_pres = fclk/64

IRDA_PRESCALER_DIV128

fclk_pres = fclk/128

IRDA_PRESCALER_DIV256

fclk_pres = fclk/256

IRDA DMA Rx

IRDA_DMA_RX_DISABLE

IRDA DMA RX disabled

IRDA_DMA_RX_ENABLE

IRDA DMA RX enabled

IRDA DMA Tx

IRDA_DMA_TX_DISABLE

IRDA DMA TX disabled

IRDA_DMA_TX_ENABLE

IRDA DMA TX enabled

IRDA Error Code Definition

HAL_IRDA_ERROR_NONE

No error

HAL_IRDA_ERROR_PE

Parity error

HAL_IRDA_ERROR_NE

Noise error

HAL_IRDA_ERROR_FE

frame error

HAL_IRDA_ERROR_ORE

Overrun error

HAL_IRDA_ERROR_DMA

DMA transfer error

HAL_IRDA_ERROR_BUSY

Busy Error

IRDA Exported Macros

__HAL_IRDA_RESET_HANDLE_STATE

Description:

- Reset IRDA handle state.

Parameters:

- __HANDLE__: IRDA handle.

Return value:

- None

__HAL_IRDA_FLUSH_DRREGISTER

Description:

- Flush the IRDA DR register.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_CLEAR_FLAG

Description:

- Clear the specified IRDA pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - IRDA_CLEAR_PEF
  - IRDA_CLEAR_FEF
  - IRDA_CLEAR_NEF
  - IRDA_CLEAR_OREF
  - IRDA_CLEAR_TCF
  - IRDA_CLEAR_IDLEF

Return value:

- None

__HAL_IRDA_CLEAR_PEFLAG

Description:

- Clear the IRDA PE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_CLEAR_FEFLAG

Description:

- Clear the IRDA FE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_CLEAR_NEFLAG

Description:

- Clear the IRDA NE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_CLEAR_OREFLAG

Description:

- Clear the IRDA ORE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_CLEAR_IDLEFLAG

Description:

- Clear the IRDA IDLE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_GET_FLAG

Description:

- Check whether the specified IRDA flag is set or not.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - IRDA_FLAG_REACK Receive enable acknowledge flag
  - IRDA_FLAG_TEACK Transmit enable acknowledge flag
  - IRDA_FLAG_BUSY Busy flag
  - IRDA_FLAG_ABRF Auto Baud rate detection flag
  - IRDA_FLAG_ABRE Auto Baud rate detection error flag
  - IRDA_FLAG_TXE Transmit data register empty flag
  - IRDA_FLAG_TC Transmission Complete flag
  - IRDA_FLAG_RXNE Receive data register not empty flag
  - IRDA_FLAG_ORE OverRun Error flag
  - IRDA_FLAG_NE Noise Error flag
  - IRDA_FLAG_FE Framing Error flag
  - IRDA_FLAG_PE Parity Error flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_IRDA_ENABLE_IT

Description:

- Enable the specified IRDA interrupt.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __INTERRUPT__: specifies the IRDA interrupt source to enable. This parameter can be one of the following values:
  - IRDA_IT_TXE Transmit Data Register empty interrupt
  - IRDA_IT_TC Transmission complete interrupt
  - IRDA_IT_RXNE Receive Data register not empty interrupt
  - IRDA_IT_IDLE Idle line detection interrupt
  - IRDA_IT_PE Parity Error interrupt
  - IRDA_IT_ERR Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

__HAL_IRDA_DISABLE_IT

Description:

- Disable the specified IRDA interrupt.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __INTERRUPT__: specifies the IRDA interrupt source to disable. This parameter can be one of the following values:
  - IRDA_IT_TXE Transmit Data Register empty interrupt
  - IRDA_IT_TC Transmission complete interrupt
  - IRDA_IT_RXNE Receive Data register not empty interrupt
  - IRDA_IT_IDLE Idle line detection interrupt
  - IRDA_IT_PE Parity Error interrupt
  - IRDA_IT_ERR Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

__HAL_IRDA_GET_IT

Description:

- Check whether the specified IRDA interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __INTERRUPT__: specifies the IRDA interrupt source to check. This parameter can be one of the following values:
  - IRDA_IT_TXE Transmit Data Register empty interrupt
  - IRDA_IT_TC Transmission complete interrupt
  - IRDA_IT_RXNE Receive Data register not empty interrupt
  - IRDA_IT_IDLE Idle line detection interrupt
  - IRDA_IT_ORE OverRun Error interrupt
  - IRDA_IT_NE Noise Error interrupt
  - IRDA_IT_FE Framing Error interrupt
  - IRDA_IT_PE Parity Error interrupt

Return value:

- The: new state of __IT__ (SET or RESET).

__HAL_IRDA_GET_IT_SOURCE

Description:

- Check whether the specified IRDA interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __INTERRUPT__: specifies the IRDA interrupt source to check. This parameter can be one of the following values:
  - IRDA_IT_TXE Transmit Data Register empty interrupt
  - IRDA_IT_TC Transmission complete interrupt
  - IRDA_IT_RXNE Receive Data register not empty interrupt
  - IRDA_IT_IDLE Idle line detection interrupt
  - IRDA_IT_ERR Framing, overrun or noise error interrupt
  - IRDA_IT_PE Parity Error interrupt

Return value:

- The: new state of __IT__ (SET or RESET).

__HAL_IRDA_CLEAR_IT

Description:

- Clear the specified IRDA ISR flag, in setting the proper ICR register flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __IT_CLEAR__: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt This parameter can be one of the following values:
  - IRDA_CLEAR_PEF Parity Error Clear Flag
  - IRDA_CLEAR_FEF Framing Error Clear Flag
  - IRDA_CLEAR_NEF Noise detected Clear Flag
  - IRDA_CLEAR_OREF OverRun Error Clear Flag
  - IRDA_CLEAR_TCF Transmission Complete Clear Flag

Return value:

- None

__HAL_IRDA_SEND_REQ

Description:

- Set a specific IRDA request flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle.
- __REQ__: specifies the request flag to set This parameter can be one of the following values:
  - IRDA_AUTOBAUD_REQUEST Auto-Baud Rate Request
  - IRDA_RXDATA_FLUSH_REQUEST Receive Data flush Request
  - IRDA_TXDATA_FLUSH_REQUEST Transmit data flush Request

Return value:

- None

__HAL_IRDA_ONE_BIT_SAMPLE_ENABLE

Description:

- Enable the IRDA one bit sample method.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_ONE_BIT_SAMPLE_DISABLE

Description:

- Disable the IRDA one bit sample method.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_ENABLE

Description:

- Enable UART/USART associated to IRDA Handle.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_DISABLE

Description:

- Disable UART/USART associated to IRDA Handle.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

IRDA Flags

IRDA_FLAG_REACK

IRDA receive enable acknowledge flag

IRDA_FLAG_TEACK

IRDA transmit enable acknowledge flag

IRDA_FLAG_BUSY

IRDA busy flag

IRDA_FLAG_ABRF

IRDA auto Baud rate flag

IRDA_FLAG_ABRE

IRDA auto Baud rate error

IRDA_FLAG_TXE

IRDA transmit data register empty

IRDA_FLAG_TC

IRDA transmission complete

IRDA_FLAG_RXNE

IRDA read data register not empty

IRDA_FLAG_ORE

IRDA overrun error

IRDA_FLAG_NE

IRDA noise error

IRDA_FLAG_FE

IRDA frame error

IRDA_FLAG_PE

IRDA parity error

IRDA interruptions flags mask

IRDA_IT_MASK

IRDA Interruptions flags mask

IRDA_CR_MASK

IRDA control register mask

IRDA_CR_POS

IRDA control register position

IRDA_ISR_MASK

IRDA ISR register mask

IRDA_ISR_POS

IRDA ISR register position

IRDA Interrupts Definition

IRDA_IT_PE

IRDA Parity error interruption

IRDA_IT_TXE

IRDA Transmit data register empty interruption

IRDA_IT_TC

IRDA Transmission complete interruption

IRDA_IT_RXNE

IRDA Read data register not empty interruption

IRDA_IT_IDLE

IRDA Idle interruption

IRDA_IT_ERR

IRDA Error interruption

IRDA_IT_ORE

IRDA Overrun error interruption

IRDA_IT_NE

IRDA Noise error interruption

IRDA_IT_FE

IRDA Frame error interruption

IRDA Interruption Clear Flags

IRDA_CLEAR_PEF

Parity Error Clear Flag

IRDA_CLEAR_FEF

Framing Error Clear Flag

IRDA_CLEAR_NEF

Noise Error detected Clear Flag

IRDA_CLEAR_OREF

OverRun Error Clear Flag

IRDA_CLEAR_IDLEF

IDLE line detected Clear Flag

IRDA_CLEAR_TCF

Transmission Complete Clear Flag

IRDA Low Power

IRDA_POWERMODE_NORMAL

IRDA normal power mode

IRDA_POWERMODE_LOWPOWER

IRDA low power mode

IRDA Mode

IRDA_MODE_DISABLE

Associated UART disabled in IRDA mode

IRDA_MODE_ENABLE

Associated UART enabled in IRDA mode

IRDA One Bit Sampling

IRDA_ONE_BIT_SAMPLE_DISABLE

One-bit sampling disabled

IRDA_ONE_BIT_SAMPLE_ENABLE

One-bit sampling enabled

IRDA Parity

IRDA_PARITY_NONE

No parity

IRDA_PARITY_EVEN

Even parity

IRDA_PARITY_ODD

Odd parity

IRDA Request Parameters

IRDA_AUTOBAUD_REQUEST

Auto-Baud Rate Request

IRDA_RXDATA_FLUSH_REQUEST

Receive Data flush Request

IRDA_TXDATA_FLUSH_REQUEST

Transmit data flush Request

IRDA State

IRDA_STATE_DISABLE

IRDA disabled

IRDA_STATE_ENABLE

IRDA enabled

IRDA State Code Definition

HAL_IRDA_STATE_RESET

Peripheral is not initialized Value is allowed for gState and RxState

HAL_IRDA_STATE_READY

Peripheral Initialized and ready for use Value is allowed for gState and RxState

HAL_IRDA_STATE_BUSY

An internal process is ongoing Value is allowed for gState only

HAL_IRDA_STATE_BUSY_TX

Data Transmission process is ongoing Value is allowed for gState only

HAL_IRDA_STATE_BUSY_RX

Data Reception process is ongoing Value is allowed for RxState only

HAL_IRDA_STATE_BUSY_TX_RX

Data Transmission and Reception process is ongoing Not to be used for neither gState nor RxState. Value is result of combination (Or) between gState and RxState values

HAL_IRDA_STATE_TIMEOUT

Timeout state Value is allowed for gState only

HAL_IRDA_STATE_ERROR

Error Value is allowed for gState only

IRDA Transfer Mode

IRDA_MODE_RX

RX mode

IRDA_MODE_TX

TX mode

IRDA_MODE_TX_RX

RX and TX mode

39 HAL IRDA Extension Driver

39.1 IRDAEx Firmware driver defines

The following section lists the various define and macros of the module.

39.1.1 IRDAEx

IRDAEx

IRDAEx Word Length

IRDA_WORDLENGTH_7B

7-bit long frame

IRDA_WORDLENGTH_8B

8-bit long frame

IRDA_WORDLENGTH_9B

9-bit long frame

40 HAL IWDG Generic Driver

40.1 IWDG Firmware driver registers structures

40.1.1 IWDG_InitTypeDef

IWDG_InitTypeDef is defined in the stm32l4xx_hal_iwdg.h

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t Reload***
- ***uint32_t Window***

Field Documentation

- ***uint32_t IWDG_InitTypeDef::Prescaler***
  Select the prescaler of the IWDG. This parameter can be a value of ***IWDG_Prescaler***
- ***uint32_t IWDG_InitTypeDef::Reload***
  Specifies the IWDG down-counter reload value. This parameter must be a number between Min_Data = 0 and Max_Data = 0x0FFF
- ***uint32_t IWDG_InitTypeDef::Window***
  Specifies the window value to be compared to the down-counter. This parameter must be a number between Min_Data = 0 and Max_Data = 0x0FFF

40.1.2 IWDG_HandleTypeDef

IWDG_HandleTypeDef is defined in the stm32l4xx_hal_iwdg.h

Data Fields

- ***IWDG_TypeDef * Instance***
- ***IWDG_InitTypeDef Init***

Field Documentation

- ***IWDG_TypeDef* IWDG_HandleTypeDef::Instance***
  Register base address
- ***IWDG_InitTypeDef IWDG_HandleTypeDef::Init***
  IWDG required parameters

40.2 IWDG Firmware driver API description

The following section lists the various functions of the IWDG library.

40.2.1 IWDG Generic features

- The IWDG can be started by either software or hardware (configurable through option byte).
- The IWDG is clocked by Low-Speed clock (LSI) and thus stays active even if the main clock fails.
- Once the IWDG is started, the LSI is forced ON and both can not be disabled. The counter starts counting down from the reset value (0xFFF). When it reaches the end of count value (0x000) a reset signal is generated (IWDG reset).
- Whenever the key value 0x0000 AAAA is written in the IWDG_KR register, the IWDG_RLR value is reloaded in the counter and the watchdog reset is prevented.
- The IWDG is implemented in the VDD voltage domain that is still functional in STOP and STANDBY mode (IWDG reset can wake-up from STANDBY). IWDGRST flag in RCC_CSR register can be used to inform when an IWDG reset occurs.
- Debug mode : When the microcontroller enters debug mode (core halted), the IWDG counter either continues to work normally or stops, depending on DBG_IWDG_STOP configuration bit in DBG module, accessible through __HAL_DBGMCU_FREEZE_IWDG() and __HAL_DBGMCU_UNFREEZE_IWDG() macros.

Min-max timeout value @32KHz (LSI): ~125us / ~32.7s The IWDG timeout may vary due to LSI frequency dispersion. STM32L4xx devices provide the capability to measure the LSI frequency (LSI clock connected internally to TIM16 CH1 input capture). The measured value can be used to have an IWDG timeout with an acceptable accuracy.

40.2.2 How to use this driver

1. Use IWDG using HAL_IWDG_Init() function to :
   - Enable instance by writing Start keyword in IWDG_KEY register. LSI clock is forced ON and IWDG counter starts counting down.
   - Enable write access to configuration registers: IWDG_PR, IWDG_RLR and IWDG_WINR.
   - Configure the IWDG prescaler and counter reload value. This reload value will be loaded in the IWDG counter each time the watchdog is reloaded, then the IWDG will start counting down from this value.
   - Wait for status flags to be reset.
   - Depending on window parameter:
     - If Window Init parameter is same as Window register value, nothing more is done but reload counter value in order to exit function with exact time base.
     - Else modify Window register. This will automatically reload watchdog counter.
2. Then the application program must refresh the IWDG counter at regular intervals during normal operation to prevent an MCU reset, using HAL_IWDG_Refresh() function.

IWDG HAL driver macros list

Below the list of most used macros in IWDG HAL driver:

- __HAL_IWDG_START: Enable the IWDG peripheral
- __HAL_IWDG_RELOAD_COUNTER: Reloads IWDG counter with value defined in the reload register

40.2.3 Initialization and Start functions

This section provides functions allowing to:

- Initialize the IWDG according to the specified parameters in the IWDG_InitTypeDef of associated handle.
- Manage Window option.
- Once initialization is performed in HAL_IWDG_Init function, Watchdog is reloaded in order to exit function with correct time base.

This section contains the following APIs:

- ***HAL_IWDG_Init***

40.2.4 IO operation functions

This section provides functions allowing to:

- Refresh the IWDG.

This section contains the following APIs:

- ***HAL_IWDG_Refresh***

40.2.5 Detailed description of functions

`HAL_IWDG_Init`

Function name

HAL_StatusTypeDef HAL_IWDG_Init (IWDG_HandleTypeDef * hiwdg)

Function description

Initialize the IWDG according to the specified parameters in the IWDG_InitTypeDef and start watchdog.

Parameters

- **hiwdg:** pointer to a IWDG_HandleTypeDef structure that contains the configuration information for the specified IWDG module.

Return values

- **HAL:** status

`HAL_IWDG_Refresh`

Function name

HAL_StatusTypeDef HAL_IWDG_Refresh (IWDG_HandleTypeDef * hiwdg)

Function description

Refresh the IWDG.

Parameters

- **hiwdg:** pointer to a IWDG_HandleTypeDef structure that contains the configuration information for the specified IWDG module.

Return values

- **HAL:** status

40.3 IWDG Firmware driver defines

The following section lists the various define and macros of the module.

40.3.1 IWDG

IWDG

IWDG Exported Macros

__HAL_IWDG_START

Description:

- Enable the IWDG peripheral.

Parameters:

- __HANDLE__: IWDG handle

Return value:

- None

__HAL_IWDG_RELOAD_COUNTER

Description:

- Reload IWDG counter with value defined in the reload register (write access to IWDG_PR, IWDG_RLR and IWDG_WINR registers disabled).

Parameters:

- __HANDLE__: IWDG handle

Return value:

- None

IWDG Prescaler

IWDG_PRESCALER_4

IWDG prescaler set to 4

IWDG_PRESCALER_8

IWDG prescaler set to 8

IWDG_PRESCALER_16

IWDG prescaler set to 16

IWDG_PRESCALER_32

IWDG prescaler set to 32

IWDG_PRESCALER_64

IWDG prescaler set to 64

IWDG_PRESCALER_128

IWDG prescaler set to 128

IWDG_PRESCALER_256

IWDG prescaler set to 256

IWDG Window option

IWDG_WINDOW_DISABLE

41 HAL LCD Generic Driver

41.1 LCD Firmware driver registers structures

41.1.1 LCD_InitTypeDef

LCD_InitTypeDef is defined in the stm32l4xx_hal_lcd.h

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t Divider***
- ***uint32_t Duty***
- ***uint32_t Bias***
- ***uint32_t VoltageSource***
- ***uint32_t Contrast***
- ***uint32_t DeadTime***
- ***uint32_t PulseOnDuration***
- ***uint32_t HighDrive***
- ***uint32_t BlinkMode***
- ***uint32_t BlinkFrequency***
- ***uint32_t MuxSegment***

Field Documentation

- ***uint32_t LCD_InitTypeDef::Prescaler***
  Configures the LCD Prescaler. This parameter can be one value of ***LCD_Prescaler***
- ***uint32_t LCD_InitTypeDef::Divider***
  Configures the LCD Divider. This parameter can be one value of ***LCD_Divider***
- ***uint32_t LCD_InitTypeDef::Duty***
  Configures the LCD Duty. This parameter can be one value of ***LCD_Duty***
- ***uint32_t LCD_InitTypeDef::Bias***
  Configures the LCD Bias. This parameter can be one value of ***LCD_Bias***
- ***uint32_t LCD_InitTypeDef::VoltageSource***
  Selects the LCD Voltage source. This parameter can be one value of ***LCD_Voltage_Source***
- ***uint32_t LCD_InitTypeDef::Contrast***
  Configures the LCD Contrast. This parameter can be one value of ***LCD_Contrast***
- ***uint32_t LCD_InitTypeDef::DeadTime***
  Configures the LCD Dead Time. This parameter can be one value of ***LCD_DeadTime***
- ***uint32_t LCD_InitTypeDef::PulseOnDuration***
  Configures the LCD Pulse On Duration. This parameter can be one value of ***LCD_PulseOnDuration***
- ***uint32_t LCD_InitTypeDef::HighDrive***
  Enable or disable the low resistance divider. This parameter can be one value of ***LCD_HighDrive***
- ***uint32_t LCD_InitTypeDef::BlinkMode***
  Configures the LCD Blink Mode. This parameter can be one value of ***LCD_BlinkMode***
- ***uint32_t LCD_InitTypeDef::BlinkFrequency***
  Configures the LCD Blink frequency. This parameter can be one value of ***LCD_BlinkFrequency***
- ***uint32_t LCD_InitTypeDef::MuxSegment***
  Enable or disable mux segment. This parameter can be one value of ***LCD_MuxSegment***

41.1.2 LCD_HandleTypeDef

LCD_HandleTypeDef is defined in the stm32l4xx_hal_lcd.h

Data Fields

- ***LCD_TypeDef * Instance***
- ***LCD_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_LCD_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***LCD_TypeDef* LCD_HandleTypeDef::Instance***
- ***LCD_InitTypeDef LCD_HandleTypeDef::Init***
- ***HAL_LockTypeDef LCD_HandleTypeDef::Lock***
- ***__IO HAL_LCD_StateTypeDef LCD_HandleTypeDef::State***
- ***__IO uint32_t LCD_HandleTypeDef::ErrorCode***

41.2 LCD Firmware driver API description

The following section lists the various functions of the LCD library.

41.2.1 How to use this driver

The LCD HAL driver can be used as follows:

1. Declare a LCD_HandleTypeDef handle structure.

Note: The frequency generator allows you to achieve various LCD frame rates starting from an LCD input clock frequency (LCDCLK) which can vary from 32 kHz up to 1 MHz.

2. Initialize the LCD low level resources by implementing the HAL_LCD_MspInit() API:
   - Enable the LCDCLK (same as RTCCLK): to configure the RTCCLK/LCDCLK, proceed as follows:
     - Use RCC function HAL_RCCEx_PeriphCLKConfig in indicating RCC_PERIPHCLK_LCD and selected clock source (HSE, LSI or LSE)
   - LCD pins configuration:
     - Enable the clock for the LCD GPIOs.
     - Configure these LCD pins as alternate function no-pull.
   - Enable the LCD interface clock.
3. Program the Prescaler, Divider, Blink mode, Blink Frequency Duty, Bias, Voltage Source, Dead Time, Pulse On Duration, Contrast, High drive and Multiplexer Segment in the Init structure of the LCD handle.
4. Initialize the LCD registers by calling the HAL_LCD_Init() API.

Note: The HAL_LCD_Init() API configures also the low level Hardware GPIO, CLOCK, ...etc) by calling the customized HAL_LCD_MspInit() API.

Note: After calling the HAL_LCD_Init() the LCD RAM memory is cleared

5. Optionally you can update the LCD configuration using these macros:
   - LCD High Drive using the __HAL_LCD_HIGHDRIVER_ENABLE() and __HAL_LCD_HIGHDRIVER_DISABLE() macros
   - Voltage output buffer using __HAL_LCD_VOLTAGE_BUFFER_ENABLE() and __HAL_LCD_VOLTAGE_BUFFER_DISABLE() macros
   - LCD Pulse ON Duration using the __HAL_LCD_PULSEONDURATION_CONFIG() macro
   - LCD Dead Time using the __HAL_LCD_DEADTIME_CONFIG() macro
   - The LCD Blink mode and frequency using the __HAL_LCD_BLINK_CONFIG() macro
   - The LCD Contrast using the __HAL_LCD_CONTRAST_CONFIG() macro
6. Write to the LCD RAM memory using the HAL_LCD_Write() API, this API can be called more time to update the different LCD RAM registers before calling HAL_LCD_UpdateDisplayRequest() API.
7. The HAL_LCD_Clear() API can be used to clear the LCD RAM memory.
8. When LCD RAM memory is updated enable the update display request using the HAL_LCD_UpdateDisplayRequest() API.

LCD and low power modes:

1. The LCD remain active during Sleep, Low Power run, Low Power Sleep and STOP modes.

41.2.2 Initialization and Configuration functions

This section contains the following APIs:

- *HAL_LCD_Init*
- *HAL_LCD_DeInit*
- *HAL_LCD_MspDeInit*
- *HAL_LCD_MspInit*

41.2.3 IO operation functions

Using its double buffer memory the LCD controller ensures the coherency of the displayed information without having to use interrupts to control LCD_RAM modification. The application software can access the first buffer level (LCD_RAM) through the APB interface. Once it has modified the LCD_RAM using the HAL_LCD_Write() API, it sets the UDR flag in the LCD_SR register using the HAL_LCD_UpdateDisplayRequest() API. This UDR flag (update display request) requests the updated information to be moved into the second buffer level (LCD_DISPLAY). This operation is done synchronously with the frame (at the beginning of the next frame), until the update is completed, the LCD_RAM is write protected and the UDR flag stays high. Once the update is completed another flag (UDD - Update Display Done) is set and generates an interrupt if the UDDIE bit in the LCD_FCR register is set. The time it takes to update LCD_DISPLAY is, in the worst case, one odd and one even frame. The update will not occur (UDR = 1 and UDD = 0) until the display is enabled (LCDEN = 1).

This section contains the following APIs:

- *HAL_LCD_Write*
- *HAL_LCD_Clear*
- *HAL_LCD_UpdateDisplayRequest*

41.2.4 Peripheral State functions

This subsection provides a set of functions allowing to control the LCD:

- HAL_LCD_GetState() API can be helpful to check in run-time the state of the LCD peripheral State.
- HAL_LCD_GetError() API to return the LCD error code.

This section contains the following APIs:

- *HAL_LCD_GetState*
- *HAL_LCD_GetError*

41.2.5 Detailed description of functions

HAL_LCD_DeInit

Function name **HAL_StatusTypeDef HAL_LCD_DeInit (LCD_HandleTypeDef * hlcd)**

Function description DeInitialize the LCD peripheral.

Parameters

- **hlcd:** LCD handle

Return values

- **HAL:** status

HAL_LCD_Init

Function name **HAL_StatusTypeDef HAL_LCD_Init (LCD_HandleTypeDef * hlcd)**

Function description Initialize the LCD peripheral according to the specified parameters in the LCD_InitStruct and initialize the associated handle.

Parameters	• **hlcd:** LCD handle
Return values	• **None:**
Notes	• This function can be used only when the LCD is disabled.

HAL_LCD_MspInit

Function name	**void HAL_LCD_MspInit (LCD_HandleTypeDef * hlcd)**
Function description	Initialize the LCD MSP.
Parameters	• **hlcd:** LCD handle
Return values	• **None:**

HAL_LCD_MspDeInit

Function name	**void HAL_LCD_MspDeInit (LCD_HandleTypeDef * hlcd)**
Function description	DeInitialize the LCD MSP.
Parameters	• **hlcd:** LCD handle
Return values	• **None:**

HAL_LCD_Write

Function name	**HAL_StatusTypeDef HAL_LCD_Write (LCD_HandleTypeDef * hlcd, uint32_t RAMRegisterIndex, uint32_t RAMRegisterMask, uint32_t Data)**
Function description	Write a word in the specific LCD RAM.

Parameters

- **hlcd:** LCD handle
- **RAMRegisterIndex:** specifies the LCD RAM Register. This parameter can be one of the following values:
  - LCD_RAM_REGISTER0: LCD RAM Register 0
  - LCD_RAM_REGISTER1: LCD RAM Register 1
  - LCD_RAM_REGISTER2: LCD RAM Register 2
  - LCD_RAM_REGISTER3: LCD RAM Register 3
  - LCD_RAM_REGISTER4: LCD RAM Register 4
  - LCD_RAM_REGISTER5: LCD RAM Register 5
  - LCD_RAM_REGISTER6: LCD RAM Register 6
  - LCD_RAM_REGISTER7: LCD RAM Register 7
  - LCD_RAM_REGISTER8: LCD RAM Register 8
  - LCD_RAM_REGISTER9: LCD RAM Register 9
  - LCD_RAM_REGISTER10: LCD RAM Register 10
  - LCD_RAM_REGISTER11: LCD RAM Register 11
  - LCD_RAM_REGISTER12: LCD RAM Register 12
  - LCD_RAM_REGISTER13: LCD RAM Register 13
  - LCD_RAM_REGISTER14: LCD RAM Register 14
  - LCD_RAM_REGISTER15: LCD RAM Register 15
- **RAMRegisterMask:** specifies the LCD RAM Register Data Mask.
- **Data:** specifies LCD Data Value to be written.

Return values

- **None:**

HAL_LCD_Clear

Function name **HAL_StatusTypeDef HAL_LCD_Clear (LCD_HandleTypeDef * hlcd)**

Function description Clear the LCD RAM registers.

Parameters

- **hlcd:** LCD handle

Return values

- **None:**

HAL_LCD_UpdateDisplayRequest

Function name **HAL_StatusTypeDef HAL_LCD_UpdateDisplayRequest (LCD_HandleTypeDef * hlcd)**

Function description Enable the Update Display Request.

Parameters

- **hlcd:** LCD handle

Return values

- **None:**

Notes

- Each time software modifies the LCD_RAM it must set the UDR bit to transfer the updated data to the second level buffer. The UDR bit stays set until the end of the update and during this time the LCD_RAM is write protected.
- When the display is disabled, the update is performed for all LCD_DISPLAY locations. When the display is enabled, the update is performed only for locations for which commons are active (depending on DUTY). For example if DUTY = 1/2, only the LCD_DISPLAY of COM0 and COM1 will be updated.

HAL_LCD_GetState

Function name **HAL_LCD_StateTypeDef HAL_LCD_GetState (LCD_HandleTypeDef * hlcd)**

Function description Return the LCD handle state.

Parameters
- **hlcd:** LCD handle

Return values
- **HAL:** state

HAL_LCD_GetError

Function name **uint32_t HAL_LCD_GetError (LCD_HandleTypeDef * hlcd)**

Function description Return the LCD error code.

Parameters
- **hlcd:** LCD handle

Return values
- **LCD:** Error Code

LCD_WaitForSynchro

Function name **HAL_StatusTypeDef LCD_WaitForSynchro (LCD_HandleTypeDef * hlcd)**

Function description Wait until the LCD FCR register is synchronized in the LCDCLK domain.

Return values
- **None:**

41.3 LCD Firmware driver defines

The following section lists the various define and macros of the module.

41.3.1 LCD

LCD

LCD Bias

LCD_BIAS_1_4 1/4 Bias

LCD_BIAS_1_2 1/2 Bias

LCD_BIAS_1_3 1/3 Bias

LCD Blink Frequency

LCD_BLINKFREQUENCY_DIV8 The Blink frequency = fLCD/8

LCD_BLINKFREQUENCY_DIV16 The Blink frequency = fLCD/16

LCD_BLINKFREQUENCY_DIV32 The Blink frequency = fLCD/32

LCD_BLINKFREQUENCY_DIV64	The Blink frequency = fLCD/64
LCD_BLINKFREQUENCY_DIV128	The Blink frequency = fLCD/128
LCD_BLINKFREQUENCY_DIV256	The Blink frequency = fLCD/256
LCD_BLINKFREQUENCY_DIV512	The Blink frequency = fLCD/512
LCD_BLINKFREQUENCY_DIV1024	The Blink frequency = fLCD/1024

LCD Blink Mode

LCD_BLINKMODE_OFF	Blink disabled
LCD_BLINKMODE_SEG0_COM0	Blink enabled on SEG[0], COM[0] (1 pixel)
LCD_BLINKMODE_SEG0_ALLCOM	Blink enabled on SEG[0], all COM (up to 8 pixels according to the programmed duty)
LCD_BLINKMODE_ALLSEG_ALLCOM	Blink enabled on all SEG and all COM (all pixels)

LCD Contrast

LCD_CONTRASTLEVEL_0	Maximum Voltage = 2.60V
LCD_CONTRASTLEVEL_1	Maximum Voltage = 2.73V
LCD_CONTRASTLEVEL_2	Maximum Voltage = 2.86V
LCD_CONTRASTLEVEL_3	Maximum Voltage = 2.99V
LCD_CONTRASTLEVEL_4	Maximum Voltage = 3.12V
LCD_CONTRASTLEVEL_5	Maximum Voltage = 3.26V
LCD_CONTRASTLEVEL_6	Maximum Voltage = 3.40V
LCD_CONTRASTLEVEL_7	Maximum Voltage = 3.55V

LCD Dead Time

LCD_DEADTIME_0	No dead Time
LCD_DEADTIME_1	One Phase between different couple of Frame
LCD_DEADTIME_2	Two Phase between different couple of Frame

LCD_DEADTIME_3	Three Phase between different couple of Frame
LCD_DEADTIME_4	Four Phase between different couple of Frame
LCD_DEADTIME_5	Five Phase between different couple of Frame
LCD_DEADTIME_6	Six Phase between different couple of Frame
LCD_DEADTIME_7	Seven Phase between different couple of Frame

LCD Divider

LCD_DIVIDER_16	LCD frequency = CLKPS/16
LCD_DIVIDER_17	LCD frequency = CLKPS/17
LCD_DIVIDER_18	LCD frequency = CLKPS/18
LCD_DIVIDER_19	LCD frequency = CLKPS/19
LCD_DIVIDER_20	LCD frequency = CLKPS/20
LCD_DIVIDER_21	LCD frequency = CLKPS/21
LCD_DIVIDER_22	LCD frequency = CLKPS/22
LCD_DIVIDER_23	LCD frequency = CLKPS/23
LCD_DIVIDER_24	LCD frequency = CLKPS/24
LCD_DIVIDER_25	LCD frequency = CLKPS/25
LCD_DIVIDER_26	LCD frequency = CLKPS/26
LCD_DIVIDER_27	LCD frequency = CLKPS/27
LCD_DIVIDER_28	LCD frequency = CLKPS/28
LCD_DIVIDER_29	LCD frequency = CLKPS/29
LCD_DIVIDER_30	LCD frequency = CLKPS/30
LCD_DIVIDER_31	LCD frequency = CLKPS/31

LCD Duty

LCD_DUTY_STATIC	Static duty
LCD_DUTY_1_2	1/2 duty
LCD_DUTY_1_3	1/3 duty

LCD_DUTY_1_4	1/4 duty
LCD_DUTY_1_8	1/8 duty

LCD Error Code

HAL_LCD_ERROR_NONE	No error
HAL_LCD_ERROR_FCRSF	Synchro flag timeout error
HAL_LCD_ERROR_UDR	Update display request flag timeout error
HAL_LCD_ERROR_UDD	Update display done flag timeout error
HAL_LCD_ERROR_ENS	LCD enabled status flag timeout error
HAL_LCD_ERROR_RDY	LCD Booster ready timeout error

LCD Exported Macros

__HAL_LCD_RESET_HANDLE_STATE

Description:
- Reset LCD handle state.

Parameters:
- __HANDLE__: specifies the LCD Handle.

Return value:
- None

__HAL_LCD_ENABLE

Description:
- Enable the LCD peripheral.

Parameters:
- __HANDLE__: specifies the LCD Handle.

Return value:
- None

__HAL_LCD_DISABLE

Description:
- Disable the LCD peripheral.

Parameters:
- __HANDLE__: specifies the LCD Handle.

Return value:
- None

__HAL_LCD_HIGHDRIVER_ENABLE

Description:

- Enable the low resistance divider.

Parameters:

- __HANDLE__: specifies the LCD Handle.

Return value:

- None

Notes:

- Displays with high internal resistance may need a longer drive time to achieve satisfactory contrast. This function is useful in this case if some additional power consumption can be tolerated. When this mode is enabled, the PulseOn Duration (PON) have to be programmed to 1/CK_PS (LCD_PULSEONDURATION_1).

__HAL_LCD_HIGHDRIVER_DISABLE

Description:

- Disable the low resistance divider.

Parameters:

- __HANDLE__: specifies the LCD Handle.

Return value:

- None

__HAL_LCD_VOLTAGE_BUFFER_ENABLE

Description:

- Enable the voltage output buffer for higher driving capability.

Parameters:

- __HANDLE__: specifies the LCD Handle.

Return value:

- None

__HAL_LCD_VOLTAGE_BUFFER_DISABLE

Description:

- Disable the voltage output buffer for higher driving capability.

Parameters:

- __HANDLE__: specifies the LCD Handle.

Return value:

- None

__HAL_LCD_PULSEONDURATION_CONFIG

Description:

- Configure the LCD pulse on duration.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __DURATION__: specifies the LCD pulse on duration in terms of CK_PS (prescaled LCD clock period) pulses. This parameter can be one of the following values:
  - LCD_PULSEONDURATION_0: 0 pulse
  - LCD_PULSEONDURATION_1: Pulse ON duration = 1/CK_PS
  - LCD_PULSEONDURATION_2: Pulse ON duration = 2/CK_PS
  - LCD_PULSEONDURATION_3: Pulse ON duration = 3/CK_PS
  - LCD_PULSEONDURATION_4: Pulse ON duration = 4/CK_PS
  - LCD_PULSEONDURATION_5: Pulse ON duration = 5/CK_PS
  - LCD_PULSEONDURATION_6: Pulse ON duration = 6/CK_PS
  - LCD_PULSEONDURATION_7: Pulse ON duration = 7/CK_PS

Return value:

- None

__HAL_LCD_DEADTIME_CONFIG

Description:

- Configure the LCD dead time.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __DEADTIME__: specifies the LCD dead time. This parameter can be one of the following values:
  - LCD_DEADTIME_0: No dead Time
  - LCD_DEADTIME_1: One Phase between different couple of Frame
  - LCD_DEADTIME_2: Two Phase between different couple of Frame
  - LCD_DEADTIME_3: Three Phase between different couple of Frame
  - LCD_DEADTIME_4: Four Phase between different couple of Frame
  - LCD_DEADTIME_5: Five Phase between different couple of Frame
  - LCD_DEADTIME_6: Six Phase between different couple of Frame
  - LCD_DEADTIME_7: Seven Phase between different couple of Frame

Return value:

- None

__HAL_LCD_CONTRAST_CONFIG

Description:

- Configure the LCD contrast.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __CONTRAST__: specifies the LCD Contrast. This parameter can be one of the following values:
  - LCD_CONTRASTLEVEL_0: Maximum Voltage = 2.60V
  - LCD_CONTRASTLEVEL_1: Maximum Voltage = 2.73V
  - LCD_CONTRASTLEVEL_2: Maximum Voltage = 2.86V
  - LCD_CONTRASTLEVEL_3: Maximum Voltage = 2.99V
  - LCD_CONTRASTLEVEL_4: Maximum Voltage = 3.12V
  - LCD_CONTRASTLEVEL_5: Maximum Voltage = 3.25V
  - LCD_CONTRASTLEVEL_6: Maximum Voltage = 3.38V
  - LCD_CONTRASTLEVEL_7: Maximum Voltage = 3.51V

Return value:

- None

__HAL_LCD_BLINK_CONFIG

Description:

- Configure the LCD Blink mode and Blink frequency.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __BLINKMODE__: specifies the LCD blink mode. This parameter can be one of the following values:
  - LCD_BLINKMODE_OFF: Blink disabled
  - LCD_BLINKMODE_SEG0_COM0: Blink enabled on SEG[0], COM[0] (1 pixel)
  - LCD_BLINKMODE_SEG0_ALLCOM: Blink enabled on SEG[0], all COM (up to 8 pixels according to the programmed duty)
  - LCD_BLINKMODE_ALLSEG_ALLCOM: Blink enabled on all SEG and all COM (all pixels)
- __BLINKFREQUENCY__: specifies the LCD blink frequency.
  - LCD_BLINKFREQUENCY_DIV8: The Blink frequency = fLcd/8
  - LCD_BLINKFREQUENCY_DIV16: The Blink frequency = fLcd/16
  - LCD_BLINKFREQUENCY_DIV32: The Blink frequency = fLcd/32
  - LCD_BLINKFREQUENCY_DIV64: The Blink frequency = fLcd/64
  - LCD_BLINKFREQUENCY_DIV128: The Blink frequency = fLcd/128
  - LCD_BLINKFREQUENCY_DIV256: The Blink frequency = fLcd/256
  - LCD_BLINKFREQUENCY_DIV512: The Blink frequency = fLcd/512
  - LCD_BLINKFREQUENCY_DIV1024: The Blink frequency = fLcd/1024

Return value:

- None

__HAL_LCD_ENABLE_IT

Description:

- Enable the specified LCD interrupt.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __INTERRUPT__: specifies the LCD interrupt source to be enabled. This parameter can be one of the following values:
  - LCD_IT_SOF: Start of Frame Interrupt
  - LCD_IT_UDD: Update Display Done Interrupt

Return value:

- None

__HAL_LCD_DISABLE_IT

Description:

- Disable the specified LCD interrupt.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __INTERRUPT__: specifies the LCD interrupt source to be disabled. This parameter can be one of the following values:
  - LCD_IT_SOF: Start of Frame Interrupt
  - LCD_IT_UDD: Update Display Done Interrupt

Return value:

- None

__HAL_LCD_GET_IT_SOURCE

Description:

- Check whether the specified LCD interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __IT__: specifies the LCD interrupt source to check. This parameter can be one of the following values:
  - LCD_IT_SOF: Start of Frame Interrupt
  - LCD_IT_UDD: Update Display Done Interrupt.

Return value:

- The: state of __IT__ (TRUE or FALSE).

Notes:

- If the device is in STOP mode (PCLK not provided) UDD will not generate an interrupt even if UDDIE = 1. If the display is not enabled the UDD interrupt will never occur.

__HAL_LCD_GET_FLAG

Description:

- Check whether the specified LCD flag is set or not.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - LCD_FLAG_ENS: LCD Enabled flag. It indicates the LCD controller status.

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

Notes:

- The ENS bit is set immediately when the LCDEN bit in the LCD_CR goes from 0 to 1. On deactivation it reflects the real status of LCD so it becomes 0 at the end of the last displayed frame. LCD_FLAG_SOF: Start of Frame flag. This flag is set by hardware at the beginning of a new frame, at the same time as the display data is updated. LCD_FLAG_UDR: Update Display Request flag. LCD_FLAG_UDD: Update Display Done flag. LCD_FLAG_RDY: Step_up converter Ready flag. It indicates the status of the step-up converter. LCD_FLAG_FCRSF: LCD Frame Control Register Synchronization Flag. This flag is set by hardware each time the LCD_FCR register is updated in the LCDCLK domain.

__HAL_LCD_CLEAR_FLAG

Description:

- Clear the specified LCD pending flag.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - LCD_FLAG_SOF: Start of Frame Interrupt
  - LCD_FLAG_UDD: Update Display Done Interrupt

Return value:

- None

LCD Flags Definition

LCD_FLAG_ENS	LCD enabled status
LCD_FLAG_SOF	Start of frame flag
LCD_FLAG_UDR	Update display request
LCD_FLAG_UDD	Update display done
LCD_FLAG_RDY	Ready flag
LCD_FLAG_FCRSF	LCD Frame Control Register Synchronization flag

LCD High Drive

LCD_HIGHDRIVE_DISABLE	High drive disabled
LCD_HIGHDRIVE_ENABLE	High drive enabled

LCD Interrupts

LCD_IT_SOF

LCD_IT_UDD

LCD Mux Segment

LCD_MUXSEGMENT_DISABLE SEG pin multiplexing disabled

LCD_MUXSEGMENT_ENABLE SEG[31:28] are multiplexed with SEG[43:40]

LCD Prescaler

LCD_PRESCALER_1 CLKPS = LCDCLK

LCD_PRESCALER_2 CLKPS = LCDCLK/2

LCD_PRESCALER_4 CLKPS = LCDCLK/4

LCD_PRESCALER_8 CLKPS = LCDCLK/8

LCD_PRESCALER_16 CLKPS = LCDCLK/16

LCD_PRESCALER_32 CLKPS = LCDCLK/32

LCD_PRESCALER_64 CLKPS = LCDCLK/64

LCD_PRESCALER_128 CLKPS = LCDCLK/128

LCD_PRESCALER_256 CLKPS = LCDCLK/256

LCD_PRESCALER_512 CLKPS = LCDCLK/512

LCD_PRESCALER_1024 CLKPS = LCDCLK/1024

LCD_PRESCALER_2048 CLKPS = LCDCLK/2048

LCD_PRESCALER_4096 CLKPS = LCDCLK/4096

LCD_PRESCALER_8192 CLKPS = LCDCLK/8192

LCD_PRESCALER_16384 CLKPS = LCDCLK/16384

LCD_PRESCALER_32768 CLKPS = LCDCLK/32768

LCD Pulse On Duration

LCD_PULSEONDURATION_0 Pulse ON duration = 0 pulse

LCD_PULSEONDURATION_1	Pulse ON duration = 1/CK_PS
LCD_PULSEONDURATION_2	Pulse ON duration = 2/CK_PS
LCD_PULSEONDURATION_3	Pulse ON duration = 3/CK_PS
LCD_PULSEONDURATION_4	Pulse ON duration = 4/CK_PS
LCD_PULSEONDURATION_5	Pulse ON duration = 5/CK_PS
LCD_PULSEONDURATION_6	Pulse ON duration = 6/CK_PS
LCD_PULSEONDURATION_7	Pulse ON duration = 7/CK_PS

LCD RAMRegister

LCD_RAM_REGISTER0	LCD RAM Register 0
LCD_RAM_REGISTER1	LCD RAM Register 1
LCD_RAM_REGISTER2	LCD RAM Register 2
LCD_RAM_REGISTER3	LCD RAM Register 3
LCD_RAM_REGISTER4	LCD RAM Register 4
LCD_RAM_REGISTER5	LCD RAM Register 5
LCD_RAM_REGISTER6	LCD RAM Register 6
LCD_RAM_REGISTER7	LCD RAM Register 7
LCD_RAM_REGISTER8	LCD RAM Register 8
LCD_RAM_REGISTER9	LCD RAM Register 9
LCD_RAM_REGISTER10	LCD RAM Register 10
LCD_RAM_REGISTER11	LCD RAM Register 11
LCD_RAM_REGISTER12	LCD RAM Register 12
LCD_RAM_REGISTER13	LCD RAM Register 13
LCD_RAM_REGISTER14	LCD RAM Register 14

LCD_RAM_REGISTER15 LCD RAM Register 15

LCD Voltage Source

LCD_VOLTAGESOURCE_INTERNAL Internal voltage source for the LCD

LCD_VOLTAGESOURCE_EXTERNAL External voltage source for the LCD

42 HAL LPTIM Generic Driver

42.1 LPTIM Firmware driver registers structures

42.1.1 LPTIM_ClockConfigTypeDef

LPTIM_ClockConfigTypeDef is defined in the stm32l4xx_hal_lptim.h

Data Fields

- ***uint32_t Source***
- ***uint32_t Prescaler***

Field Documentation

- ***uint32_t LPTIM_ClockConfigTypeDef::Source***
  Selects the clock source. This parameter can be a value of ***LPTIM_Clock_Source***
- ***uint32_t LPTIM_ClockConfigTypeDef::Prescaler***
  Specifies the counter clock Prescaler. This parameter can be a value of ***LPTIM_Clock_Prescaler***

42.1.2 LPTIM_ULPClockConfigTypeDef

LPTIM_ULPClockConfigTypeDef is defined in the stm32l4xx_hal_lptim.h

Data Fields

- ***uint32_t Polarity***
- ***uint32_t SampleTime***

Field Documentation

- ***uint32_t LPTIM_ULPClockConfigTypeDef::Polarity***
  Selects the polarity of the active edge for the counter unit if the ULPTIM input is selected. Note: This parameter is used only when Ultra low power clock source is used. Note: If the polarity is configured on 'both edges', an auxiliary clock (one of the Low power oscillator) must be active. This parameter can be a value of ***LPTIM_Clock_Polarity***
- ***uint32_t LPTIM_ULPClockConfigTypeDef::SampleTime***
  Selects the clock sampling time to configure the clock glitch filter. Note: This parameter is used only when Ultra low power clock source is used. This parameter can be a value of ***LPTIM_Clock_Sample_Time***

42.1.3 LPTIM_TriggerConfigTypeDef

LPTIM_TriggerConfigTypeDef is defined in the stm32l4xx_hal_lptim.h

Data Fields

- ***uint32_t Source***
- ***uint32_t ActiveEdge***
- ***uint32_t SampleTime***

Field Documentation

- ***uint32_t LPTIM_TriggerConfigTypeDef::Source***
  Selects the Trigger source. This parameter can be a value of ***LPTIM_Trigger_Source***
- ***uint32_t LPTIM_TriggerConfigTypeDef::ActiveEdge***
  Selects the Trigger active edge. Note: This parameter is used only when an external trigger is used. This parameter can be a value of ***LPTIM_External_Trigger_Polarity***
- ***uint32_t LPTIM_TriggerConfigTypeDef::SampleTime***
  Selects the trigger sampling time to configure the clock glitch filter. Note: This parameter is used only when an external trigger is used. This parameter can be a value of ***LPTIM_Trigger_Sample_Time***

42.1.4 LPTIM_InitTypeDef

LPTIM_InitTypeDef is defined in the stm32l4xx_hal_lptim.h

Data Fields

- ***LPTIM_ClockConfigTypeDef Clock***
- ***LPTIM_ULPClockConfigTypeDef UltraLowPowerClock***
- ***LPTIM_TriggerConfigTypeDef Trigger***
- ***uint32_t OutputPolarity***
- ***uint32_t UpdateMode***
- ***uint32_t CounterSource***
- ***uint32_t Input1Source***
- ***uint32_t Input2Source***

Field Documentation

- ***LPTIM_ClockConfigTypeDef LPTIM_InitTypeDef::Clock***
  Specifies the clock parameters
- ***LPTIM_ULPClockConfigTypeDef LPTIM_InitTypeDef::UltraLowPowerClock***
  Specifies the Ultra Low Power clock parameters
- ***LPTIM_TriggerConfigTypeDef LPTIM_InitTypeDef::Trigger***
  Specifies the Trigger parameters
- ***uint32_t LPTIM_InitTypeDef::OutputPolarity***
  Specifies the Output polarity. This parameter can be a value of ***LPTIM_Output_Polarity***
- ***uint32_t LPTIM_InitTypeDef::UpdateMode***
  Specifies whether the update of the autoreload and the compare values is done immediately or after the end of current period. This parameter can be a value of ***LPTIM_Updating_Mode***
- ***uint32_t LPTIM_InitTypeDef::CounterSource***
  Specifies whether the counter is incremented each internal event or each external event. This parameter can be a value of ***LPTIM_Counter_Source***
- ***uint32_t LPTIM_InitTypeDef::Input1Source***
  Specifies source selected for input1 (GPIO or comparator output). This parameter can be a value of ***LPTIM_Input1_Source***
- ***uint32_t LPTIM_InitTypeDef::Input2Source***
  Specifies source selected for input2 (GPIO or comparator output). Note: This parameter is used only for encoder feature so is used only for LPTIM1 instance. This parameter can be a value of ***LPTIM_Input2_Source***

42.1.5 LPTIM_HandleTypeDef

LPTIM_HandleTypeDef is defined in the stm32l4xx_hal_lptim.h

Data Fields

- ***LPTIM_TypeDef * Instance***
- ***LPTIM_InitTypeDef Init***
- ***HAL_StatusTypeDef Status***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_LPTIM_StateTypeDef State***

Field Documentation

- ***LPTIM_TypeDef* LPTIM_HandleTypeDef::Instance***
  Register base address
- ***LPTIM_InitTypeDef LPTIM_HandleTypeDef::Init***
  LPTIM required parameters
- ***HAL_StatusTypeDef LPTIM_HandleTypeDef::Status***
  LPTIM peripheral status
- ***HAL_LockTypeDef LPTIM_HandleTypeDef::Lock***
  LPTIM locking object
- ***__IO HAL_LPTIM_StateTypeDef LPTIM_HandleTypeDef::State***
  LPTIM peripheral state

42.2 LPTIM Firmware driver API description

The following section lists the various functions of the LPTIM library.

42.2.1 How to use this driver

The LPTIM HAL driver can be used as follows:

1. Initialize the LPTIM low level resources by implementing the HAL_LPTIM_MspInit():
   - Enable the LPTIM interface clock using __HAL_RCC_LPTIMx_CLK_ENABLE().
   - In case of using interrupts (e.g. HAL_LPTIM_PWM_Start_IT()):
     - Configure the LPTIM interrupt priority using HAL_NVIC_SetPriority().
     - Enable the LPTIM IRQ handler using HAL_NVIC_EnableIRQ().
     - In LPTIM IRQ handler, call HAL_LPTIM_IRQHandler().
2. Initialize the LPTIM HAL using HAL_LPTIM_Init(). This function configures mainly:
   - The instance: LPTIM1 or LPTIM2.
   - Clock: the counter clock.
     - Source : it can be either the ULPTIM input (IN1) or one of the internal clock; (APB, LSE, LSI or MSI).
     - Prescaler: select the clock divider.
   - UltraLowPowerClock : To be used only if the ULPTIM is selected as counter clock source.
     - Polarity: polarity of the active edge for the counter unit if the ULPTIM input is selected.
     - SampleTime: clock sampling time to configure the clock glitch filter.
   - Trigger: How the counter start.
     - Source: trigger can be software or one of the hardware triggers.
     - ActiveEdge : only for hardware trigger.
     - SampleTime : trigger sampling time to configure the trigger glitch filter.
   - OutputPolarity : 2 opposite polarities are possible.
   - UpdateMode: specifies whether the update of the autoreload and the compare values is done immediately or after the end of current period.
   - Input1Source: Source selected for input1 (GPIO or comparator output).
   - Input2Source: Source selected for input2 (GPIO or comparator output). Input2 is used only for encoder feature so is used only for LPTIM1 instance.
3. Six modes are available:
   - PWM Mode: To generate a PWM signal with specified period and pulse, call HAL_LPTIM_PWM_Start() or HAL_LPTIM_PWM_Start_IT() for interruption mode.
   - One Pulse Mode: To generate pulse with specified width in response to a stimulus, call HAL_LPTIM_OnePulse_Start() or HAL_LPTIM_OnePulse_Start_IT() for interruption mode.
   - Set once Mode: In this mode, the output changes the level (from low level to high level if the output polarity is configured high, else the opposite) when a compare match occurs. To start this mode, call HAL_LPTIM_SetOnce_Start() or HAL_LPTIM_SetOnce_Start_IT() for interruption mode.
   - Encoder Mode: To use the encoder interface call HAL_LPTIM_Encoder_Start() or HAL_LPTIM_Encoder_Start_IT() for interruption mode. Only available for LPTIM1 instance.
   - Time out Mode: an active edge on one selected trigger input rests the counter. The first trigger event will start the timer, any successive trigger event will reset the counter and the timer will restart. To start this mode call HAL_LPTIM_TimeOut_Start_IT() or HAL_LPTIM_TimeOut_Start_IT() for interruption mode.
   - Counter Mode: counter can be used to count external events on the LPTIM Input1 or it can be used to count internal clock cycles. To start this mode, call HAL_LPTIM_Counter_Start() or HAL_LPTIM_Counter_Start_IT() for interruption mode.
4. User can stop any process by calling the corresponding API: HAL_LPTIM_Xxx_Stop() or HAL_LPTIM_Xxx_Stop_IT() if the process is already started in interruption mode.
5. De-initialize the LPTIM peripheral using HAL_LPTIM_DeInit().

Callback registration

The compilation define USE_HAL_LPTIM_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_LPTIM_RegisterCallback() to register a callback. @ref HAL_LPTIM_RegisterCallback() takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_LPTIM_UnRegisterCallback() to reset a callback to the default weak function. @ref HAL_LPTIM_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID.

These functions allow to register/unregister following callbacks:

- MspInitCallback : LPTIM Base Msp Init Callback.
- MspDeInitCallback : LPTIM Base Msp DeInit Callback.
- CompareMatchCallback : Compare match Callback.
- AutoReloadMatchCallback : Auto-reload match Callback.
- TriggerCallback : External trigger event detection Callback.
- CompareWriteCallback : Compare register write complete Callback.
- AutoReloadWriteCallback : Auto-reload register write complete Callback.
- DirectionUpCallback : Up-counting direction change Callback.
- DirectionDownCallback : Down-counting direction change Callback.

By default, after the Init and when the state is HAL_LPTIM_STATE_RESET all interrupt callbacks are set to the corresponding weak functions: examples @ref HAL_LPTIM_TriggerCallback(), @ref HAL_LPTIM_CompareMatchCallback().

Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functionalities in the Init/ DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the Init/DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand)

Callbacks can be registered/unregistered in HAL_LPTIM_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_LPTIM_STATE_READY or HAL_LPTIM_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_LPTIM_RegisterCallback() before calling DeInit or Init function.

When The compilation define USE_HAL_LPTIM_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

42.2.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize the LPTIM according to the specified parameters in the LPTIM_InitTypeDef and initialize the associated handle.
- DeInitialize the LPTIM peripheral.
- Initialize the LPTIM MSP.
- DeInitialize the LPTIM MSP.

This section contains the following APIs:

- ***HAL_LPTIM_Init***
- ***HAL_LPTIM_DeInit***
- ***HAL_LPTIM_MspInit***
- ***HAL_LPTIM_MspDeInit***

42.2.3 LPTIM Start Stop operation functions

This section provides functions allowing to:

- Start the PWM mode.
- Stop the PWM mode.
- Start the One pulse mode.
- Stop the One pulse mode.

- Start the Set once mode.
- Stop the Set once mode.
- Start the Encoder mode.
- Stop the Encoder mode.
- Start the Timeout mode.
- Stop the Timeout mode.
- Start the Counter mode.
- Stop the Counter mode.

This section contains the following APIs:

- ***HAL_LPTIM_PWM_Start***
- ***HAL_LPTIM_PWM_Stop***
- ***HAL_LPTIM_PWM_Start_IT***
- ***HAL_LPTIM_PWM_Stop_IT***
- ***HAL_LPTIM_OnePulse_Start***
- ***HAL_LPTIM_OnePulse_Stop***
- ***HAL_LPTIM_OnePulse_Start_IT***
- ***HAL_LPTIM_OnePulse_Stop_IT***
- ***HAL_LPTIM_SetOnce_Start***
- ***HAL_LPTIM_SetOnce_Stop***
- ***HAL_LPTIM_SetOnce_Start_IT***
- ***HAL_LPTIM_SetOnce_Stop_IT***
- ***HAL_LPTIM_Encoder_Start***
- ***HAL_LPTIM_Encoder_Stop***
- ***HAL_LPTIM_Encoder_Start_IT***
- ***HAL_LPTIM_Encoder_Stop_IT***
- ***HAL_LPTIM_TimeOut_Start***
- ***HAL_LPTIM_TimeOut_Stop***
- ***HAL_LPTIM_TimeOut_Start_IT***
- ***HAL_LPTIM_TimeOut_Stop_IT***
- ***HAL_LPTIM_Counter_Start***
- ***HAL_LPTIM_Counter_Stop***
- ***HAL_LPTIM_Counter_Start_IT***
- ***HAL_LPTIM_Counter_Stop_IT***

42.2.4 LPTIM Read operation functions

This section provides LPTIM Reading functions.

- Read the counter value.
- Read the period (Auto-reload) value.
- Read the pulse (Compare)value.

This section contains the following APIs:

- ***HAL_LPTIM_ReadCounter***
- ***HAL_LPTIM_ReadAutoReload***
- ***HAL_LPTIM_ReadCompare***

42.2.5 LPTIM IRQ handler and callbacks

This section provides LPTIM IRQ handler and callback functions called within the IRQ handler:

- LPTIM interrupt request handler
- Compare match Callback

- Auto-reload match Callback
- External trigger event detection Callback
- Compare register write complete Callback
- Auto-reload register write complete Callback
- Up-counting direction change Callback
- Down-counting direction change Callback

This section contains the following APIs:

- ***HAL_LPTIM_IRQHandler***
- ***HAL_LPTIM_CompareMatchCallback***
- ***HAL_LPTIM_AutoReloadMatchCallback***
- ***HAL_LPTIM_TriggerCallback***
- ***HAL_LPTIM_CompareWriteCallback***
- ***HAL_LPTIM_AutoReloadWriteCallback***
- ***HAL_LPTIM_DirectionUpCallback***
- ***HAL_LPTIM_DirectionDownCallback***

42.2.6 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- ***HAL_LPTIM_GetState***

42.2.7 Detailed description of functions

`HAL_LPTIM_Init`

Function name

HAL_StatusTypeDef HAL_LPTIM_Init (LPTIM_HandleTypeDef * hlptim)

Function description

Initialize the LPTIM according to the specified parameters in the LPTIM_InitTypeDef and initialize the associated handle.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_DeInit`

Function name

HAL_StatusTypeDef HAL_LPTIM_DeInit (LPTIM_HandleTypeDef * hlptim)

Function description

DeInitialize the LPTIM peripheral.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_MspInit

Function name

void HAL_LPTIM_MspInit (LPTIM_HandleTypeDef * hlptim)

Function description

Initialize the LPTIM MSP.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

HAL_LPTIM_MspDeInit

Function name

void HAL_LPTIM_MspDeInit (LPTIM_HandleTypeDef * hlptim)

Function description

DeInitialize LPTIM MSP.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

HAL_LPTIM_PWM_Start

Function name

HAL_StatusTypeDef HAL_LPTIM_PWM_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)

Function description

Start the LPTIM PWM generation.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_PWM_Stop

Function name

HAL_StatusTypeDef HAL_LPTIM_PWM_Stop (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the LPTIM PWM generation.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_PWM_Start_IT

Function name

HAL_StatusTypeDef HAL_LPTIM_PWM_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)

Function description

Start the LPTIM PWM generation in interrupt mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF
- **Pulse:** Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF

Return values

- **HAL:** status

HAL_LPTIM_PWM_Stop_IT

Function name

HAL_StatusTypeDef HAL_LPTIM_PWM_Stop_IT (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the LPTIM PWM generation in interrupt mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_OnePulse_Start

Function name

HAL_StatusTypeDef HAL_LPTIM_OnePulse_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)

Function description

Start the LPTIM One pulse generation.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_OnePulse_Stop

Function name

HAL_StatusTypeDef HAL_LPTIM_OnePulse_Stop (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the LPTIM One pulse generation.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_OnePulse_Start_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_OnePulse_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)

Function description

Start the LPTIM One pulse generation in interrupt mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

`HAL_LPTIM_OnePulse_Stop_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_OnePulse_Stop_IT (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the LPTIM One pulse generation in interrupt mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_SetOnce_Start`

Function name

HAL_StatusTypeDef HAL_LPTIM_SetOnce_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)

Function description

Start the LPTIM in Set once mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Stop

Function name

HAL_StatusTypeDef HAL_LPTIM_SetOnce_Stop (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the LPTIM Set once mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Start_IT

Function name

HAL_StatusTypeDef HAL_LPTIM_SetOnce_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Pulse)

Function description

Start the LPTIM Set once mode in interrupt mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Pulse:** Specifies the compare value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

HAL_LPTIM_SetOnce_Stop_IT

Function name

HAL_StatusTypeDef HAL_LPTIM_SetOnce_Stop_IT (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the LPTIM Set once mode in interrupt mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

HAL_LPTIM_Encoder_Start

Function name

HAL_StatusTypeDef HAL_LPTIM_Encoder_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period)

Function description

Start the Encoder interface.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

`HAL_LPTIM_Encoder_Stop`

Function name

HAL_StatusTypeDef HAL_LPTIM_Encoder_Stop (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the Encoder interface.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_Encoder_Start_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_Encoder_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period)

Function description

Start the Encoder interface in interrupt mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

`HAL_LPTIM_Encoder_Stop_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_Encoder_Stop_IT (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the Encoder interface in interrupt mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_TimeOut_Start`

Function name

HAL_StatusTypeDef HAL_LPTIM_TimeOut_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Timeout)

Function description

Start the Timeout function.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Timeout:** Specifies the TimeOut value to reset the counter. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

Notes

- The first trigger event will start the timer, any successive trigger event will reset the counter and the timer restarts.

`HAL_LPTIM_TimeOut_Stop`

Function name

HAL_StatusTypeDef HAL_LPTIM_TimeOut_Stop (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the Timeout function.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_TimeOut_Start_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_TimeOut_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period, uint32_t Timeout)

Function description

Start the Timeout function in interrupt mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.
- **Timeout:** Specifies the TimeOut value to reset the counter. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

Notes

- The first trigger event will start the timer, any successive trigger event will reset the counter and the timer restarts.

`HAL_LPTIM_TimeOut_Stop_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_TimeOut_Stop_IT (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the Timeout function in interrupt mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_Counter_Start`

Function name

HAL_StatusTypeDef HAL_LPTIM_Counter_Start (LPTIM_HandleTypeDef * hlptim, uint32_t Period)

Function description

Start the Counter mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

`HAL_LPTIM_Counter_Stop`

Function name

HAL_StatusTypeDef HAL_LPTIM_Counter_Stop (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the Counter mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_Counter_Start_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_Counter_Start_IT (LPTIM_HandleTypeDef * hlptim, uint32_t Period)

Function description

Start the Counter mode in interrupt mode.

Parameters

- **hlptim:** LPTIM handle
- **Period:** Specifies the Autoreload value. This parameter must be a value between 0x0000 and 0xFFFF.

Return values

- **HAL:** status

`HAL_LPTIM_Counter_Stop_IT`

Function name

HAL_StatusTypeDef HAL_LPTIM_Counter_Stop_IT (LPTIM_HandleTypeDef * hlptim)

Function description

Stop the Counter mode in interrupt mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** status

`HAL_LPTIM_ReadCounter`

Function name

uint32_t HAL_LPTIM_ReadCounter (LPTIM_HandleTypeDef * hlptim)

Function description

Return the current counter value.

Parameters

- **hlptim:** LPTIM handle

Return values

- **Counter:** value.

`HAL_LPTIM_ReadAutoReload`

Function name

uint32_t HAL_LPTIM_ReadAutoReload (LPTIM_HandleTypeDef * hlptim)

Function description

Return the current Autoreload (Period) value.

Parameters

- **hlptim:** LPTIM handle

Return values

- **Autoreload:** value.

`HAL_LPTIM_ReadCompare`

Function name

uint32_t HAL_LPTIM_ReadCompare (LPTIM_HandleTypeDef * hlptim)

Function description

Return the current Compare (Pulse) value.

Parameters

- **hlptim:** LPTIM handle

Return values

- **Compare:** value.

`HAL_LPTIM_IRQHandler`

Function name

void HAL_LPTIM_IRQHandler (LPTIM_HandleTypeDef * hlptim)

Function description

Handle LPTIM interrupt request.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_CompareMatchCallback`

Function name

void HAL_LPTIM_CompareMatchCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Compare match callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_AutoReloadMatchCallback`

Function name

void HAL_LPTIM_AutoReloadMatchCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Autoreload match callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_TriggerCallback`

Function name

void HAL_LPTIM_TriggerCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Trigger detected callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_CompareWriteCallback`

Function name

void HAL_LPTIM_CompareWriteCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Compare write callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_AutoReloadWriteCallback`

Function name

void HAL_LPTIM_AutoReloadWriteCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Autoreload write callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_DirectionUpCallback`

Function name

void HAL_LPTIM_DirectionUpCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Direction counter changed from Down to Up callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_DirectionDownCallback`

Function name

void HAL_LPTIM_DirectionDownCallback (LPTIM_HandleTypeDef * hlptim)

Function description

Direction counter changed from Up to Down callback in non-blocking mode.

Parameters

- **hlptim:** LPTIM handle

Return values

- **None:**

`HAL_LPTIM_GetState`

Function name

HAL_LPTIM_StateTypeDef HAL_LPTIM_GetState (LPTIM_HandleTypeDef * hlptim)

Function description

Return the LPTIM handle state.

Parameters

- **hlptim:** LPTIM handle

Return values

- **HAL:** state

`LPTIM_Disable`

Function name

void LPTIM_Disable (LPTIM_HandleTypeDef * lptim)

Function description

Disable LPTIM HW instance.

Parameters

- **lptim:** pointer to a LPTIM_HandleTypeDef structure that contains the configuration information for LPTIM module.

Return values

- **None:**

Notes

- The following sequence is required to solve LPTIM disable HW limitation. Please check Errata Sheet ES0335 for more details under "MCU may remain stuck in LPTIM interrupt when entering Stop mode" section.

42.3 LPTIM Firmware driver defines

The following section lists the various define and macros of the module.

42.3.1 LPTIM

LPTIM

LPTIM Clock Polarity

LPTIM_CLOCKPOLARITY_RISING

LPTIM_CLOCKPOLARITY_FALLING

LPTIM_CLOCKPOLARITY_RISING_FALLING

LPTIM Clock Prescaler

LPTIM_PRESCALER_DIV1

LPTIM_PRESCALER_DIV2

LPTIM_PRESCALER_DIV4

LPTIM_PRESCALER_DIV8

LPTIM_PRESCALER_DIV16

LPTIM_PRESCALER_DIV32

LPTIM_PRESCALER_DIV64

LPTIM_PRESCALER_DIV128

LPTIM Clock Sample Time

LPTIM_CLOCKSAMPLETIME_DIRECTTRANSITION

LPTIM_CLOCKSAMPLETIME_2TRANSITIONS

LPTIM_CLOCKSAMPLETIME_4TRANSITIONS

LPTIM_CLOCKSAMPLETIME_8TRANSITIONS

LPTIM Clock Source

LPTIM_CLOCKSOURCE_APBCLOCK_LPOSC

LPTIM_CLOCKSOURCE_ULPTIM

LPTIM Counter Source

LPTIM_COUNTERSOURCE_INTERNAL

LPTIM_COUNTERSOURCE_EXTERNAL

LPTIM Exported Macros

__HAL_LPTIM_RESET_HANDLE_STATE

Description:

- Reset LPTIM handle state.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

__HAL_LPTIM_ENABLE

Description:

- Enable the LPTIM peripheral.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

__HAL_LPTIM_DISABLE

Description:

- Disable the LPTIM peripheral.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

Notes:

- The following sequence is required to solve LPTIM disable HW limitation. Please check Errata Sheet ES0335 for more details under "MCU may remain stuck in LPTIM interrupt when entering Stop mode" section.

__HAL_LPTIM_START_CONTINUOUS

Description:

- Start the LPTIM peripheral in Continuous mode.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

__HAL_LPTIM_START_SINGLE

Description:

- Start the LPTIM peripheral in single mode.

Parameters:

- __HANDLE__: LPTIM handle

Return value:

- None

__HAL_LPTIM_AUTORELOAD_SET

Description:

- Write the passed parameter in the Autoreload register.

Parameters:

- __HANDLE__: LPTIM handle
- __VALUE__: Autoreload value

Return value:

- None

__HAL_LPTIM_COMPARE_SET

Description:

- Write the passed parameter in the Compare register.

Parameters:

- __HANDLE__: LPTIM handle
- __VALUE__: Compare value

Return value:

- None

__HAL_LPTIM_GET_FLAG

Description:

- Check whether the specified LPTIM flag is set or not.

Parameters:

- __HANDLE__: LPTIM handle
- __FLAG__: LPTIM flag to check This parameter can be a value of:
  - LPTIM_FLAG_REPOK : Repetition register update OK Flag (when available).
  - LPTIM_FLAG_UPDATE : Update event Flag (when available).
  - LPTIM_FLAG_DOWN : Counter direction change up Flag.
  - LPTIM_FLAG_UP : Counter direction change down to up Flag.
  - LPTIM_FLAG_ARROK : Autoreload register update OK Flag.
  - LPTIM_FLAG_CMPOK : Compare register update OK Flag.
  - LPTIM_FLAG_EXTTRIG : External trigger edge event Flag.
  - LPTIM_FLAG_ARRM : Autoreload match Flag.
  - LPTIM_FLAG_CMPM : Compare match Flag.

Return value:

- The: state of the specified flag (SET or RESET).

__HAL_LPTIM_CLEAR_FLAG

Description:

- Clear the specified LPTIM flag.

Parameters:

- __HANDLE__: LPTIM handle.
- __FLAG__: LPTIM flag to clear. This parameter can be a value of:
  - LPTIM_FLAG_REPOK : Repetition register update OK Flag (when available).
  - LPTIM_FLAG_UPDATE : Update event Flag (when available).
  - LPTIM_FLAG_DOWN : Counter direction change up Flag.
  - LPTIM_FLAG_UP : Counter direction change down to up Flag.
  - LPTIM_FLAG_ARROK : Autoreload register update OK Flag.
  - LPTIM_FLAG_CMPOK : Compare register update OK Flag.
  - LPTIM_FLAG_EXTTRIG : External trigger edge event Flag.
  - LPTIM_FLAG_ARRM : Autoreload match Flag.
  - LPTIM_FLAG_CMPM : Compare match Flag.

Return value:

- None.

__HAL_LPTIM_ENABLE_IT

Description:

- Enable the specified LPTIM interrupt.

Parameters:

- __HANDLE__: LPTIM handle.
- __INTERRUPT__: LPTIM interrupt to set. This parameter can be a value of:
  - LPTIM_IT_REPOK : Repetition register update Interrupt (when available).
  - LPTIM_IT_UPDATE : Update event Interrupt (when available).
  - LPTIM_IT_DOWN : Counter direction change up Interrupt.
  - LPTIM_IT_UP : Counter direction change down to up Interrupt.
  - LPTIM_IT_ARROK : Autoreload register update OK Interrupt.
  - LPTIM_IT_CMPOK : Compare register update OK Interrupt.
  - LPTIM_IT_EXTTRIG : External trigger edge event Interrupt.
  - LPTIM_IT_ARRM : Autoreload match Interrupt.
  - LPTIM_IT_CMPM : Compare match Interrupt.

Return value:

- None.

__HAL_LPTIM_DISABLE_IT

Description:

- Disable the specified LPTIM interrupt.

Parameters:

- __HANDLE__: LPTIM handle.
- __INTERRUPT__: LPTIM interrupt to set. This parameter can be a value of:
  - LPTIM_IT_DOWN : Counter direction change up Interrupt.
  - LPTIM_IT_UP : Counter direction change down to up Interrupt.
  - LPTIM_IT_ARROK : Autoreload register update OK Interrupt.
  - LPTIM_IT_CMPOK : Compare register update OK Interrupt.
  - LPTIM_IT_EXTTRIG : External trigger edge event Interrupt.
  - LPTIM_IT_ARRM : Autoreload match Interrupt.
  - LPTIM_IT_CMPM : Compare match Interrupt.

Return value:

- None.

__HAL_LPTIM_GET_IT_SOURCE

Description:

- Check whether the specified LPTIM interrupt source is enabled or not.

Parameters:

- __HANDLE__: LPTIM handle.
- __INTERRUPT__: LPTIM interrupt to check. This parameter can be a value of:
  - LPTIM_IT_DOWN : Counter direction change up Interrupt.
  - LPTIM_IT_UP : Counter direction change down to up Interrupt.
  - LPTIM_IT_ARROK : Autoreload register update OK Interrupt.
  - LPTIM_IT_CMPOK : Compare register update OK Interrupt.
  - LPTIM_IT_EXTTRIG : External trigger edge event Interrupt.
  - LPTIM_IT_ARRM : Autoreload match Interrupt.
  - LPTIM_IT_CMPM : Compare match Interrupt.

Return value:

- Interrupt: status.

__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_IT

Description:

- Enable interrupt on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None

__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_IT

Description:

- Disable interrupt on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None

__HAL_LPTIM_WAKEUPTIMER_EXTI_ENABLE_EVENT

Description:

- Enable event on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None.

__HAL_LPTIM_WAKEUPTIMER_EXTI_DISABLE_EVENT

Description:

- Disable event on the LPTIM Wake-up Timer associated Exti line.

Return value:

- None.

LPTIM Exported Types

LPTIM_EXTI_LINE_WAKEUPTIMER_EVENT

External interrupt line 32 Connected to the LPTIM EXTI Line

LPTIM External Trigger Polarity

LPTIM_ACTIVEEDGE_RISING

LPTIM_ACTIVEEDGE_FALLING

LPTIM_ACTIVEEDGE_RISING_FALLING

LPTIM Flags Definition

LPTIM_FLAG_DOWN

LPTIM_FLAG_UP

LPTIM_FLAG_ARROK

LPTIM_FLAG_CMPOK

LPTIM_FLAG_EXTTRIG

LPTIM_FLAG_ARRM

LPTIM_FLAG_CMPM

LPTIM Input1 Source

LPTIM_INPUT1SOURCE_GPIO

For LPTIM1 and LPTIM2

LPTIM_INPUT1SOURCE_COMP1

For LPTIM1 and LPTIM2

LPTIM_INPUT1SOURCE_COMP2

For LPTIM2

LPTIM_INPUT1SOURCE_COMP1_COMP2

For LPTIM2

LPTIM Input2 Source

LPTIM_INPUT2SOURCE_GPIO

For LPTIM1

LPTIM_INPUT2SOURCE_COMP2

For LPTIM1

LPTIM Interrupts Definition

LPTIM_IT_DOWN

LPTIM_IT_UP

LPTIM_IT_ARROK

LPTIM_IT_CMPOK

LPTIM_IT_EXTTRIG

LPTIM_IT_ARRM

LPTIM_IT_CMPM

LPTIM Output Polarity

LPTIM_OUTPUTPOLARITY_HIGH

LPTIM_OUTPUTPOLARITY_LOW

LPTIM Trigger Sample Time

LPTIM_TRIGSAMPLETIME_DIRECTTRANSITION

LPTIM_TRIGSAMPLETIME_2TRANSITIONS

LPTIM_TRIGSAMPLETIME_4TRANSITIONS

LPTIM_TRIGSAMPLETIME_8TRANSITIONS

LPTIM Trigger Source

LPTIM_TRIGSOURCE_SOFTWARE

LPTIM_TRIGSOURCE_0

LPTIM_TRIGSOURCE_1

LPTIM_TRIGSOURCE_2

LPTIM_TRIGSOURCE_3

LPTIM_TRIGSOURCE_4

LPTIM_TRIGSOURCE_5

LPTIM_TRIGSOURCE_6

LPTIM_TRIGSOURCE_7

LPTIM Updating Mode

LPTIM_UPDATE_IMMEDIATE

LPTIM_UPDATE_ENDOFPERIOD

43 HAL LTDC Generic Driver

43.1 LTDC Firmware driver registers structures

43.1.1 LTDC_ColorTypeDef

LTDC_ColorTypeDef is defined in the stm32l4xx_hal_ltdc.h

Data Fields

- ***uint8_t Blue***
- ***uint8_t Green***
- ***uint8_t Red***
- ***uint8_t Reserved***

Field Documentation

- ***uint8_t LTDC_ColorTypeDef::Blue***
  Configures the blue value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint8_t LTDC_ColorTypeDef::Green***
  Configures the green value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint8_t LTDC_ColorTypeDef::Red***
  Configures the red value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint8_t LTDC_ColorTypeDef::Reserved***
  Reserved 0xFF

43.1.2 LTDC_InitTypeDef

LTDC_InitTypeDef is defined in the stm32l4xx_hal_ltdc.h

Data Fields

- ***uint32_t HSPolarity***
- ***uint32_t VSPolarity***
- ***uint32_t DEPolarity***
- ***uint32_t PCPolarity***
- ***uint32_t HorizontalSync***
- ***uint32_t VerticalSync***
- ***uint32_t AccumulatedHBP***
- ***uint32_t AccumulatedVBP***
- ***uint32_t AccumulatedActiveW***
- ***uint32_t AccumulatedActiveH***
- ***uint32_t TotalWidth***
- ***uint32_t TotalHeigh***
- ***LTDC_ColorTypeDef Backcolor***

Field Documentation

- ***uint32_t LTDC_InitTypeDef::HSPolarity***
  configures the horizontal synchronization polarity. This parameter can be one value of ***LTDC_HS_POLARITY***
- ***uint32_t LTDC_InitTypeDef::VSPolarity***
  configures the vertical synchronization polarity. This parameter can be one value of ***LTDC_VS_POLARITY***
- ***uint32_t LTDC_InitTypeDef::DEPolarity***
  configures the data enable polarity. This parameter can be one of value of ***LTDC_DE_POLARITY***

- ***uint32_t LTDC_InitTypeDef::PCPolarity***
  configures the pixel clock polarity. This parameter can be one of value of ***LTDC_PC_POLARITY***
- ***uint32_t LTDC_InitTypeDef::HorizontalSync***
  configures the number of Horizontal synchronization width. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF.
- ***uint32_t LTDC_InitTypeDef::VerticalSync***
  configures the number of Vertical synchronization height. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0x7FF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedHBP***
  configures the accumulated horizontal back porch width. This parameter must be a number between Min_Data = LTDC_HorizontalSync and Max_Data = 0xFFF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedVBP***
  configures the accumulated vertical back porch height. This parameter must be a number between Min_Data = LTDC_VerticalSync and Max_Data = 0x7FF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedActiveW***
  configures the accumulated active width. This parameter must be a number between Min_Data = LTDC_AccumulatedHBP and Max_Data = 0xFFF.
- ***uint32_t LTDC_InitTypeDef::AccumulatedActiveH***
  configures the accumulated active height. This parameter must be a number between Min_Data = LTDC_AccumulatedVBP and Max_Data = 0x7FF.
- ***uint32_t LTDC_InitTypeDef::TotalWidth***
  configures the total width. This parameter must be a number between Min_Data = LTDC_AccumulatedActiveW and Max_Data = 0xFFF.
- ***uint32_t LTDC_InitTypeDef::TotalHeigh***
  configures the total height. This parameter must be a number between Min_Data = LTDC_AccumulatedActiveH and Max_Data = 0x7FF.
- ***LTDC_ColorTypeDef LTDC_InitTypeDef::Backcolor***
  Configures the background color.

43.1.3 LTDC_LayerCfgTypeDef

LTDC_LayerCfgTypeDef is defined in the stm32l4xx_hal_ltdc.h

Data Fields

- ***uint32_t WindowX0***
- ***uint32_t WindowX1***
- ***uint32_t WindowY0***
- ***uint32_t WindowY1***
- ***uint32_t PixelFormat***
- ***uint32_t Alpha***
- ***uint32_t Alpha0***
- ***uint32_t BlendingFactor1***
- ***uint32_t BlendingFactor2***
- ***uint32_t FBStartAdress***
- ***uint32_t ImageWidth***
- ***uint32_t ImageHeight***
- ***LTDC_ColorTypeDef Backcolor***

Field Documentation

- ***uint32_t LTDC_LayerCfgTypeDef::WindowX0***
  Configures the Window Horizontal Start Position. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF.

- ***uint32_t LTDC_LayerCfgTypeDef::WindowX1***
  Configures the Window Horizontal Stop Position. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF.
- ***uint32_t LTDC_LayerCfgTypeDef::WindowY0***
  Configures the Window vertical Start Position. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0x7FF.
- ***uint32_t LTDC_LayerCfgTypeDef::WindowY1***
  Configures the Window vertical Stop Position. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x7FF.
- ***uint32_t LTDC_LayerCfgTypeDef::PixelFormat***
  Specifies the pixel format. This parameter can be one of value of ***LTDC_Pixelformat***
- ***uint32_t LTDC_LayerCfgTypeDef::Alpha***
  Specifies the constant alpha used for blending. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint32_t LTDC_LayerCfgTypeDef::Alpha0***
  Configures the default alpha value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.
- ***uint32_t LTDC_LayerCfgTypeDef::BlendingFactor1***
  Select the blending factor 1. This parameter can be one of value of ***LTDC_BlendingFactor1***
- ***uint32_t LTDC_LayerCfgTypeDef::BlendingFactor2***
  Select the blending factor 2. This parameter can be one of value of ***LTDC_BlendingFactor2***
- ***uint32_t LTDC_LayerCfgTypeDef::FBStartAdress***
  Configures the color frame buffer address
- ***uint32_t LTDC_LayerCfgTypeDef::ImageWidth***
  Configures the color frame buffer line length. This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x1FFF.
- ***uint32_t LTDC_LayerCfgTypeDef::ImageHeight***
  Specifies the number of line in frame buffer. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0x7FF.
- ***LTDC_ColorTypeDef LTDC_LayerCfgTypeDef::Backcolor***
  Configures the layer background color.

43.1.4 LTDC_HandleTypeDef

LTDC_HandleTypeDef is defined in the stm32l4xx_hal_ltdc.h

Data Fields

- ***LTDC_TypeDef * Instance***
- ***LTDC_InitTypeDef Init***
- ***LTDC_LayerCfgTypeDef LayerCfg***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_LTDC_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***LTDC_TypeDef* LTDC_HandleTypeDef::Instance***
  LTDC Register base address
- ***LTDC_InitTypeDef LTDC_HandleTypeDef::Init***
  LTDC parameters
- ***LTDC_LayerCfgTypeDef LTDC_HandleTypeDef::LayerCfg[MAX_LAYER]***
  LTDC Layers parameters
- ***HAL_LockTypeDef LTDC_HandleTypeDef::Lock***
  LTDC Lock

- ***__IO HAL_LTDC_StateTypeDef LTDC_HandleTypeDef::State***
  LTDC state
- ***__IO uint32_t LTDC_HandleTypeDef::ErrorCode***
  LTDC Error code

43.2 LTDC Firmware driver API description

The following section lists the various functions of the LTDC library.

43.2.1 How to use this driver

The LTDC HAL driver can be used as follows:

1. Declare a LTDC_HandleTypeDef handle structure, for example: LTDC_HandleTypeDef hltdc;
2. Initialize the LTDC low level resources by implementing the HAL_LTDC_MspInit() API:
   a. Enable the LTDC interface clock
   b. NVIC configuration if you need to use interrupt process
      - Configure the LTDC interrupt priority
      - Enable the NVIC LTDC IRQ Channel
3. Initialize the required configuration through the following parameters: the LTDC timing, the horizontal and vertical polarity, the pixel clock polarity, Data Enable polarity and the LTDC background color value using HAL_LTDC_Init() function

Configuration

1. Program the required configuration through the following parameters: the pixel format, the blending factors, input alpha value, the window size and the image size using HAL_LTDC_ConfigLayer() function for foreground or/and background layer.
2. Optionally, configure and enable the CLUT using HAL_LTDC_ConfigCLUT() and HAL_LTDC_EnableCLUT functions.
3. Optionally, enable the Dither using HAL_LTDC_EnableDither().
4. Optionally, configure and enable the Color keying using HAL_LTDC_ConfigColorKeying() and HAL_LTDC_EnableColorKeying functions.
5. Optionally, configure LineInterrupt using HAL_LTDC_ProgramLineEvent() function
6. If needed, reconfigure and change the pixel format value, the alpha value value, the window size, the window position and the layer start address for foreground or/and background layer using respectively the following functions: HAL_LTDC_SetPixelFormat(), HAL_LTDC_SetAlpha(), HAL_LTDC_SetWindowSize(), HAL_LTDC_SetWindowPosition() and HAL_LTDC_SetAddress().
7. Variant functions with _NoReload suffix allows to set the LTDC configuration/settings without immediate reload. This is useful in case when the program requires to modify serval LTDC settings (on one or both layers) then applying(reload) these settings in one shot by calling the function HAL_LTDC_Reload(). After calling the _NoReload functions to set different color/format/layer settings, the program shall call the function HAL_LTDC_Reload() to apply(reload) these settings. Function HAL_LTDC_Reload() can be called with the parameter ReloadType set to LTDC_RELOAD_IMMEDIATE if an immediate reload is required. Function HAL_LTDC_Reload() can be called with the parameter ReloadType set to LTDC_RELOAD_VERTICAL_BLANKING if the reload should be done in the next vertical blanking period, this option allows to avoid display flicker by applying the new settings during the vertical blanking period.
8. To control LTDC state you can use the following function: HAL_LTDC_GetState()

LTDC HAL driver macros list

Below the list of most used macros in LTDC HAL driver.

- __HAL_LTDC_ENABLE: Enable the LTDC.
- __HAL_LTDC_DISABLE: Disable the LTDC.
- __HAL_LTDC_LAYER_ENABLE: Enable an LTDC Layer.
- __HAL_LTDC_LAYER_DISABLE: Disable an LTDC Layer.
- __HAL_LTDC_RELOAD_IMMEDIATE_CONFIG: Reload Layer Configuration.
- __HAL_LTDC_GET_FLAG: Get the LTDC pending flags.

- __HAL_LTDC_CLEAR_FLAG: Clear the LTDC pending flags.
- __HAL_LTDC_ENABLE_IT: Enable the specified LTDC interrupts.
- __HAL_LTDC_DISABLE_IT: Disable the specified LTDC interrupts.
- __HAL_LTDC_GET_IT_SOURCE: Check whether the specified LTDC interrupt has occurred or not.

Note: You can refer to the LTDC HAL driver header file for more useful macros

Callback registration

The compilation define USE_HAL_LTDC_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use function HAL_LTDC_RegisterCallback() to register a callback.

Function HAL_LTDC_RegisterCallback() allows to register following callbacks:

- LineEventCallback : LTDC Line Event Callback.
- ReloadEventCallback : LTDC Reload Event Callback.
- ErrorCallback : LTDC Error Callback
- MspInitCallback : LTDC MspInit.
- MspDeInitCallback : LTDC MspDeInit.

This function takes as parameters the HAL peripheral handle, the callback ID and a pointer to the user callback function.

Use function HAL_LTDC_UnRegisterCallback() to reset a callback to the default weak function. HAL_LTDC_UnRegisterCallback() takes as parameters the HAL peripheral handle and the callback ID.

This function allows to reset following callbacks:

- LineEventCallback : LTDC Line Event Callback
- ReloadEventCallback : LTDC Reload Event Callback
- ErrorCallback : LTDC Error Callback
- MspInitCallback : LTDC MspInit
- MspDeInitCallback : LTDC MspDeInit.

By default, after the HAL_LTDC_Init and when the state is HAL_LTDC_STATE_RESET all callbacks are set to the corresponding weak functions: examples HAL_LTDC_LineEventCallback(), HAL_LTDC_ErrorCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak (surcharged) functions in the HAL_LTDC_Init() and HAL_LTDC_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the HAL_LTDC_Init() and HAL_LTDC_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_LTDC_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_LTDC_STATE_READY or HAL_LTDC_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using HAL_LTDC_RegisterCallback() before calling HAL_LTDC_DeInit() or HAL_LTDC_Init() function.

When the compilation define USE_HAL_LTDC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

43.2.2 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the LTDC
- De-initialize the LTDC

This section contains the following APIs:

- ***HAL_LTDC_Init***
- ***HAL_LTDC_DeInit***
- ***HAL_LTDC_MspInit***
- ***HAL_LTDC_MspDeInit***
- ***HAL_LTDC_ErrorCallback***
- ***HAL_LTDC_LineEventCallback***
- ***HAL_LTDC_ReloadEventCallback***

43.2.3 IO operation functions

This section provides function allowing to:

- Handle LTDC interrupt request

This section contains the following APIs:

- ***HAL_LTDC_IRQHandler***
- ***HAL_LTDC_ErrorCallback***
- ***HAL_LTDC_LineEventCallback***
- ***HAL_LTDC_ReloadEventCallback***

43.2.4 Peripheral Control functions

This section provides functions allowing to:

- Configure the LTDC foreground or/and background parameters.
- Set the active layer.
- Configure the color keying.
- Configure the C-LUT.
- Enable / Disable the color keying.
- Enable / Disable the C-LUT.
- Update the layer position.
- Update the layer size.
- Update pixel format on the fly.
- Update transparency on the fly.
- Update address on the fly.

This section contains the following APIs:

- ***HAL_LTDC_ConfigLayer***
- ***HAL_LTDC_ConfigColorKeying***
- ***HAL_LTDC_ConfigCLUT***
- ***HAL_LTDC_EnableColorKeying***
- ***HAL_LTDC_DisableColorKeying***
- ***HAL_LTDC_EnableCLUT***
- ***HAL_LTDC_DisableCLUT***
- ***HAL_LTDC_EnableDither***
- ***HAL_LTDC_DisableDither***
- ***HAL_LTDC_SetWindowSize***
- ***HAL_LTDC_SetWindowPosition***
- ***HAL_LTDC_SetPixelFormat***
- ***HAL_LTDC_SetAlpha***
- ***HAL_LTDC_SetAddress***
- ***HAL_LTDC_SetPitch***
- ***HAL_LTDC_ProgramLineEvent***
- ***HAL_LTDC_Reload***
- ***HAL_LTDC_ConfigLayer_NoReload***
- ***HAL_LTDC_SetWindowSize_NoReload***
- ***HAL_LTDC_SetWindowPosition_NoReload***
- ***HAL_LTDC_SetPixelFormat_NoReload***
- ***HAL_LTDC_SetAlpha_NoReload***
- ***HAL_LTDC_SetAddress_NoReload***
- ***HAL_LTDC_SetPitch_NoReload***

- *HAL_LTDC_ConfigColorKeying_NoReload*
- *HAL_LTDC_EnableColorKeying_NoReload*
- *HAL_LTDC_DisableColorKeying_NoReload*
- *HAL_LTDC_EnableCLUT_NoReload*
- *HAL_LTDC_DisableCLUT_NoReload*

43.2.5 Peripheral State and Errors functions

This subsection provides functions allowing to

- Check the LTDC handle state.
- Get the LTDC handle error code.

This section contains the following APIs:

- *HAL_LTDC_GetState*
- *HAL_LTDC_GetError*

43.2.6 Detailed description of functions

`HAL_LTDC_Init`

Function name

HAL_StatusTypeDef HAL_LTDC_Init (LTDC_HandleTypeDef * hltdc)

Function description

Initialize the LTDC according to the specified parameters in the LTDC_InitTypeDef.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL:** status

`HAL_LTDC_DeInit`

Function name

HAL_StatusTypeDef HAL_LTDC_DeInit (LTDC_HandleTypeDef * hltdc)

Function description

De-initialize the LTDC peripheral.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **None:**

`HAL_LTDC_MspInit`

Function name

void HAL_LTDC_MspInit (LTDC_HandleTypeDef * hltdc)

Function description

Initialize the LTDC MSP.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **None:**

`HAL_LTDC_MspDeInit`

Function name

void HAL_LTDC_MspDeInit (LTDC_HandleTypeDef * hltdc)

Function description

De-initialize the LTDC MSP.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **None:**

`HAL_LTDC_ErrorCallback`

Function name

void HAL_LTDC_ErrorCallback (LTDC_HandleTypeDef * hltdc)

Function description

Error LTDC callback.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **None:**

`HAL_LTDC_LineEventCallback`

Function name

void HAL_LTDC_LineEventCallback (LTDC_HandleTypeDef * hltdc)

Function description

Line Event callback.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **None:**

`HAL_LTDC_ReloadEventCallback`

Function name

void HAL_LTDC_ReloadEventCallback (LTDC_HandleTypeDef * hltdc)

Function description

Reload Event callback.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **None:**

`HAL_LTDC_IRQHandler`

Function name

void HAL_LTDC_IRQHandler (LTDC_HandleTypeDef * hltdc)

Function description

Handle LTDC interrupt request.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL:** status

`HAL_LTDC_ConfigLayer`

Function name

HAL_StatusTypeDef HAL_LTDC_ConfigLayer (LTDC_HandleTypeDef * hltdc, LTDC_LayerCfgTypeDef * pLayerCfg, uint32_t LayerIdx)

Function description

Configure the LTDC Layer according to the specified parameters in the LTDC_InitTypeDef and create the associated handle.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **pLayerCfg:** pointer to a LTDC_LayerCfgTypeDef structure that contains the configuration information for the Layer.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_SetWindowSize`

Function name

HAL_StatusTypeDef HAL_LTDC_SetWindowSize (LTDC_HandleTypeDef * hltdc, uint32_t XSize, uint32_t YSize, uint32_t LayerIdx)

Function description

Set the LTDC window size.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **XSize:** LTDC Pixel per line
- **YSize:** LTDC Line number
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_SetWindowPosition

Function name

HAL_StatusTypeDef HAL_LTDC_SetWindowPosition (LTDC_HandleTypeDef * hltdc, uint32_t X0, uint32_t Y0, uint32_t LayerIdx)

Function description

Set the LTDC window position.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **X0:** LTDC window X offset
- **Y0:** LTDC window Y offset
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_SetPixelFormat

Function name

HAL_StatusTypeDef HAL_LTDC_SetPixelFormat (LTDC_HandleTypeDef * hltdc, uint32_t Pixelformat, uint32_t LayerIdx)

Function description

Reconfigure the pixel format.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Pixelformat:** new pixel format value.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1).

Return values

- **HAL:** status

HAL_LTDC_SetAlpha

Function name

HAL_StatusTypeDef HAL_LTDC_SetAlpha (LTDC_HandleTypeDef * hltdc, uint32_t Alpha, uint32_t LayerIdx)

Function description

Reconfigure the layer alpha value.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Alpha:** new alpha value.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_SetAddress

Function name

HAL_StatusTypeDef HAL_LTDC_SetAddress (LTDC_HandleTypeDef * hltdc, uint32_t Address, uint32_t LayerIdx)

Function description

Reconfigure the frame buffer Address.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Address:** new address value.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1).

Return values

- **HAL:** status

HAL_LTDC_SetPitch

Function name

HAL_StatusTypeDef HAL_LTDC_SetPitch (LTDC_HandleTypeDef * hltdc, uint32_t LinePitchInPixels, uint32_t LayerIdx)

Function description

Function used to reconfigure the pitch for specific cases where the attached LayerIdx buffer have a width that is larger than the one intended to be displayed on screen.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LinePitchInPixels:** New line pitch in pixels to configure for LTDC layer 'LayerIdx'.
- **LayerIdx:** LTDC layer index concerned by the modification of line pitch.

Return values

- **HAL:** status

Notes

- This function should be called only after a previous call to HAL_LTDC_ConfigLayer() to modify the default pitch configured by HAL_LTDC_ConfigLayer() when required (refer to example described just above).

HAL_LTDC_ConfigColorKeying

Function name

HAL_StatusTypeDef HAL_LTDC_ConfigColorKeying (LTDC_HandleTypeDef * hltdc, uint32_t RGBValue, uint32_t LayerIdx)

Function description

Configure the color keying.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **RGBValue:** the color key value
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_ConfigCLUT

Function name

HAL_StatusTypeDef HAL_LTDC_ConfigCLUT (LTDC_HandleTypeDef * hltdc, uint32_t * pCLUT, uint32_t CLUTSize, uint32_t LayerIdx)

Function description

Load the color lookup table.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **pCLUT:** pointer to the color lookup table address.
- **CLUTSize:** the color lookup table size.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_EnableColorKeying

Function name

HAL_StatusTypeDef HAL_LTDC_EnableColorKeying (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Enable the color keying.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_DisableColorKeying

Function name

HAL_StatusTypeDef HAL_LTDC_DisableColorKeying (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Disable the color keying.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_EnableCLUT

Function name

HAL_StatusTypeDef HAL_LTDC_EnableCLUT (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Enable the color lookup table.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_DisableCLUT

Function name

HAL_StatusTypeDef HAL_LTDC_DisableCLUT (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Disable the color lookup table.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_ProgramLineEvent

Function name

HAL_StatusTypeDef HAL_LTDC_ProgramLineEvent (LTDC_HandleTypeDef * hltdc, uint32_t Line)

Function description

Define the position of the line interrupt.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Line:** Line Interrupt Position.

Return values

- **HAL:** status

Notes

- User application may resort to HAL_LTDC_LineEventCallback() at line interrupt generation.

HAL_LTDC_EnableDither

Function name

HAL_StatusTypeDef HAL_LTDC_EnableDither (LTDC_HandleTypeDef * hltdc)

Function description

Enable Dither.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL:** status

`HAL_LTDC_DisableDither`

Function name

HAL_StatusTypeDef HAL_LTDC_DisableDither (LTDC_HandleTypeDef * hltdc)

Function description

Disable Dither.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL:** status

`HAL_LTDC_Reload`

Function name

HAL_StatusTypeDef HAL_LTDC_Reload (LTDC_HandleTypeDef * hltdc, uint32_t ReloadType)

Function description

Reload LTDC Layers configuration.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **ReloadType:** This parameter can be one of the following values : LTDC_RELOAD_IMMEDIATE : Immediate Reload LTDC_RELOAD_VERTICAL_BLANKING : Reload in the next Vertical Blanking

Return values

- **HAL:** status

Notes

- User application may resort to HAL_LTDC_ReloadEventCallback() at reload interrupt generation.

`HAL_LTDC_ConfigLayer_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_ConfigLayer_NoReload (LTDC_HandleTypeDef * hltdc, LTDC_LayerCfgTypeDef * pLayerCfg, uint32_t LayerIdx)

Function description

Configure the LTDC Layer according to the specified without reloading parameters in the LTDC_InitTypeDef and create the associated handle.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **pLayerCfg:** pointer to a LTDC_LayerCfgTypeDef structure that contains the configuration information for the Layer.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_SetWindowSize_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_SetWindowSize_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t XSize, uint32_t YSize, uint32_t LayerIdx)

Function description

Set the LTDC window size without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **XSize:** LTDC Pixel per line
- **YSize:** LTDC Line number
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_SetWindowPosition_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_SetWindowPosition_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t X0, uint32_t Y0, uint32_t LayerIdx)

Function description

Set the LTDC window position without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **X0:** LTDC window X offset
- **Y0:** LTDC window Y offset
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_SetPixelFormat_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_SetPixelFormat_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t Pixelformat, uint32_t LayerIdx)

Function description

Reconfigure the pixel format without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDfef structure that contains the configuration information for the LTDC.
- **Pixelformat:** new pixel format value.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1).

Return values

- **HAL:** status

HAL_LTDC_SetAlpha_NoReload

Function name

HAL_StatusTypeDef HAL_LTDC_SetAlpha_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t Alpha, uint32_t LayerIdx)

Function description

Reconfigure the layer alpha value without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Alpha:** new alpha value.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

HAL_LTDC_SetAddress_NoReload

Function name

HAL_StatusTypeDef HAL_LTDC_SetAddress_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t Address, uint32_t LayerIdx)

Function description

Reconfigure the frame buffer Address without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **Address:** new address value.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1).

Return values

- **HAL:** status

HAL_LTDC_SetPitch_NoReload

Function name

HAL_StatusTypeDef HAL_LTDC_SetPitch_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LinePitchInPixels, uint32_t LayerIdx)

Function description

Function used to reconfigure the pitch for specific cases where the attached LayerIdx buffer have a width that is larger than the one intended to be displayed on screen.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LinePitchInPixels:** New line pitch in pixels to configure for LTDC layer 'LayerIdx'.
- **LayerIdx:** LTDC layer index concerned by the modification of line pitch.

Return values

- **HAL:** status

Notes

- This function should be called only after a previous call to HAL_LTDC_ConfigLayer() to modify the default pitch configured by HAL_LTDC_ConfigLayer() when required (refer to example described just above). Variant of the function HAL_LTDC_SetPitch without immediate reload.

`HAL_LTDC_ConfigColorKeying_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_ConfigColorKeying_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t RGBValue, uint32_t LayerIdx)

Function description

Configure the color keying without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **RGBValue:** the color key value
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_EnableColorKeying_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_EnableColorKeying_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Enable the color keying without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_DisableColorKeying_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_DisableColorKeying_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Disable the color keying without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_EnableCLUT_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_EnableCLUT_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Enable the color lookup table without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_DisableCLUT_NoReload`

Function name

HAL_StatusTypeDef HAL_LTDC_DisableCLUT_NoReload (LTDC_HandleTypeDef * hltdc, uint32_t LayerIdx)

Function description

Disable the color lookup table without reloading.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **LayerIdx:** LTDC Layer index. This parameter can be one of the following values: LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1)

Return values

- **HAL:** status

`HAL_LTDC_GetState`

Function name

HAL_LTDC_StateTypeDef HAL_LTDC_GetState (LTDC_HandleTypeDef * hltdc)

Function description

Return the LTDC handle state.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **HAL:** state

`HAL_LTDC_GetError`

Function name

uint32_t HAL_LTDC_GetError (LTDC_HandleTypeDef * hltdc)

Function description

Return the LTDC handle error code.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.

Return values

- **LTDC:** Error Code

43.3 LTDC Firmware driver defines

The following section lists the various define and macros of the module.

43.3.1 LTDC

LTDC

LTDC Alpha

LTDC_ALPHA

LTDC Constant Alpha mask

LTDC BACK COLOR

LTDC_COLOR

Color mask

LTDC Blending Factor1

LTDC_BLENDING_FACTOR1_CA

Blending factor : Cte Alpha

LTDC_BLENDING_FACTOR1_PAxCA

Blending factor : Cte Alpha x Pixel Alpha

LTDC Blending Factor2

LTDC_BLENDING_FACTOR2_CA

Blending factor : Cte Alpha

LTDC_BLENDING_FACTOR2_PAxCA

Blending factor : Cte Alpha x Pixel Alpha

LTDC DE POLARITY

LTDC_DEPOLARITY_AL

Data Enable, is active low.

LTDC_DEPOLARITY_AH

Data Enable, is active high.

LTDC Error Code

HAL_LTDC_ERROR_NONE

LTDC No error

HAL_LTDC_ERROR_TE

LTDC Transfer error

HAL_LTDC_ERROR_FU

LTDC FIFO Underrun

HAL_LTDC_ERROR_TIMEOUT

LTDC Timeout error

LTDC Exported Macros

__HAL_LTDC_RESET_HANDLE_STATE

Description:

- Reset LTDC handle state.

Parameters:

- __HANDLE__: LTDC handle

Return value:

- None

__HAL_LTDC_ENABLE

Description:

- Enable the LTDC.

Parameters:

- __HANDLE__: LTDC handle

Return value:

- None.

__HAL_LTDC_DISABLE

Description:

- Disable the LTDC.

Parameters:

- __HANDLE__: LTDC handle

Return value:

- None.

__HAL_LTDC_LAYER_ENABLE

Description:

- Enable the LTDC Layer.

Parameters:

- __HANDLE__: LTDC handle
- __LAYER__: Specify the layer to be enabled. This parameter can be LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1).

Return value:

- None.

__HAL_LTDC_LAYER_DISABLE

Description:

- Disable the LTDC Layer.

Parameters:

- __HANDLE__: LTDC handle
- __LAYER__: Specify the layer to be disabled. This parameter can be LTDC_LAYER_1 (0) or LTDC_LAYER_2 (1).

Return value:

- None.

__HAL_LTDC_RELOAD_IMMEDIATE_CONFIG

Description:

- Reload immediately all LTDC Layers.

Parameters:

- __HANDLE__: LTDC handle

Return value:

- None.

__HAL_LTDC_VERTICAL_BLANKING_RELOAD_CONFIG

Description:

- Reload during vertical blanking period all LTDC Layers.

Parameters:

- __HANDLE__: LTDC handle

Return value:

- None.

__HAL_LTDC_GET_FLAG

Description:

- Get the LTDC pending flags.

Parameters:

- __HANDLE__: LTDC handle
- __FLAG__: Get the specified flag. This parameter can be any combination of the following values:
  - LTDC_FLAG_LI: Line Interrupt flag
  - LTDC_FLAG_FU: FIFO Underrun Interrupt flag
  - LTDC_FLAG_TE: Transfer Error interrupt flag
  - LTDC_FLAG_RR: Register Reload Interrupt Flag

Return value:

- The: state of FLAG (SET or RESET).

__HAL_LTDC_CLEAR_FLAG

Description:

- Clears the LTDC pending flags.

Parameters:

- __HANDLE__: LTDC handle
- __FLAG__: Specify the flag to clear. This parameter can be any combination of the following values:
  - LTDC_FLAG_LI: Line Interrupt flag
  - LTDC_FLAG_FU: FIFO Underrun Interrupt flag
  - LTDC_FLAG_TE: Transfer Error interrupt flag
  - LTDC_FLAG_RR: Register Reload Interrupt Flag

Return value:

- None

__HAL_LTDC_ENABLE_IT

Description:

- Enables the specified LTDC interrupts.

Parameters:

- __HANDLE__: LTDC handle
- __INTERRUPT__: Specify the LTDC interrupt sources to be enabled. This parameter can be any combination of the following values:
  - LTDC_IT_LI: Line Interrupt flag
  - LTDC_IT_FU: FIFO Underrun Interrupt flag
  - LTDC_IT_TE: Transfer Error interrupt flag
  - LTDC_IT_RR: Register Reload Interrupt Flag

Return value:

- None

__HAL_LTDC_DISABLE_IT

Description:

- Disables the specified LTDC interrupts.

Parameters:

- __HANDLE__: LTDC handle
- __INTERRUPT__: Specify the LTDC interrupt sources to be disabled. This parameter can be any combination of the following values:
  - LTDC_IT_LI: Line Interrupt flag
  - LTDC_IT_FU: FIFO Underrun Interrupt flag
  - LTDC_IT_TE: Transfer Error interrupt flag
  - LTDC_IT_RR: Register Reload Interrupt Flag

Return value:

- None

__HAL_LTDC_GET_IT_SOURCE

Description:

- Check whether the specified LTDC interrupt has occurred or not.

Parameters:

- __HANDLE__: LTDC handle
- __INTERRUPT__: Specify the LTDC interrupt source to check. This parameter can be one of the following values:
  - LTDC_IT_LI: Line Interrupt flag
  - LTDC_IT_FU: FIFO Underrun Interrupt flag
  - LTDC_IT_TE: Transfer Error interrupt flag
  - LTDC_IT_RR: Register Reload Interrupt Flag

Return value:

- The: state of INTERRUPT (SET or RESET).

LTDC Exported Types

MAX_LAYER

LTDC Flags

LTDC_FLAG_LI

LTDC Line Interrupt Flag

LTDC_FLAG_FU

LTDC FIFO Underrun interrupt Flag

LTDC_FLAG_TE

LTDC Transfer Error interrupt Flag

LTDC_FLAG_RR

LTDC Register Reload interrupt Flag

LTDC HS POLARITY

LTDC_HSPOLARITY_AL

Horizontal Synchronization is active low.

LTDC_HSPOLARITY_AH

Horizontal Synchronization is active high.

LTDC Interrupts

LTDC_IT_LI

LTDC Line Interrupt

LTDC_IT_FU

LTDC FIFO Underrun Interrupt

LTDC_IT_TE

LTDC Transfer Error Interrupt

LTDC_IT_RR

LTDC Register Reload Interrupt

LTDC Layer

LTDC_LAYER_1

LTDC Layer 1

LTDC_LAYER_2

LTDC Layer 2

LTDC LAYER Config

LTDC_STOPPOSITION

LTDC Layer stop position

LTDC_STARTPOSITION

LTDC Layer start position

LTDC_COLOR_FRAME_BUFFER

LTDC Layer Line length

LTDC_LINE_NUMBER

LTDC Layer Line number

LTDC PC POLARITY

LTDC_PCPOLARITY_IPC

input pixel clock.

LTDC_PCPOLARITY_IIPC

inverted input pixel clock.

LTDC Pixel format

LTDC_PIXEL_FORMAT_ARGB8888

ARGB8888 LTDC pixel format

LTDC_PIXEL_FORMAT_RGB888

RGB888 LTDC pixel format

LTDC_PIXEL_FORMAT_RGB565

RGB565 LTDC pixel format

LTDC_PIXEL_FORMAT_ARGB1555

ARGB1555 LTDC pixel format

LTDC_PIXEL_FORMAT_ARGB4444

ARGB4444 LTDC pixel format

LTDC_PIXEL_FORMAT_L8

L8 LTDC pixel format

LTDC_PIXEL_FORMAT_AL44

AL44 LTDC pixel format

LTDC_PIXEL_FORMAT_AL88

AL88 LTDC pixel format

LTDC Reload Type

LTDC_RELOAD_IMMEDIATE

Immediate Reload

LTDC_RELOAD_VERTICAL_BLANKING

Vertical Blanking Reload

LTDC SYNC

LTDC_HORIZONTALSYNC

Horizontal synchronization width.

LTDC_VERTICALSYNC

Vertical synchronization height.

LTDC VS POLARITY

LTDC_VSPOLARITY_AL

Vertical Synchronization is active low.

LTDC_VSPOLARITY_AH

Vertical Synchronization is active high.

44 HAL LTDC Extension Driver

44.1 LTDCEx Firmware driver API description

The following section lists the various functions of the LTDCEx library.

44.1.1 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and configure the LTDC

This section contains the following APIs:

- ***HAL_LTDCEx_StructInitFromVideoConfig***
- ***HAL_LTDCEx_StructInitFromAdaptedCommandConfig***

44.1.2 Detailed description of functions

`HAL_LTDCEx_StructInitFromVideoConfig`

Function name

HAL_StatusTypeDef HAL_LTDCEx_StructInitFromVideoConfig (LTDC_HandleTypeDef * hltdc, DSI_VidCfgTypeDef * VidCfg)

Function description

Retrieve common parameters from DSI Video mode configuration structure.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **VidCfg:** pointer to a DSI_VidCfgTypeDef structure that contains the DSI video mode configuration parameters

Return values

- **HAL:** status

Notes

- The implementation of this function is taking into account the LTDC polarities inversion as described in the current LTDC specification

`HAL_LTDCEx_StructInitFromAdaptedCommandConfig`

Function name

HAL_StatusTypeDef HAL_LTDCEx_StructInitFromAdaptedCommandConfig (LTDC_HandleTypeDef * hltdc, DSI_CmdCfgTypeDef * CmdCfg)

Function description

Retrieve common parameters from DSI Adapted command mode configuration structure.

Parameters

- **hltdc:** pointer to a LTDC_HandleTypeDef structure that contains the configuration information for the LTDC.
- **CmdCfg:** pointer to a DSI_CmdCfgTypeDef structure that contains the DSI command mode configuration parameters

Return values

- **HAL:** status

Notes

- The implementation of this function is taking into account the LTDC polarities inversion as described in the current LTDC specification

45 HAL MMC Generic Driver

45.1 MMC Firmware driver registers structures

45.1.1 HAL_MMC_CardInfoTypeDef

HAL_MMC_CardInfoTypeDef is defined in the stm32l4xx_hal_mmc.h

Data Fields

- ***uint32_t CardType***
- ***uint32_t Class***
- ***uint32_t RelCardAdd***
- ***uint32_t BlockNbr***
- ***uint32_t BlockSize***
- ***uint32_t LogBlockNbr***
- ***uint32_t LogBlockSize***

Field Documentation

- ***uint32_t HAL_MMC_CardInfoTypeDef::CardType***
  Specifies the card Type
- ***uint32_t HAL_MMC_CardInfoTypeDef::Class***
  Specifies the class of the card class
- ***uint32_t HAL_MMC_CardInfoTypeDef::RelCardAdd***
  Specifies the Relative Card Address
- ***uint32_t HAL_MMC_CardInfoTypeDef::BlockNbr***
  Specifies the Card Capacity in blocks
- ***uint32_t HAL_MMC_CardInfoTypeDef::BlockSize***
  Specifies one block size in bytes
- ***uint32_t HAL_MMC_CardInfoTypeDef::LogBlockNbr***
  Specifies the Card logical Capacity in blocks
- ***uint32_t HAL_MMC_CardInfoTypeDef::LogBlockSize***
  Specifies logical block size in bytes

45.1.2 MMC_HandleTypeDef

MMC_HandleTypeDef is defined in the stm32l4xx_hal_mmc.h

Data Fields

- ***MMC_TypeDef * Instance***
- ***MMC_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***uint8_t * pTxBuffPtr***
- ***uint32_t TxXferSize***
- ***uint8_t * pRxBuffPtr***
- ***uint32_t RxXferSize***
- ***__IO uint32_t Context***
- ***__IO HAL_MMC_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***HAL_MMC_CardInfoTypeDef MmcCard***
- ***uint32_t CSD***
- ***uint32_t CID***
- ***uint32_t Ext_CSD***

Field Documentation

- ***MMC_TypeDef* MMC_HandleTypeDef::Instance***
  MMC registers base address
- ***MMC_InitTypeDef MMC_HandleTypeDef::Init***
  MMC required parameters
- ***HAL_LockTypeDef MMC_HandleTypeDef::Lock***
  MMC locking object
- ***uint8_t* MMC_HandleTypeDef::pTxBuffPtr***
  Pointer to MMC Tx transfer Buffer
- ***uint32_t MMC_HandleTypeDef::TxXferSize***
  MMC Tx Transfer size
- ***uint8_t* MMC_HandleTypeDef::pRxBuffPtr***
  Pointer to MMC Rx transfer Buffer
- ***uint32_t MMC_HandleTypeDef::RxXferSize***
  MMC Rx Transfer size
- ***__IO uint32_t MMC_HandleTypeDef::Context***
  MMC transfer context
- ***__IO HAL_MMC_StateTypeDef MMC_HandleTypeDef::State***
  MMC card State
- ***__IO uint32_t MMC_HandleTypeDef::ErrorCode***
  MMC Card Error codes
- ***HAL_MMC_CardInfoTypeDef MMC_HandleTypeDef::MmcCard***
  MMC Card information
- ***uint32_t MMC_HandleTypeDef::CSD[4U]***
  MMC card specific data table
- ***uint32_t MMC_HandleTypeDef::CID[4U]***
  MMC card identification number table
- ***uint32_t MMC_HandleTypeDef::Ext_CSD[128]***

45.1.3 HAL_MMC_CardCSDTypeDef

HAL_MMC_CardCSDTypeDef is defined in the stm32l4xx_hal_mmc.h

Data Fields

- ***__IO uint8_t CSDStruct***
- ***__IO uint8_t SysSpecVersion***
- ***__IO uint8_t Reserved1***
- ***__IO uint8_t TAAC***
- ***__IO uint8_t NSAC***
- ***__IO uint8_t MaxBusClkFrec***
- ***__IO uint16_t CardComdClasses***
- ***__IO uint8_t RdBlockLen***
- ***__IO uint8_t PartBlockRead***
- ***__IO uint8_t WrBlockMisalign***
- ***__IO uint8_t RdBlockMisalign***
- ***__IO uint8_t DSRImpl***
- ***__IO uint8_t Reserved2***
- ***__IO uint32_t DeviceSize***
- ***__IO uint8_t MaxRdCurrentVDDMin***
- ***__IO uint8_t MaxRdCurrentVDDMax***
- ***__IO uint8_t MaxWrCurrentVDDMin***

- ***__IO uint8_t MaxWrCurrentVDDMax***
- ***__IO uint8_t DeviceSizeMul***
- ***__IO uint8_t EraseGrSize***
- ***__IO uint8_t EraseGrMul***
- ***__IO uint8_t WrProtectGrSize***
- ***__IO uint8_t WrProtectGrEnable***
- ***__IO uint8_t ManDeflECC***
- ***__IO uint8_t WrSpeedFact***
- ***__IO uint8_t MaxWrBlockLen***
- ***__IO uint8_t WriteBlockPaPartial***
- ***__IO uint8_t Reserved3***
- ***__IO uint8_t ContentProtectAppli***
- ***__IO uint8_t FileFormatGroup***
- ***__IO uint8_t CopyFlag***
- ***__IO uint8_t PermWrProtect***
- ***__IO uint8_t TempWrProtect***
- ***__IO uint8_t FileFormat***
- ***__IO uint8_t ECC***
- ***__IO uint8_t CSD_CRC***
- ***__IO uint8_t Reserved4***

Field Documentation

- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::CSDStruct***
  CSD structure
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::SysSpecVersion***
  System specification version
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved1***
  Reserved
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::TAAC***
  Data read access time 1
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::NSAC***
  Data read access time 2 in CLK cycles
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxBusClkFrec***
  Max. bus clock frequency
- ***__IO uint16_t HAL_MMC_CardCSDTypeDef::CardComdClasses***
  Card command classes
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::RdBlockLen***
  Max. read data block length
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::PartBlockRead***
  Partial blocks for read allowed
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::WrBlockMisalign***
  Write block misalignment
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::RdBlockMisalign***
  Read block misalignment
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::DSRImpl***
  DSR implemented
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved2***
  Reserved
- ***__IO uint32_t HAL_MMC_CardCSDTypeDef::DeviceSize***
  Device Size

- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxRdCurrentVDDMin***
  Max. read current @ VDD min
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxRdCurrentVDDMax***
  Max. read current @ VDD max
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxWrCurrentVDDMin***
  Max. write current @ VDD min
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxWrCurrentVDDMax***
  Max. write current @ VDD max
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::DeviceSizeMul***
  Device size multiplier
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::EraseGrSize***
  Erase group size
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::EraseGrMul***
  Erase group size multiplier
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::WrProtectGrSize***
  Write protect group size
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::WrProtectGrEnable***
  Write protect group enable
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::ManDeflECC***
  Manufacturer default ECC
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::WrSpeedFact***
  Write speed factor
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::MaxWrBlockLen***
  Max. write data block length
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::WriteBlockPaPartial***
  Partial blocks for write allowed
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved3***
  Reserved
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::ContentProtectAppli***
  Content protection application
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::FileFormatGroup***
  File format group
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::CopyFlag***
  Copy flag (OTP)
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::PermWrProtect***
  Permanent write protection
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::TempWrProtect***
  Temporary write protection
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::FileFormat***
  File format
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::ECC***
  ECC code
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::CSD_CRC***
  CSD CRC
- ***__IO uint8_t HAL_MMC_CardCSDTypeDef::Reserved4***
  Always 1

45.1.4 HAL_MMC_CardCIDTypeDef

HAL_MMC_CardCIDTypeDef is defined in the stm32l4xx_hal_mmc.h

Data Fields

- ***__IO uint8_t ManufacturerID***
- ***__IO uint16_t OEM_AppliID***
- ***__IO uint32_t ProdName1***
- ***__IO uint8_t ProdName2***
- ***__IO uint8_t ProdRev***
- ***__IO uint32_t ProdSN***
- ***__IO uint8_t Reserved1***
- ***__IO uint16_t ManufactDate***
- ***__IO uint8_t CID_CRC***
- ***__IO uint8_t Reserved2***

Field Documentation

- ***__IO uint8_t HAL_MMC_CardCIDTypeDef::ManufacturerID***
  Manufacturer ID
- ***__IO uint16_t HAL_MMC_CardCIDTypeDef::OEM_AppliID***
  OEM/Application ID
- ***__IO uint32_t HAL_MMC_CardCIDTypeDef::ProdName1***
  Product Name part1
- ***__IO uint8_t HAL_MMC_CardCIDTypeDef::ProdName2***
  Product Name part2
- ***__IO uint8_t HAL_MMC_CardCIDTypeDef::ProdRev***
  Product Revision
- ***__IO uint32_t HAL_MMC_CardCIDTypeDef::ProdSN***
  Product Serial Number
- ***__IO uint8_t HAL_MMC_CardCIDTypeDef::Reserved1***
  Reserved1
- ***__IO uint16_t HAL_MMC_CardCIDTypeDef::ManufactDate***
  Manufacturing Date
- ***__IO uint8_t HAL_MMC_CardCIDTypeDef::CID_CRC***
  CID CRC
- ***__IO uint8_t HAL_MMC_CardCIDTypeDef::Reserved2***
  Always 1

45.2 MMC Firmware driver API description

The following section lists the various functions of the MMC library.

45.2.1 How to use this driver

This driver implements a high level communication layer for read and write from/to this memory. The needed STM32 hardware resources (SDMMC and GPIO) are performed by the user in HAL_MMC_MspInit() function (MSP layer). Basically, the MSP layer configuration should be the same as we provide in the examples. You can easily tailor this configuration according to hardware resources.

This driver is a generic layered driver for SDMMC memories which uses the HAL SDMMC driver functions to interface with MMC and eMMC cards devices. It is used as follows:

1. Initialize the SDMMC low level resources by implement the HAL_MMC_MspInit() API:
   a. Enable the SDMMC interface clock using __HAL_RCC_SDMMC_CLK_ENABLE();
   b. SDMMC pins configuration for MMC card
      - Enable the clock for the SDMMC GPIOs using the functions __HAL_RCC_GPIOx_CLK_ENABLE();
      - Configure these SDMMC pins as alternate function pull-up using HAL_GPIO_Init() and according to your pin assignment;
   c. On STM32L4Rx/STM32L4Sxx devices, no DMA configuration is need, an internal DMA for SDMMC Peripheral is used.
   d. On other devices, perform DMA Configuration if you need to use DMA process (HAL_MMC_ReadBlocks_DMA() and HAL_MMC_WriteBlocks_DMA() APIs).
      - Enable the DMAx interface clock using __HAL_RCC_DMAx_CLK_ENABLE();
      - Configure the DMA using the function HAL_DMA_Init() with predeclared and filled.
   e. NVIC configuration if you need to use interrupt process when using DMA transfer.
      - Configure the SDMMC and DMA interrupt priorities using function HAL_NVIC_SetPriority(); DMA priority is superior to SDMMC's priority
      - Enable the NVIC DMA and SDMMC IRQs using function HAL_NVIC_EnableIRQ()
      - SDMMC interrupts are managed using the macros __HAL_MMC_ENABLE_IT() and __HAL_MMC_DISABLE_IT() inside the communication process.
      - SDMMC interrupts pending bits are managed using the macros __HAL_MMC_GET_IT() and __HAL_MMC_CLEAR_IT()
   f. NVIC configuration if you need to use interrupt process (HAL_MMC_ReadBlocks_IT() and HAL_MMC_WriteBlocks_IT() APIs).
      - Configure the SDMMC interrupt priorities using function HAL_NVIC_SetPriority();
      - Enable the NVIC SDMMC IRQs using function HAL_NVIC_EnableIRQ()
      - SDMMC interrupts are managed using the macros __HAL_MMC_ENABLE_IT() and __HAL_MMC_DISABLE_IT() inside the communication process.
      - SDMMC interrupts pending bits are managed using the macros __HAL_MMC_GET_IT() and __HAL_MMC_CLEAR_IT()
2. At this stage, you can perform MMC read/write/erase operations after MMC card initialization

MMC Card Initialization and configuration

To initialize the MMC Card, use the HAL_MMC_Init() function. It Initializes SDMMC Peripheral (STM32 side) and the MMC Card, and put it into StandBy State (Ready for data transfer). This function provide the following operations:

1. Initialize the SDMMC peripheral interface with defaullt configuration. The initialization process is done at 400KHz. You can change or adapt this frequency by adjusting the "ClockDiv" field. The MMC Card frequency (SDMMC_CK) is computed as follows: SDMMC_CK = SDMMCCLK / (2 * ClockDiv) on STM32L4Rx/STM32L4Sxx devices SDMMC_CK = SDMMCCLK / (ClockDiv + 2) on other devices In initialization mode and according to the MMC Card standard, make sure that the SDMMC_CK frequency doesn't exceed 400KHz. This phase of initialization is done through SDMMC_Init() and SDMMC_PowerState_ON() SDMMC low level APIs.
2. Initialize the MMC card. The API used is HAL_MMC_InitCard(). This phase allows the card initialization and identification and check the MMC Card type (Standard Capacity or High Capacity) The initialization flow is compatible with MMC standard. This API (HAL_MMC_InitCard()) could be used also to reinitialize the card in case of plug-off plug-in.
3. Configure the MMC Card Data transfer frequency. By Default, the card transfer frequency by adjusting the "ClockDiv" field. In transfer mode and according to the MMC Card standard, make sure that the SDMMC_CK frequency doesn't exceed 25MHz and 100MHz in High-speed mode switch.
4. Select the corresponding MMC Card according to the address read with the step 2.
5. Configure the MMC Card in wide bus mode: 4-bits data.

MMC Card Read operation

- You can read from MMC card in polling mode by using function HAL_MMC_ReadBlocks(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state.
- You can read from MMC card in DMA mode by using function HAL_MMC_ReadBlocks_DMA(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state. You could also check the DMA transfer process through the MMC Rx interrupt event.
- You can read from MMC card in Interrupt mode by using function HAL_MMC_ReadBlocks_IT(). This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state. You could also check the IT transfer process through the MMC Rx interrupt event.

MMC Card Write operation

- You can write to MMC card in polling mode by using function HAL_MMC_WriteBlocks(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state.
- You can write to MMC card in DMA mode by using function HAL_MMC_WriteBlocks_DMA(). This function support only 512-bytes block length (the block size should be chosen as 512 byte). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state. You could also check the DMA transfer process through the MMC Tx interrupt event.
- You can write to MMC card in Interrupt mode by using function HAL_MMC_WriteBlocks_IT(). This function allows the read of 512 bytes blocks. You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_MMC_GetCardState() function for MMC card state. You could also check the IT transfer process through the MMC Tx interrupt event.

MMC card information

- To get MMC card information, you can use the function HAL_MMC_GetCardInfo(). It returns useful information about the MMC card such as block size, card type, block number ...

MMC card CSD register

- The HAL_MMC_GetCardCSD() API allows to get the parameters of the CSD register. Some of the CSD parameters are useful for card initialization and identification.

MMC card CID register

- The HAL_MMC_GetCardCID() API allows to get the parameters of the CID register. Some of the CID parameters are useful for card initialization and identification.

MMC HAL driver macros list

Below the list of most used macros in MMC HAL driver.

- __HAL_MMC_ENABLE : Enable the MMC device
- __HAL_MMC_DISABLE : Disable the MMC device
- __HAL_MMC_DMA_ENABLE: Enable the SDMMC DMA transfer
- __HAL_MMC_DMA_DISABLE: Disable the SDMMC DMA transfer

- __HAL_MMC_ENABLE_IT: Enable the MMC device interrupt
- __HAL_MMC_DISABLE_IT: Disable the MMC device interrupt
- __HAL_MMC_GET_FLAG:Check whether the specified MMC flag is set or not
- __HAL_MMC_CLEAR_FLAG: Clear the MMC's pending flags

Note: You can refer to the MMC HAL driver header file for more useful macros

Callback registration

The compilation define USE_HAL_MMC_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_MMC_RegisterCallback() to register a user callback, it allows to register following callbacks:

- TxCpltCallback : callback when a transmission transfer is completed.
- RxCpltCallback : callback when a reception transfer is completed.
- ErrorCallback : callback when error occurs.
- AbortCpltCallback : callback when abort is completed.
- Read_DMADblBuf0CpltCallback : callback when the DMA reception of first buffer is completed.
- Read_DMADblBuf1CpltCallback : callback when the DMA reception of second buffer is completed.
- Write_DMADblBuf0CpltCallback : callback when the DMA transmission of first buffer is completed.
- Write_DMADblBuf1CpltCallback : callback when the DMA transmission of second buffer is completed.
- MspInitCallback : MMC MspInit.
- MspDeInitCallback : MMC MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. Use function @ref HAL_MMC_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. It allows to reset following callbacks:
- TxCpltCallback : callback when a transmission transfer is completed.
- RxCpltCallback : callback when a reception transfer is completed.
- ErrorCallback : callback when error occurs.
- AbortCpltCallback : callback when abort is completed.
- Read_DMADblBuf0CpltCallback : callback when the DMA reception of first buffer is completed.
- Read_DMADblBuf1CpltCallback : callback when the DMA reception of second buffer is completed.
- Write_DMADblBuf0CpltCallback : callback when the DMA transmission of first buffer is completed.
- Write_DMADblBuf1CpltCallback : callback when the DMA transmission of second buffer is completed.
- MspInitCallback : MMC MspInit.
- MspDeInitCallback : MMC MspDeInit. This function) takes as parameters the HAL peripheral handle and the Callback ID. By default, after the @ref HAL_MMC_Init and if the state is HAL_MMC_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions. Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_MMC_Init and @ref HAL_MMC_DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_MMC_Init and @ref HAL_MMC_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand) Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_MMC_RegisterCallback before calling @ref HAL_MMC_DeInit or @ref HAL_MMC_Init function. When The compilation define USE_HAL_MMC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

45.2.2 IO operation functions

This subsection provides a set of functions allowing to manage the data transfer from/to MMC card.

This section contains the following APIs:

- ***HAL_MMC_ReadBlocks***
- ***HAL_MMC_WriteBlocks***
- ***HAL_MMC_ReadBlocks_IT***
- ***HAL_MMC_WriteBlocks_IT***

- *HAL_MMC_ReadBlocks_DMA*
- *HAL_MMC_WriteBlocks_DMA*
- *HAL_MMC_Erase*
- *HAL_MMC_IRQHandler*
- *HAL_MMC_GetState*
- *HAL_MMC_GetError*
- *HAL_MMC_TxCpltCallback*
- *HAL_MMC_RxCpltCallback*
- *HAL_MMC_ErrorCallback*
- *HAL_MMC_AbortCallback*

45.2.3 Peripheral Control functions

This subsection provides a set of functions allowing to control the MMC card operations and get the related information

This section contains the following APIs:

- *HAL_MMC_GetCardCID*
- *HAL_MMC_GetCardCSD*
- *HAL_MMC_GetCardInfo*
- *HAL_MMC_ConfigWideBusOperation*
- *HAL_MMC_ConfigSpeedBusOperation*
- *HAL_MMC_GetCardState*
- *HAL_MMC_Abort*
- *HAL_MMC_Abort_IT*

45.2.4 Initialization and de-initialization functions

This section provides functions allowing to initialize/de-initialize the MMC card device to be ready for use.

This section contains the following APIs:

- *HAL_MMC_Init*
- *HAL_MMC_InitCard*
- *HAL_MMC_DeInit*
- *HAL_MMC_MspInit*
- *HAL_MMC_MspDeInit*

45.2.5 Detailed description of functions

`HAL_MMC_Init`

Function name

HAL_StatusTypeDef HAL_MMC_Init (MMC_HandleTypeDef * hmmc)

Function description

Initializes the MMC according to the specified parameters in the MMC_HandleTypeDef and create the associated handle.

Parameters

- **hmmc:** Pointer to the MMC handle

Return values

- **HAL:** status

HAL_MMC_InitCard

Function name

HAL_StatusTypeDef HAL_MMC_InitCard (MMC_HandleTypeDef * hmmc)

Function description

Initializes the MMC Card.

Parameters

- **hmmc:** Pointer to MMC handle

Return values

- **HAL:** status

Notes

- This function initializes the MMC card. It could be used when a card re-initialization is needed.

HAL_MMC_DeInit

Function name

HAL_StatusTypeDef HAL_MMC_DeInit (MMC_HandleTypeDef * hmmc)

Function description

De-Initializes the MMC card.

Parameters

- **hmmc:** Pointer to MMC handle

Return values

- **HAL:** status

HAL_MMC_MspInit

Function name

void HAL_MMC_MspInit (MMC_HandleTypeDef * hmmc)

Function description

Initializes the MMC MSP.

Parameters

- **hmmc:** Pointer to MMC handle

Return values

- **None:**

HAL_MMC_MspDeInit

Function name

void HAL_MMC_MspDeInit (MMC_HandleTypeDef * hmmc)

Function description

De-Initialize MMC MSP.

Parameters

- **hmmc:** Pointer to MMC handle

Return values

- **None:**

`HAL_MMC_ReadBlocks`

Function name

HAL_StatusTypeDef HAL_MMC_ReadBlocks (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hmmc:** Pointer to MMC handle
- **pData:** pointer to the buffer that will contain the received data
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Number of MMC blocks to read
- **Timeout:** Specify timeout value

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().

`HAL_MMC_WriteBlocks`

Function name

HAL_StatusTypeDef HAL_MMC_WriteBlocks (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)

Function description

Allows to write block(s) to a specified address in a card.

Parameters

- **hmmc:** Pointer to MMC handle
- **pData:** pointer to the buffer that will contain the data to transmit
- **BlockAdd:** Block Address where data will be written
- **NumberOfBlocks:** Number of MMC blocks to write
- **Timeout:** Specify timeout value

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().

`HAL_MMC_Erase`

Function name

HAL_StatusTypeDef HAL_MMC_Erase (MMC_HandleTypeDef * hmmc, uint32_t BlockStartAdd, uint32_t BlockEndAdd)

Function description

Erases the specified memory area of the given MMC card.

Parameters

- **hmmc:** Pointer to MMC handle
- **BlockStartAdd:** Start Block address
- **BlockEndAdd:** End Block address

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().

HAL_MMC_ReadBlocks_IT

Function name

HAL_StatusTypeDef HAL_MMC_ReadBlocks_IT (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hmmc:** Pointer to MMC handle
- **pData:** Pointer to the buffer that will contain the received data
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Number of blocks to read.

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().
- You could also check the IT transfer process through the MMC Rx interrupt event.

HAL_MMC_WriteBlocks_IT

Function name

HAL_StatusTypeDef HAL_MMC_WriteBlocks_IT (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Writes block(s) to a specified address in a card.

Parameters

- **hmmc:** Pointer to MMC handle
- **pData:** Pointer to the buffer that will contain the data to transmit
- **BlockAdd:** Block Address where data will be written
- **NumberOfBlocks:** Number of blocks to write

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().
- You could also check the IT transfer process through the MMC Tx interrupt event.

HAL_MMC_ReadBlocks_DMA

Function name

HAL_StatusTypeDef HAL_MMC_ReadBlocks_DMA (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hmmc:** Pointer MMC handle
- **pData:** Pointer to the buffer that will contain the received data
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Number of blocks to read.

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().
- You could also check the DMA transfer process through the MMC Rx interrupt event.

HAL_MMC_WriteBlocks_DMA

Function name

HAL_StatusTypeDef HAL_MMC_WriteBlocks_DMA (MMC_HandleTypeDef * hmmc, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Writes block(s) to a specified address in a card.

Parameters

- **hmmc:** Pointer to MMC handle
- **pData:** Pointer to the buffer that will contain the data to transmit
- **BlockAdd:** Block Address where data will be written
- **NumberOfBlocks:** Number of blocks to write

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_MMC_GetCardState().
- You could also check the DMA transfer process through the MMC Tx interrupt event.

HAL_MMC_IRQHandler

Function name

void HAL_MMC_IRQHandler (MMC_HandleTypeDef * hmmc)

Function description

This function handles MMC card interrupt request.

Parameters

- **hmmc:** Pointer to MMC handle

Return values

- **None:**

`HAL_MMC_TxCpltCallback`

Function name

void HAL_MMC_TxCpltCallback (MMC_HandleTypeDef * hmmc)

Function description

Tx Transfer completed callbacks.

Parameters

- **hmmc:** Pointer to MMC handle

Return values

- **None:**

`HAL_MMC_RxCpltCallback`

Function name

void HAL_MMC_RxCpltCallback (MMC_HandleTypeDef * hmmc)

Function description

Rx Transfer completed callbacks.

Parameters

- **hmmc:** Pointer MMC handle

Return values

- **None:**

`HAL_MMC_ErrorCallback`

Function name

void HAL_MMC_ErrorCallback (MMC_HandleTypeDef * hmmc)

Function description

MMC error callbacks.

Parameters

- **hmmc:** Pointer MMC handle

Return values

- **None:**

`HAL_MMC_AbortCallback`

Function name

void HAL_MMC_AbortCallback (MMC_HandleTypeDef * hmmc)

Function description

MMC Abort callbacks.

Parameters

- **hmmc:** Pointer MMC handle

Return values

- **None:**

`HAL_MMC_ConfigWideBusOperation`

Function name

HAL_StatusTypeDef HAL_MMC_ConfigWideBusOperation (MMC_HandleTypeDef * hmmc, uint32_t WideMode)

Function description

Enables wide bus operation for the requested card if supported by card.

Parameters

- **hmmc:** Pointer to MMC handle
- **WideMode:** Specifies the MMC card wide bus mode This parameter can be one of the following values:
  - SDMMC_BUS_WIDE_8B: 8-bit data transfer
  - SDMMC_BUS_WIDE_4B: 4-bit data transfer
  - SDMMC_BUS_WIDE_1B: 1-bit data transfer

Return values

- **HAL:** status

`HAL_MMC_ConfigSpeedBusOperation`

Function name

HAL_StatusTypeDef HAL_MMC_ConfigSpeedBusOperation (MMC_HandleTypeDef * hmmc, uint32_t SpeedMode)

Function description

Configure the speed bus mode.

Parameters

- **hmmc:** Pointer to the MMC handle
- **SpeedMode:** Specifies the MMC card speed bus mode This parameter can be one of the following values:
  - SDMMC_SPEED_MODE_AUTO: Max speed mode supported by the card
  - SDMMC_SPEED_MODE_DEFAULT: Default Speed (MMC @ 26MHz)
  - SDMMC_SPEED_MODE_HIGH: High Speed (MMC @ 52 MHz)
  - SDMMC_SPEED_MODE_DDR: High Speed DDR (MMC DDR @ 52 MHz)

Return values

- **HAL:** status

`HAL_MMC_GetCardState`

Function name

HAL_MMC_CardStateTypeDef HAL_MMC_GetCardState (MMC_HandleTypeDef * hmmc)

Function description

Gets the current mmc card data state.

Parameters

- **hmmc:** pointer to MMC handle

Return values

- **Card:** state

HAL_MMC_GetCardCID

Function name

HAL_StatusTypeDef HAL_MMC_GetCardCID (MMC_HandleTypeDef * hmmc, HAL_MMC_CardCIDTypeDef * pCID)

Function description

Returns information the information of the card which are stored on the CID register.

Parameters

- **hmmc:** Pointer to MMC handle
- **pCID:** Pointer to a HAL_MMC_CIDTypedef structure that contains all CID register parameters

Return values

- **HAL:** status

HAL_MMC_GetCardCSD

Function name

HAL_StatusTypeDef HAL_MMC_GetCardCSD (MMC_HandleTypeDef * hmmc, HAL_MMC_CardCSDTypeDef * pCSD)

Function description

Returns information the information of the card which are stored on the CSD register.

Parameters

- **hmmc:** Pointer to MMC handle
- **pCSD:** Pointer to a HAL_MMC_CardCSDTypeDef structure that contains all CSD register parameters

Return values

- **HAL:** status

HAL_MMC_GetCardInfo

Function name

HAL_StatusTypeDef HAL_MMC_GetCardInfo (MMC_HandleTypeDef * hmmc, HAL_MMC_CardInfoTypeDef * pCardInfo)

Function description

Gets the MMC card info.

Parameters

- **hmmc:** Pointer to MMC handle
- **pCardInfo:** Pointer to the HAL_MMC_CardInfoTypeDef structure that will contain the MMC card status information

Return values

- **HAL:** status

HAL_MMC_GetState

Function name

HAL_MMC_StateTypeDef HAL_MMC_GetState (MMC_HandleTypeDef * hmmc)

Function description

return the MMC state

Parameters

- **hmmc:** Pointer to mmc handle

Return values

- **HAL:** state

`HAL_MMC_GetError`

Function name

uint32_t HAL_MMC_GetError (MMC_HandleTypeDef * hmmc)

Function description

Return the MMC error code.

Parameters

- **hmmc:** : Pointer to a MMC_HandleTypeDef structure that contains the configuration information.

Return values

- **MMC:** Error Code

`HAL_MMC_Abort`

Function name

HAL_StatusTypeDef HAL_MMC_Abort (MMC_HandleTypeDef * hmmc)

Function description

Abort the current transfer and disable the MMC.

Parameters

- **hmmc:** pointer to a MMC_HandleTypeDef structure that contains the configuration information for MMC module.

Return values

- **HAL:** status

`HAL_MMC_Abort_IT`

Function name

HAL_StatusTypeDef HAL_MMC_Abort_IT (MMC_HandleTypeDef * hmmc)

Function description

Abort the current transfer and disable the MMC (IT mode).

Parameters

- **hmmc:** pointer to a MMC_HandleTypeDef structure that contains the configuration information for MMC module.

Return values

- **HAL:** status

45.3 MMC Firmware driver defines

The following section lists the various define and macros of the module.

45.3.1 MMC

MMC

MMC Error status enumeration Structure definition

HAL_MMC_ERROR_NONE

No error

HAL_MMC_ERROR_CMD_CRC_FAIL

Command response received (but CRC check failed)

HAL_MMC_ERROR_DATA_CRC_FAIL

Data block sent/received (CRC check failed)

HAL_MMC_ERROR_CMD_RSP_TIMEOUT

Command response timeout

HAL_MMC_ERROR_DATA_TIMEOUT

Data timeout

HAL_MMC_ERROR_TX_UNDERRUN

Transmit FIFO underrun

HAL_MMC_ERROR_RX_OVERRUN

Receive FIFO overrun

HAL_MMC_ERROR_ADDR_MISALIGNED

Misaligned address

HAL_MMC_ERROR_BLOCK_LEN_ERR

Transferred block length is not allowed for the card or the number of transferred bytes does not match the block length

HAL_MMC_ERROR_ERASE_SEQ_ERR

An error in the sequence of erase command occurs

HAL_MMC_ERROR_BAD_ERASE_PARAM

An invalid selection for erase groups

HAL_MMC_ERROR_WRITE_PROT_VIOLATION

Attempt to program a write protect block

HAL_MMC_ERROR_LOCK_UNLOCK_FAILED

Sequence or password error has been detected in unlock command or if there was an attempt to access a locked card

HAL_MMC_ERROR_COM_CRC_FAILED

CRC check of the previous command failed

HAL_MMC_ERROR_ILLEGAL_CMD

Command is not legal for the card state

HAL_MMC_ERROR_CARD_ECC_FAILED

Card internal ECC was applied but failed to correct the data

HAL_MMC_ERROR_CC_ERR

Internal card controller error

HAL_MMC_ERROR_GENERAL_UNKNOWN_ERR

General or unknown error

HAL_MMC_ERROR_STREAM_READ_UNDERRUN

The card could not sustain data reading in stream rmode

HAL_MMC_ERROR_STREAM_WRITE_OVERRUN

The card could not sustain data programming in stream mode

HAL_MMC_ERROR_CID_CSD_OVERWRITE

CID/CSD overwrite error

HAL_MMC_ERROR_WP_ERASE_SKIP

Only partial address space was erased

HAL_MMC_ERROR_CARD_ECC_DISABLED

Command has been executed without using internal ECC

HAL_MMC_ERROR_ERASE_RESET

Erase sequence was cleared before executing because an out of erase sequence command was received

HAL_MMC_ERROR_AKE_SEQ_ERR

Error in sequence of authentication

HAL_MMC_ERROR_INVALID_VOLTRANGE

Error in case of invalid voltage range

HAL_MMC_ERROR_ADDR_OUT_OF_RANGE

Error when addressed block is out of range

HAL_MMC_ERROR_REQUEST_NOT_APPLICABLE

Error when command request is not applicable

HAL_MMC_ERROR_PARAM

the used parameter is not valid

HAL_MMC_ERROR_UNSUPPORTED_FEATURE

Error when feature is not insupported

HAL_MMC_ERROR_BUSY

Error when transfer process is busy

HAL_MMC_ERROR_DMA

Error while DMA transfer

HAL_MMC_ERROR_TIMEOUT

Timeout error

MMC context enumeration

MMC_CONTEXT_NONE

None

MMC_CONTEXT_READ_SINGLE_BLOCK

Read single block operation

MMC_CONTEXT_READ_MULTIPLE_BLOCK

Read multiple blocks operation

MMC_CONTEXT_WRITE_SINGLE_BLOCK

Write single block operation

MMC_CONTEXT_WRITE_MULTIPLE_BLOCK

Write multiple blocks operation

MMC_CONTEXT_IT

Process in Interrupt mode

MMC_CONTEXT_DMA

Process in DMA mode

MMC Voltage mode

MMC_HIGH_VOLTAGE_RANGE

VALUE OF ARGUMENT

MMC_DUAL_VOLTAGE_RANGE

VALUE OF ARGUMENT

eMMC_HIGH_VOLTAGE_RANGE

for eMMC > 2Gb sector mode

eMMC_DUAL_VOLTAGE_RANGE

for eMMC > 2Gb sector mode

MMC_INVALID_VOLTAGE_RANGE

MMC Memory Cards

MMC_LOW_CAPACITY_CARD

MMC Card Capacity <=2Gbytes

MMC_HIGH_CAPACITY_CARD

MMC Card Capacity >2Gbytes and <2Tbytes

Exported Constants

MMC_BLOCKSIZE

Block size is 512 bytes

MMC Exported Macros

__HAL_MMC_RESET_HANDLE_STATE

Description:

- Reset MMC handle state.

Parameters:

- __HANDLE__: : MMC handle.

Return value:

- None

__HAL_MMC_ENABLE_IT

Description:

- Enable the MMC device interrupt.

Parameters:

- __HANDLE__: MMC Handle
- __INTERRUPT__: specifies the SDMMC interrupt sources to be enabled. This parameter can be one or a combination of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_CMDACT: Command transfer in progress interrupt
  - SDMMC_IT_TXACT: Data transmit in progress interrupt
  - SDMMC_IT_RXACT: Data receive in progress interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- None

__HAL_MMC_DISABLE_IT

Description:

- Disable the MMC device interrupt.

Parameters:

- __HANDLE__: MMC Handle
- __INTERRUPT__: specifies the SDMMC interrupt sources to be disabled. This parameter can be one or a combination of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_CMDACT: Command transfer in progress interrupt
  - SDMMC_IT_TXACT: Data transmit in progress interrupt
  - SDMMC_IT_RXACT: Data receive in progress interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- None

__HAL_MMC_GET_FLAG

Description:

- Check whether the specified MMC flag is set or not.

Parameters:

- __HANDLE__: MMC Handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
  - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
  - SDMMC_FLAG_CTIMEOUT: Command response timeout
  - SDMMC_FLAG_DTIMEOUT: Data timeout
  - SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
  - SDMMC_FLAG_RXOVERR: Received FIFO overrun error
  - SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
  - SDMMC_FLAG_CMDSENT: Command sent (no response required)
  - SDMMC_FLAG_DATAEND: Data end (data counter, DATACOUNT, is zero)
  - SDMMC_FLAG_DHOLD: Data transfer Hold
  - SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
  - SDMMC_FLAG_DABORT: Data transfer aborted by CMD12
  - SDMMC_FLAG_DPSMACT: Data path state machine active
  - SDMMC_FLAG_CPSMACT: Command path state machine active
  - SDMMC_FLAG_CMDACT: Command transfer in progress
  - SDMMC_FLAG_TXACT: Data transmit in progress
  - SDMMC_FLAG_RXACT: Data receive in progress
  - SDMMC_FLAG_TXFIFOHE: Transmit FIFO Half Empty
  - SDMMC_FLAG_RXFIFOHF: Receive FIFO Half Full
  - SDMMC_FLAG_TXFIFOF: Transmit FIFO full
  - SDMMC_FLAG_RXFIFOF: Receive FIFO full
  - SDMMC_FLAG_TXFIFOE: Transmit FIFO empty
  - SDMMC_FLAG_RXFIFOE: Receive FIFO empty
  - SDMMC_FLAG_BUSYD0: Inverted value of SDMMC_D0 line (Busy)
  - SDMMC_FLAG_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected
  - SDMMC_FLAG_TXDAVL: Data available in transmit FIFO
  - SDMMC_FLAG_RXDAVL: Data available in receive FIFO
  - SDMMC_FLAG_SDIOIT: SD I/O interrupt received
  - SDMMC_FLAG_ACKFAIL: Boot Acknowledgment received
  - SDMMC_FLAG_ACKTIMEOUT: Boot Acknowledgment timeout
  - SDMMC_FLAG_VSWEND: Voltage switch critical timing section completion
  - SDMMC_FLAG_CKSTOP: SDMMC_CK stopped in Voltage switch procedure
  - SDMMC_FLAG_IDMATE: IDMA transfer error
  - SDMMC_FLAG_IDMABTC: IDMA buffer transfer complete

Return value:

- The: new state of MMC FLAG (SET or RESET).

__HAL_MMC_CLEAR_FLAG

Description:

- Clear the MMC's pending flags.

Parameters:

- __HANDLE__: MMC Handle
- __FLAG__: specifies the flag to clear. This parameter can be one or a combination of the following values:
  - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
  - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
  - SDMMC_FLAG_CTIMEOUT: Command response timeout
  - SDMMC_FLAG_DTIMEOUT: Data timeout
  - SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
  - SDMMC_FLAG_RXOVERR: Received FIFO overrun error
  - SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
  - SDMMC_FLAG_CMDSENT: Command sent (no response required)
  - SDMMC_FLAG_DATAEND: Data end (data counter, DATACOUNT, is zero)
  - SDMMC_FLAG_DHOLD: Data transfer Hold
  - SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
  - SDMMC_FLAG_DABORT: Data transfer aborted by CMD12
  - SDMMC_FLAG_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected
  - SDMMC_FLAG_SDIOIT: SD I/O interrupt received
  - SDMMC_FLAG_ACKFAIL: Boot Acknowledgment received
  - SDMMC_FLAG_ACKTIMEOUT: Boot Acknowledgment timeout
  - SDMMC_FLAG_VSWEND: Voltage switch critical timing section completion
  - SDMMC_FLAG_CKSTOP: SDMMC_CK stopped in Voltage switch procedure
  - SDMMC_FLAG_IDMATE: IDMA transfer error
  - SDMMC_FLAG_IDMABTC: IDMA buffer transfer complete

Return value:

- None

__HAL_MMC_GET_IT

Description:

- Check whether the specified MMC interrupt has occurred or not.

Parameters:

- __HANDLE__: MMC Handle
- __INTERRUPT__: specifies the SDMMC interrupt source to check. This parameter can be one of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_CMDACT: Command transfer in progress interrupt
  - SDMMC_IT_TXACT: Data transmit in progress interrupt
  - SDMMC_IT_RXACT: Data receive in progress interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- The: new state of MMC IT (SET or RESET).

__HAL_MMC_CLEAR_IT

Description:

- Clear the MMC's interrupt pending bits.

Parameters:

- __HANDLE__: MMC Handle
- __INTERRUPT__: specifies the interrupt pending bit to clear. This parameter can be one or a combination of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SD I/O interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- None

MMC Card State enumeration structure

HAL_MMC_CARD_READY

Card state is ready

HAL_MMC_CARD_IDENTIFICATION

Card is in identification state

HAL_MMC_CARD_STANDBY

Card is in standby state

HAL_MMC_CARD_TRANSFER

Card is in transfer state

HAL_MMC_CARD_SENDING

Card is sending an operation

HAL_MMC_CARD_RECEIVING

Card is receiving operation information

HAL_MMC_CARD_PROGRAMMING

Card is in programming state

HAL_MMC_CARD_DISCONNECTED

Card is disconnected

HAL_MMC_CARD_ERROR

Card response Error

MMC Handle Structure definition

MMC_InitTypeDef

MMC_TypeDef

46 HAL MMC Extension Driver

46.1 MMCEx Firmware driver API description

The following section lists the various functions of the MMCEx library.

46.1.1 How to use this driver

The MMC Extension HAL driver can be used as follows:

- Configure Buffer0 and Buffer1 start address and Buffer size using HAL_MMCEx_ConfigDMAMultiBuffer() function.
- Start Read and Write for multibuffer mode using HAL_MMCEx_ReadBlocksDMAMultiBuffer() and HAL_MMCEx_WriteBlocksDMAMultiBuffer() functions.

46.1.2 Detailed description of functions

`HAL_MMCEx_ConfigDMAMultiBuffer`

Function name

HAL_StatusTypeDef HAL_MMCEx_ConfigDMAMultiBuffer (MMC_HandleTypeDef * hmmc, uint32_t * pDataBuffer0, uint32_t * pDataBuffer1, uint32_t BufferSize)

Function description

Configure DMA Dual Buffer mode.

Parameters

- **hmmc:** MMC handle
- **pDataBuffer0:** Pointer to the buffer0 that will contain/receive the transfered data
- **pDataBuffer1:** Pointer to the buffer1 that will contain/receive the transfered data
- **BufferSize:** Size of Buffer0 in Blocks. Buffer0 and Buffer1 must have the same size.

Return values

- **HAL:** status

`HAL_MMCEx_ReadBlocksDMAMultiBuffer`

Function name

HAL_StatusTypeDef HAL_MMCEx_ReadBlocksDMAMultiBuffer (MMC_HandleTypeDef * hmmc, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hmmc:** MMC handle
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Total number of blocks to read

Return values

- **HAL:** status

HAL_MMCEx_WriteBlocksDMAMultiBuffer

Function name

HAL_StatusTypeDef HAL_MMCEx_WriteBlocksDMAMultiBuffer (MMC_HandleTypeDef * hmmc, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Write block(s) to a specified address in a card.

Parameters

- **hmmc:** MMC handle
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Total number of blocks to read

Return values

- **HAL:** status

HAL_MMCEx_ChangeDMABuffer

Function name

HAL_StatusTypeDef HAL_MMCEx_ChangeDMABuffer (MMC_HandleTypeDef * hmmc, HAL_MMCEx_DMABuffer_MemoryTypeDef Buffer, uint32_t * pDataBuffer)

Function description

Change the DMA Buffer0 or Buffer1 address on the fly.

Parameters

- **hmmc:** pointer to a MMC_HandleTypeDef structure.
- **Buffer:** the buffer to be changed, This parameter can be one of the following values: MMC_DMA_BUFFER0 or MMC_DMA_BUFFER1
- **pDataBuffer:** The new address

Return values

- **HAL:** status

Notes

- The BUFFER0 address can be changed only when the current transfer use BUFFER1 and the BUFFER1 address can be changed only when the current transfer use BUFFER0.

HAL_MMCEx_Read_DMADoubleBuffer0CpltCallback

Function name

void HAL_MMCEx_Read_DMADoubleBuffer0CpltCallback (MMC_HandleTypeDef * hmmc)

Function description

Read DMA Buffer 0 Transfer completed callbacks.

Parameters

- **hmmc:** MMC handle

Return values

- **None:**

HAL_MMCEx_Read_DMADoubleBuffer1CpltCallback

Function name

void HAL_MMCEx_Read_DMADoubleBuffer1CpltCallback (MMC_HandleTypeDef * hmmc)

Function description

Read DMA Buffer 1 Transfer completed callbacks.

Parameters

- **hmmc:** MMC handle

Return values

- **None:**

HAL_MMCEx_Write_DMADoubleBuffer0CpltCallback

Function name

void HAL_MMCEx_Write_DMADoubleBuffer0CpltCallback (MMC_HandleTypeDef * hmmc)

Function description

Write DMA Buffer 0 Transfer completed callbacks.

Parameters

- **hmmc:** MMC handle

Return values

- **None:**

HAL_MMCEx_Write_DMADoubleBuffer1CpltCallback

Function name

void HAL_MMCEx_Write_DMADoubleBuffer1CpltCallback (MMC_HandleTypeDef * hmmc)

Function description

Write DMA Buffer 1 Transfer completed callbacks.

Parameters

- **hmmc:** MMC handle

Return values

- **None:**

47 HAL OPAMP Generic Driver

47.1 OPAMP Firmware driver registers structures

47.1.1 OPAMP_InitTypeDef

OPAMP_InitTypeDef is defined in the stm32l4xx_hal_opamp.h

Data Fields

- ***uint32_t PowerSupplyRange***
- ***uint32_t PowerMode***
- ***uint32_t Mode***
- ***uint32_t InvertingInput***
- ***uint32_t NonInvertingInput***
- ***uint32_t PgaGain***
- ***uint32_t UserTrimming***
- ***uint32_t TrimmingValueP***
- ***uint32_t TrimmingValueN***
- ***uint32_t TrimmingValuePLowPower***
- ***uint32_t TrimmingValueNLowPower***

Field Documentation

- ***uint32_t OPAMP_InitTypeDef::PowerSupplyRange***

  Specifies the power supply range: above or under 2.4V. This parameter must be a value of ***OPAMP_PowerSupplyRange*** Caution: This parameter is common to all OPAMP instances: a modification of this parameter for the selected OPAMP impacts the other OPAMP instances.
- ***uint32_t OPAMP_InitTypeDef::PowerMode***

  Specifies the power mode Normal or Low-Power. This parameter must be a value of ***OPAMP_PowerMode***
- ***uint32_t OPAMP_InitTypeDef::Mode***

  Specifies the OPAMP mode This parameter must be a value of ***OPAMP_Mode*** mode is either Standalone, - Follower or PGA
- ***uint32_t OPAMP_InitTypeDef::InvertingInput***

  Specifies the inverting input in Standalone & PGA modes
  - In Standalone mode: i.e. when mode is OPAMP_STANDALONE_MODE & PGA mode: i.e. when mode is OPAMP_PGA_MODE This parameter must be a value of ***OPAMP_InvertingInput***
  - In Follower mode i.e. when mode is OPAMP_FOLLOWER_MODE This parameter is Not Applicable
- ***uint32_t OPAMP_InitTypeDef::NonInvertingInput***

  Specifies the non inverting input of the opamp: This parameter must be a value of ***OPAMP_NonInvertingInput***
- ***uint32_t OPAMP_InitTypeDef::PgaGain***

  Specifies the gain in PGA mode i.e. when mode is OPAMP_PGA_MODE. This parameter must be a value of ***OPAMP_PgaGain*** (2, 4, 8 or 16)
- ***uint32_t OPAMP_InitTypeDef::UserTrimming***

  Specifies the trimming mode This parameter must be a value of ***OPAMP_UserTrimming*** UserTrimming is either factory or user trimming.
- ***uint32_t OPAMP_InitTypeDef::TrimmingValueP***

  Specifies the offset trimming value (PMOS) i.e. when UserTrimming is OPAMP_TRIMMING_USER. This parameter must be a number between Min_Data = 0 and Max_Data = 31 16 is typical default value
- ***uint32_t OPAMP_InitTypeDef::TrimmingValueN***

  Specifies the offset trimming value (NMOS) i.e. when UserTrimming is OPAMP_TRIMMING_USER. This parameter must be a number between Min_Data = 0 and Max_Data = 31 16 is typical default value

- ***uint32_t OPAMP_InitTypeDef::TrimmingValuePLowPower***
  Specifies the offset trimming value (PMOS) i.e. when UserTrimming is OPAMP_TRIMMING_USER. This parameter must be a number between Min_Data = 0 and Max_Data = 31 16 is typical default value
- ***uint32_t OPAMP_InitTypeDef::TrimmingValueNLowPower***
  Specifies the offset trimming value (NMOS) i.e. when UserTrimming is OPAMP_TRIMMING_USER. This parameter must be a number between Min_Data = 0 and Max_Data = 31 16 is typical default value

47.1.2 OPAMP_HandleTypeDef

OPAMP_HandleTypeDef is defined in the stm32l4xx_hal_opamp.h

Data Fields

- ***OPAMP_TypeDef * Instance***
- ***OPAMP_InitTypeDef Init***
- ***HAL_StatusTypeDef Status***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_OPAMP_StateTypeDef State***

Field Documentation

- ***OPAMP_TypeDef* OPAMP_HandleTypeDef::Instance***
  OPAMP instance's registers base address
- ***OPAMP_InitTypeDef OPAMP_HandleTypeDef::Init***
  OPAMP required parameters
- ***HAL_StatusTypeDef OPAMP_HandleTypeDef::Status***
  OPAMP peripheral status
- ***HAL_LockTypeDef OPAMP_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_OPAMP_StateTypeDef OPAMP_HandleTypeDef::State***
  OPAMP communication state

47.2 OPAMP Firmware driver API description

The following section lists the various functions of the OPAMP library.

47.2.1 OPAMP Peripheral Features

The device integrates 1 or 2 operational amplifiers OPAMP1 & OPAMP2

1. The OPAMP(s) provide(s) several exclusive running modes.
   – 1 OPAMP: STM32L412xx STM32L422xx STM32L431xx STM32L432xx STM32L433xx STM32L442xx STM32L443xx
   – 2 OPAMP: STM32L471xx STM32L475xx STM32L476xx STM32L485xx STM32L486xx
2. The OPAMP(s) provide(s) several exclusive running modes.
   – Standalone mode
   – Programmable Gain Amplifier (PGA) mode (Resistor feedback output)
   – Follower mode
3. All OPAMP (same for all OPAMPs) can operate in
   – Either Low range (VDDA < 2.4V) power supply
   – Or High range (VDDA > 2.4V) power supply
4. Each OPAMP(s) can be configured in normal and low power mode.

5. The OPAMP(s) provide(s) calibration capabilities.
   - Calibration aims at correcting some offset for running mode.
   - The OPAMP uses either factory calibration settings OR user defined calibration (trimming) settings (i.e. trimming mode).
   - The user defined settings can be figured out using self calibration handled by HAL_OPAMP_SelfCalibrate, HAL_OPAMPEx_SelfCalibrateAll
   - HAL_OPAMP_SelfCalibrate:
     - Runs automatically the calibration.
     - Enables the user trimming mode
     - Updates the init structure with trimming values with fresh calibration results. The user may store the calibration results for larger (ex monitoring the trimming as a function of temperature for instance)
     - HAL_OPAMPEx_SelfCalibrateAll runs calibration of all OPAMPs in parallel to save search time.
6. Running mode: Standalone mode
   - Gain is set externally (gain depends on external loads).
   - Follower mode also possible externally by connecting the inverting input to the output.
7. Running mode: Follower mode
   - No Inverting Input is connected.
8. Running mode: Programmable Gain Amplifier (PGA) mode (Resistor feedback output)
   - The OPAMP(s) output(s) can be internally connected to resistor feedback output.
   - OPAMP gain is either 2, 4, 8 or 16.
9. The OPAMPs inverting input can be selected according to the Reference Manual "OPAMP function description" chapter.
10. The OPAMPs non inverting input can be selected according to the Reference Manual "OPAMP function description" chapter.

47.2.2 How to use this driver

Power supply range

To run in low power mode:

1. Configure the OPAMP using HAL_OPAMP_Init() function:
   - Select OPAMP_POWERSUPPLY_LOW (VDDA lower than 2.4V)
   - Otherwise select OPAMP_POWERSUPPLY_HIGH (VDDA higher than 2.4V)

Low / normal power mode

To run in low power mode:

1. Configure the OPAMP using HAL_OPAMP_Init() function:
   - Select OPAMP_POWERMODE_LOWPOWER
   - Otherwise select OPAMP_POWERMODE_NORMAL

Calibration

To run the OPAMP calibration self calibration:

1. Start calibration using HAL_OPAMP_SelfCalibrate. Store the calibration results.

Running mode

To use the OPAMP, perform the following steps:

1. Fill in the HAL_OPAMP_MspInit() to
   - Enable the OPAMP Peripheral clock using macro __HAL_RCC_OPAMP_CLK_ENABLE()
   - Configure the OPAMP input AND output in analog mode using HAL_GPIO_Init() to map the OPAMP output to the GPIO pin.

2. Registrate Callbacks
   - The compilation define USE_HAL_OPAMP_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.
   - Use Functions @ref HAL_OPAMP_RegisterCallback() to register a user callback, it allows to register following callbacks:
     - MspInitCallback : OPAMP MspInit.
     - MspDeInitCallback : OPAMP MspFeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.
   - Use function @ref HAL_OPAMP_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. It allows to reset following callbacks:
     - MspInitCallback : OPAMP MspInit.
     - MspDeInitCallback : OPAMP MspdeInit.
     - All Callbacks
3. Configure the OPAMP using HAL_OPAMP_Init() function:
   - Select the mode
   - Select the inverting input
   - Select the non-inverting input
   - If PGA mode is enabled, Select if inverting input is connected.
   - Select either factory or user defined trimming mode.
   - If the user-defined trimming mode is enabled, select PMOS & NMOS trimming values (typically values set by HAL_OPAMP_SelfCalibrate function).
4. Enable the OPAMP using HAL_OPAMP_Start() function.
5. Disable the OPAMP using HAL_OPAMP_Stop() function.
6. Lock the OPAMP in running mode using HAL_OPAMP_Lock() function. Caution: On STM32L4, HAL OPAMP lock is software lock only (not hardware lock as on some other STM32 devices)
7. If needed, unlock the OPAMP using HAL_OPAMPEx_Unlock() function.

Running mode: change of configuration while OPAMP ON

To Re-configure OPAMP when OPAMP is ON (change on the fly)

1. If needed, fill in the HAL_OPAMP_MspInit()
   - This is the case for instance if you wish to use new OPAMP I/O
2. Configure the OPAMP using HAL_OPAMP_Init() function:
   - As in configure case, select first the parameters you wish to modify.
3. Change from low power mode to normal power mode (& vice versa) requires first HAL_OPAMP_DeInit() (force OPAMP OFF) and then HAL_OPAMP_Init(). In other words, of OPAMP is ON, HAL_OPAMP_Init can NOT change power mode alone.

47.2.3 Initialization and de-initialization functions

This section contains the following APIs:

- ***HAL_OPAMP_Init***
- ***HAL_OPAMP_DeInit***
- ***HAL_OPAMP_MspInit***
- ***HAL_OPAMP_MspDeInit***

47.2.4 IO operation functions

This subsection provides a set of functions allowing to manage the OPAMP start, stop and calibration actions.

This section contains the following APIs:

- ***HAL_OPAMP_Start***
- ***HAL_OPAMP_Stop***
- ***HAL_OPAMP_SelfCalibrate***

47.2.5 Peripheral Control functions

This subsection provides a set of functions allowing to control the OPAMP data transfers.

This section contains the following APIs:

- ***HAL_OPAMP_Lock***
- ***HAL_OPAMP_GetTrimOffset***

47.2.6 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral.

This section contains the following APIs:

- ***HAL_OPAMP_GetState***

47.2.7 Detailed description of functions

HAL_OPAMP_Init

Function name

HAL_StatusTypeDef HAL_OPAMP_Init (OPAMP_HandleTypeDef * hopamp)

Function description

Initializes the OPAMP according to the specified parameters in the OPAMP_InitTypeDef and initialize the associated handle.

Parameters

- **hopamp:** OPAMP handle

Return values

- **HAL:** status

Notes

- If the selected opamp is locked, initialization can't be performed. To unlock the configuration, perform a system reset.

HAL_OPAMP_DeInit

Function name

HAL_StatusTypeDef HAL_OPAMP_DeInit (OPAMP_HandleTypeDef * hopamp)

Function description

DeInitialize the OPAMP peripheral.

Parameters

- **hopamp:** OPAMP handle

Return values

- **HAL:** status

Notes

- Deinitialization can be performed if the OPAMP configuration is locked. (the lock is SW in L4)

HAL_OPAMP_MspInit

Function name

void HAL_OPAMP_MspInit (OPAMP_HandleTypeDef * hopamp)

Function description

Initialize the OPAMP MSP.

Parameters

- **hopamp:** OPAMP handle

Return values

- **None:**

`HAL_OPAMP_MspDeInit`

Function name

void HAL_OPAMP_MspDeInit (OPAMP_HandleTypeDef * hopamp)

Function description

DeInitialize OPAMP MSP.

Parameters

- **hopamp:** OPAMP handle

Return values

- **None:**

`HAL_OPAMP_Start`

Function name

HAL_StatusTypeDef HAL_OPAMP_Start (OPAMP_HandleTypeDef * hopamp)

Function description

Start the OPAMP.

Parameters

- **hopamp:** OPAMP handle

Return values

- **HAL:** status

`HAL_OPAMP_Stop`

Function name

HAL_StatusTypeDef HAL_OPAMP_Stop (OPAMP_HandleTypeDef * hopamp)

Function description

Stop the OPAMP.

Parameters

- **hopamp:** OPAMP handle

Return values

- **HAL:** status

`HAL_OPAMP_SelfCalibrate`

Function name

HAL_StatusTypeDef HAL_OPAMP_SelfCalibrate (OPAMP_HandleTypeDef * hopamp)

Function description

Run the self calibration of one OPAMP.

Parameters

- **hopamp:** handle

Return values

- **Updated:** offset trimming values (PMOS & NMOS), user trimming is enabled
- **HAL:** status

Notes

- Calibration is performed in the mode specified in OPAMP init structure (mode normal or low-power). To perform calibration for both modes, repeat this function twice after OPAMP init structure accordingly updated.
- Calibration runs about 10 ms.

`HAL_OPAMP_Lock`

Function name

HAL_StatusTypeDef HAL_OPAMP_Lock (OPAMP_HandleTypeDef * hopamp)

Function description

Lock the selected OPAMP configuration.

Parameters

- **hopamp:** OPAMP handle

Return values

- **HAL:** status

Notes

- On STM32L4, HAL OPAMP lock is software lock only (in contrast of hardware lock available on some other STM32 devices).

`HAL_OPAMP_GetTrimOffset`

Function name

HAL_OPAMP_TrimmingValueTypeDef HAL_OPAMP_GetTrimOffset (OPAMP_HandleTypeDef * hopamp, uint32_t trimmingoffset)

Function description

Return the OPAMP factory trimming value.

Parameters

- **hopamp:** : OPAMP handle
- **trimmingoffset:** : Trimming offset (P or N) This parameter must be a value of OPAMP Factory Trimming

Return values

- **Trimming:** value (P or N): range: 0->31 or OPAMP_FACTORYTRIMMING_DUMMY if trimming value is not available

Notes

- On STM32L4 OPAMP, user can retrieve factory trimming if OPAMP has never been set to user trimming before. Therefore, this function must be called when OPAMP init parameter "UserTrimming" is set to trimming factory, and before OPAMP calibration (function "HAL_OPAMP_SelfCalibrate()"). Otherwise, factory trimming value cannot be retrieved and error status is returned.
- Calibration parameter retrieved is corresponding to the mode specified in OPAMP init structure (mode normal or low-power). To retrieve calibration parameters for both modes, repeat this function after OPAMP init structure accordingly updated.

`HAL_OPAMP_GetState`

Function name

HAL_OPAMP_StateTypeDef HAL_OPAMP_GetState (OPAMP_HandleTypeDef * hopamp)

Function description

Return the OPAMP handle state.

Parameters

- **hopamp:** : OPAMP handle

Return values

- **HAL:** state

47.3 OPAMP Firmware driver defines

The following section lists the various define and macros of the module.

47.3.1 OPAMP

OPAMP

OPAMP Exported Macros

__HAL_OPAMP_RESET_HANDLE_STATE

Description:

- Reset OPAMP handle state.

Parameters:

- __HANDLE__: OPAMP handle.

Return value:

- None

OPAMP Factory Trimming

OPAMP_FACTORYTRIMMING_DUMMY

Dummy value if trimming value could not be retrieved

OPAMP_FACTORYTRIMMING_N

Offset trimming N

OPAMP_FACTORYTRIMMING_P

Offset trimming P

OPAMP Inverting Input

OPAMP_INVERTINGINPUT_IO0

OPAMP inverting input connected to dedicated IO pin low-leakage

OPAMP_INVERTINGINPUT_IO1

OPAMP inverting input connected to alternative IO pin available on some device packages

OPAMP_INVERTINGINPUT_CONNECT_NO

OPAMP inverting input not connected externally (PGA mode only)

OPAMP Mode

OPAMP_STANDALONE_MODE

standalone mode

OPAMP_PGA_MODE

PGA mode

OPAMP_FOLLOWER_MODE

follower mode

OPAMP Non Inverting Input

OPAMP_NONINVERTINGINPUT_IO0

OPAMP non-inverting input connected to dedicated IO pin

OPAMP_NONINVERTINGINPUT_DAC_CH

OPAMP non-inverting input connected internally to DAC channel

OPAMP Pga Gain

OPAMP_PGA_GAIN_2

PGA gain = 2

OPAMP_PGA_GAIN_4

PGA gain = 4

OPAMP_PGA_GAIN_8

PGA gain = 8

OPAMP_PGA_GAIN_16

PGA gain = 16

OPAMP PowerMode

OPAMP_POWERMODE_NORMAL

OPAMP_POWERMODE_LOWPOWER

OPAMP PowerSupplyRange

OPAMP_POWERSUPPLY_LOW

Power supply range low (VDDA lower than 2.4V)

OPAMP_POWERSUPPLY_HIGH

Power supply range high (VDDA higher than 2.4V)

OPAMP User Trimming

OPAMP_TRIMMING_FACTORY

Factory trimming

OPAMP_TRIMMING_USER

User trimming

48 HAL OPAMP Extension Driver

48.1 OPAMPEx Firmware driver API description

The following section lists the various functions of the OPAMPEx library.

48.1.1 Extended IO operation functions

- OPAMP Self calibration.

48.1.2 Peripheral Control functions

- OPAMP unlock.

This section contains the following APIs:

- ***HAL_OPAMPEx_Unlock***

48.1.3 Detailed description of functions

`HAL_OPAMPEx_SelfCalibrateAll`

Function name

HAL_StatusTypeDef HAL_OPAMPEx_SelfCalibrateAll (OPAMP_HandleTypeDef * hopamp1, OPAMP_HandleTypeDef * hopamp2)

Function description

Run the self calibration of the 2 OPAMPs in parallel.

Parameters

- **hopamp1:** handle
- **hopamp2:** handle

Return values

- **HAL:** status

Notes

- Trimming values (PMOS & NMOS) are updated and user trimming is enabled is calibration is successful.
- Calibration is performed in the mode specified in OPAMP init structure (mode normal or low-power). To perform calibration for both modes, repeat this function twice after OPAMP init structure accordingly updated.
- Calibration runs about 10 ms (5 dichotomy steps, repeated for P and N transistors: 10 steps with 1 ms for each step).

`HAL_OPAMPEx_Unlock`

Function name

HAL_StatusTypeDef HAL_OPAMPEx_Unlock (OPAMP_HandleTypeDef * hopamp)

Function description

Unlock the selected OPAMP configuration.

Parameters

- **hopamp:** OPAMP handle

Return values

- **HAL:** status

Notes

- This function must be called only when OPAMP is in state "locked".

49 HAL OSPI Generic Driver

49.1 OSPI Firmware driver registers structures

49.1.1 OSPI_InitTypeDef

OSPI_InitTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- ***uint32_t FifoThreshold***
- ***uint32_t DualQuad***
- ***uint32_t MemoryType***
- ***uint32_t DeviceSize***
- ***uint32_t ChipSelectHighTime***
- ***uint32_t FreeRunningClock***
- ***uint32_t ClockMode***
- ***uint32_t WrapSize***
- ***uint32_t ClockPrescaler***
- ***uint32_t SampleShifting***
- ***uint32_t DelayHoldQuarterCycle***
- ***uint32_t ChipSelectBoundary***

Field Documentation

- ***uint32_t OSPI_InitTypeDef::FifoThreshold***
- ***uint32_t OSPI_InitTypeDef::DualQuad***
- ***uint32_t OSPI_InitTypeDef::MemoryType***
- ***uint32_t OSPI_InitTypeDef::DeviceSize***
- ***uint32_t OSPI_InitTypeDef::ChipSelectHighTime***
- ***uint32_t OSPI_InitTypeDef::FreeRunningClock***
- ***uint32_t OSPI_InitTypeDef::ClockMode***
- ***uint32_t OSPI_InitTypeDef::WrapSize***
- ***uint32_t OSPI_InitTypeDef::ClockPrescaler***
- ***uint32_t OSPI_InitTypeDef::SampleShifting***
- ***uint32_t OSPI_InitTypeDef::DelayHoldQuarterCycle***
- ***uint32_t OSPI_InitTypeDef::ChipSelectBoundary***

49.1.2 OSPI_HandleTypeDef

OSPI_HandleTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- ***OCTOSPI_TypeDef * Instance***
- ***OSPI_InitTypeDef Init***
- ***uint8_t * pBuffPtr***
- ***__IO uint32_t XferSize***
- ***__IO uint32_t XferCount***
- ***DMA_HandleTypeDef * hdma***
- ***__IO uint32_t State***
- ***__IO uint32_t ErrorCode***
- ***uint32_t Timeout***

Field Documentation

- *OCTOSPI_TypeDef* OSPI_HandleTypeDef::Instance*
- *OSPI_InitTypeDef OSPI_HandleTypeDef::Init*
- *uint8_t* OSPI_HandleTypeDef::pBuffPtr*
- *__IO uint32_t OSPI_HandleTypeDef::XferSize*
- *__IO uint32_t OSPI_HandleTypeDef::XferCount*
- *DMA_HandleTypeDef* OSPI_HandleTypeDef::hdma*
- *__IO uint32_t OSPI_HandleTypeDef::State*
- *__IO uint32_t OSPI_HandleTypeDef::ErrorCode*
- *uint32_t OSPI_HandleTypeDef::Timeout*

49.1.3 OSPI_RegularCmdTypeDef

OSPI_RegularCmdTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- *uint32_t OperationType*
- *uint32_t FlashId*
- *uint32_t Instruction*
- *uint32_t InstructionMode*
- *uint32_t InstructionSize*
- *uint32_t InstructionDtrMode*
- *uint32_t Address*
- *uint32_t AddressMode*
- *uint32_t AddressSize*
- *uint32_t AddressDtrMode*
- *uint32_t AlternateBytes*
- *uint32_t AlternateBytesMode*
- *uint32_t AlternateBytesSize*
- *uint32_t AlternateBytesDtrMode*
- *uint32_t DataMode*
- *uint32_t NbData*
- *uint32_t DataDtrMode*
- *uint32_t DummyCycles*
- *uint32_t DQSMode*
- *uint32_t SIOOMode*

Field Documentation

- *uint32_t OSPI_RegularCmdTypeDef::OperationType*
- *uint32_t OSPI_RegularCmdTypeDef::FlashId*
- *uint32_t OSPI_RegularCmdTypeDef::Instruction*
- *uint32_t OSPI_RegularCmdTypeDef::InstructionMode*
- *uint32_t OSPI_RegularCmdTypeDef::InstructionSize*
- *uint32_t OSPI_RegularCmdTypeDef::InstructionDtrMode*
- *uint32_t OSPI_RegularCmdTypeDef::Address*
- *uint32_t OSPI_RegularCmdTypeDef::AddressMode*
- *uint32_t OSPI_RegularCmdTypeDef::AddressSize*
- *uint32_t OSPI_RegularCmdTypeDef::AddressDtrMode*

- *uint32_t OSPI_RegularCmdTypeDef::AlternateBytes*
- *uint32_t OSPI_RegularCmdTypeDef::AlternateBytesMode*
- *uint32_t OSPI_RegularCmdTypeDef::AlternateBytesSize*
- *uint32_t OSPI_RegularCmdTypeDef::AlternateBytesDtrMode*
- *uint32_t OSPI_RegularCmdTypeDef::DataMode*
- *uint32_t OSPI_RegularCmdTypeDef::NbData*
- *uint32_t OSPI_RegularCmdTypeDef::DataDtrMode*
- *uint32_t OSPI_RegularCmdTypeDef::DummyCycles*
- *uint32_t OSPI_RegularCmdTypeDef::DQSMode*
- *uint32_t OSPI_RegularCmdTypeDef::SIOOMode*

49.1.4 OSPI_HyperbusCfgTypeDef

OSPI_HyperbusCfgTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- *uint32_t RWRecoveryTime*
- *uint32_t AccessTime*
- *uint32_t WriteZeroLatency*
- *uint32_t LatencyMode*

Field Documentation

- *uint32_t OSPI_HyperbusCfgTypeDef::RWRecoveryTime*
- *uint32_t OSPI_HyperbusCfgTypeDef::AccessTime*
- *uint32_t OSPI_HyperbusCfgTypeDef::WriteZeroLatency*
- *uint32_t OSPI_HyperbusCfgTypeDef::LatencyMode*

49.1.5 OSPI_HyperbusCmdTypeDef

OSPI_HyperbusCmdTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- *uint32_t AddressSpace*
- *uint32_t Address*
- *uint32_t AddressSize*
- *uint32_t NbData*
- *uint32_t DQSMode*

Field Documentation

- *uint32_t OSPI_HyperbusCmdTypeDef::AddressSpace*
- *uint32_t OSPI_HyperbusCmdTypeDef::Address*
- *uint32_t OSPI_HyperbusCmdTypeDef::AddressSize*
- *uint32_t OSPI_HyperbusCmdTypeDef::NbData*
- *uint32_t OSPI_HyperbusCmdTypeDef::DQSMode*

49.1.6 OSPI_AutoPollingTypeDef

OSPI_AutoPollingTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- *uint32_t Match*
- *uint32_t Mask*
- *uint32_t MatchMode*
- *uint32_t AutomaticStop*

- ***uint32_t Interval***

Field Documentation

- ***uint32_t OSPI_AutoPollingTypeDef::Match***
- ***uint32_t OSPI_AutoPollingTypeDef::Mask***
- ***uint32_t OSPI_AutoPollingTypeDef::MatchMode***
- ***uint32_t OSPI_AutoPollingTypeDef::AutomaticStop***
- ***uint32_t OSPI_AutoPollingTypeDef::Interval***

49.1.7 OSPI_MemoryMappedTypeDef

OSPI_MemoryMappedTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- ***uint32_t TimeOutActivation***
- ***uint32_t TimeOutPeriod***

Field Documentation

- ***uint32_t OSPI_MemoryMappedTypeDef::TimeOutActivation***
- ***uint32_t OSPI_MemoryMappedTypeDef::TimeOutPeriod***

49.1.8 OSPIM_CfgTypeDef

OSPIM_CfgTypeDef is defined in the stm32l4xx_hal_ospi.h

Data Fields

- ***uint32_t ClkPort***
- ***uint32_t DQSPort***
- ***uint32_t NCSPort***
- ***uint32_t IOLowPort***
- ***uint32_t IOHighPort***

Field Documentation

- ***uint32_t OSPIM_CfgTypeDef::ClkPort***
- ***uint32_t OSPIM_CfgTypeDef::DQSPort***
- ***uint32_t OSPIM_CfgTypeDef::NCSPort***
- ***uint32_t OSPIM_CfgTypeDef::IOLowPort***
- ***uint32_t OSPIM_CfgTypeDef::IOHighPort***

49.2 OSPI Firmware driver API description

The following section lists the various functions of the OSPI library.

49.2.1 How to use this driver

Initialization

1. As prerequisite, fill in the HAL_OSPI_MspInit() :
   - Enable OctoSPI and OctoSPIM clocks interface with __HAL_RCC_OSPIx_CLK_ENABLE().
   - Reset OctoSPI Peripheral with __HAL_RCC_OSPIx_FORCE_RESET() and __HAL_RCC_OSPIx_RELEASE_RESET().
   - Enable the clocks for the OctoSPI GPIOS with __HAL_RCC_GPIOx_CLK_ENABLE().
   - Configure these OctoSPI pins in alternate mode using HAL_GPIO_Init().
   - If interrupt or DMA mode is used, enable and configure OctoSPI global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
   - If DMA mode is used, enable the clocks for the OctoSPI DMA channel with __HAL_RCC_DMAx_CLK_ENABLE(), configure DMA with HAL_DMA_Init(), link it with OctoSPI handle using __HAL_LINKDMA(), enable and configure DMA channel global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
2. Configure the fifo threshold, the dual-quad mode, the memory type, the device size, the CS high time, the free running clock, the clock mode, the wrap size, the clock prescaler, the sample shifting, the hold delay and the CS boundary using the HAL_OSPI_Init() function.
3. When using Hyperbus, configure the RW recovery time, the access time, the write latency and the latency mode unsing the HAL_OSPI_HyperbusCfg() function.

Indirect functional mode

1. In regular mode, configure the command sequence using the HAL_OSPI_Command() or HAL_OSPI_Command_IT() functions :
   - Instruction phase : the mode used and if present the size, the instruction opcode and the DTR mode.
   - Address phase : the mode used and if present the size, the address value and the DTR mode.
   - Alternate-bytes phase : the mode used and if present the size, the alternate bytes values and the DTR mode.
   - Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
   - Data phase : the mode used and if present the number of bytes and the DTR mode.
   - Data strobe (DQS) mode : the activation (or not) of this mode
   - Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
   - Flash identifier : in dual-quad mode, indicates which flash is concerned
   - Operation type : always common configuration
2. In Hyperbus mode, configure the command sequence using the HAL_OSPI_HyperbusCmd() function :
   - Address space : indicate if the access will be done in register or memory
   - Address size
   - Number of data
   - Data strobe (DQS) mode : the activation (or not) of this mode
3. If no data is required for the command (only for regular mode, not for Hyperbus mode), it is sent directly to the memory :
   - In polling mode, the output of the function is done when the transfer is complete.
   - In interrupt mode, HAL_OSPI_CmdCpltCallback() will be called when the transfer is complete.
4. For the indirect write mode, use HAL_OSPI_Transmit(), HAL_OSPI_Transmit_DMA() or HAL_OSPI_Transmit_IT() after the command configuration :
   - In polling mode, the output of the function is done when the transfer is complete.
   - In interrupt mode, HAL_OSPI_FifoThresholdCallback() will be called when the fifo threshold is reached and HAL_OSPI_TxCpltCallback() will be called when the transfer is complete.
   - In DMA mode, HAL_OSPI_TxHalfCpltCallback() will be called at the half transfer and HAL_OSPI_TxCpltCallback() will be called when the transfer is complete.

5. For the indirect read mode, use HAL_OSPI_Receive(), HAL_OSPI_Receive_DMA() or HAL_OSPI_Receive_IT() after the command configuration :
   – In polling mode, the output of the function is done when the transfer is complete.
   – In interrupt mode, HAL_OSPI_FifoThresholdCallback() will be called when the fifo threshold is reached and HAL_OSPI_RxCpltCallback() will be called when the transfer is complete.
   – In DMA mode, HAL_OSPI_RxHalfCpltCallback() will be called at the half transfer and HAL_OSPI_RxCpltCallback() will be called when the transfer is complete.

Auto-polling functional mode

1. Configure the command sequence by the same way than the indirect mode
2. Configure the auto-polling functional mode using the HAL_OSPI_AutoPolling() or HAL_OSPI_AutoPolling_IT() functions :
   – The size of the status bytes, the match value, the mask used, the match mode (OR/AND), the polling interval and the automatic stop activation.
3. After the configuration :
   – In polling mode, the output of the function is done when the status match is reached. The automatic stop is activated to avoid an infinite loop.
   – In interrupt mode, HAL_OSPI_StatusMatchCallback() will be called each time the status match is reached.

Memory-mapped functional mode

1. Configure the command sequence by the same way than the indirect mode except for the operation type in regular mode :
   – Operation type equals to read configuration : the command configuration applies to read access in memory-mapped mode
   – Operation type equals to write configuration : the command configuration applies to write access in memory-mapped mode
   – Both read and write configuration should be performed before activating memory-mapped mode
2. Configure the memory-mapped functional mode using the HAL_OSPI_MemoryMapped() functions :
   – The timeout activation and the timeout period.
3. After the configuration, the OctoSPI will be used as soon as an access on the AHB is done on the address range. HAL_OSPI_TimeOutCallback() will be called when the timeout expires.

Errors management and abort functionality

1. HAL_OSPI_GetError() function gives the error raised during the last operation.
2. HAL_OSPI_Abort() and HAL_OSPI_AbortIT() functions aborts any on-going operation and flushes the fifo :
   – In polling mode, the output of the function is done when the transfer complete bit is set and the busy bit cleared.
   – In interrupt mode, HAL_OSPI_AbortCpltCallback() will be called when the transfer complete bit is set.

Control functions

1. HAL_OSPI_GetState() function gives the current state of the HAL OctoSPI driver.
2. HAL_OSPI_SetTimeout() function configures the timeout value used in the driver.
3. HAL_OSPI_SetFifoThreshold() function configures the threshold on the Fifo of the OSPI Peripheral.
4. HAL_OSPI_GetFifoThreshold() function gives the current of the Fifo's threshold

IO manager configuration functions

1. HAL_OSPIM_Config() function configures the IO manager for the OctoSPI instance.

Callback registration

The compilation define USE_HAL_OSPI_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_OSPI_RegisterCallback() to register a user callback, it allows to register following callbacks:

- ErrorCallback : callback when error occurs.
- AbortCpltCallback : callback when abort is completed.
- FifoThresholdCallback : callback when the fifo threshold is reached.
- CmdCpltCallback : callback when a command without data is completed.
- RxCpltCallback : callback when a reception transfer is completed.
- TxCpltCallback : callback when a transmission transfer is completed.
- RxHalfCpltCallback : callback when half of the reception transfer is completed.
- TxHalfCpltCallback : callback when half of the transmission transfer is completed.
- StatusMatchCallback : callback when a status match occurs.
- TimeOutCallback : callback when the timeout perioed expires.
- MspInitCallback : OSPI MspInit.
- MspDeInitCallback : OSPI MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. Use function @ref HAL_OSPI_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. It allows to reset following callbacks:
- ErrorCallback : callback when error occurs.
- AbortCpltCallback : callback when abort is completed.
- FifoThresholdCallback : callback when the fifo threshold is reached.
- CmdCpltCallback : callback when a command without data is completed.
- RxCpltCallback : callback when a reception transfer is completed.
- TxCpltCallback : callback when a transmission transfer is completed.
- RxHalfCpltCallback : callback when half of the reception transfer is completed.
- TxHalfCpltCallback : callback when half of the transmission transfer is completed.
- StatusMatchCallback : callback when a status match occurs.
- TimeOutCallback : callback when the timeout perioed expires.
- MspInitCallback : OSPI MspInit.
- MspDeInitCallback : OSPI MspDeInit. This function) takes as parameters the HAL peripheral handle and the Callback ID. By default, after the @ref HAL_OSPI_Init and if the state is HAL_OSPI_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions. Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_OSPI_Init and @ref HAL_OSPI_DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_OSPI_Init and @ref HAL_OSPI_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand) Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_OSPI_RegisterCallback before calling @ref HAL_OSPI_DeInit or @ref HAL_OSPI_Init function. When The compilation define USE_HAL_OSPI_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

49.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to :

- Initialize the OctoSPI.
- De-initialize the OctoSPI.

This section contains the following APIs:

- ***HAL_OSPI_Init***
- ***HAL_OSPI_MspInit***
- ***HAL_OSPI_DeInit***

- *HAL_OSPI_MspDeInit*

49.2.3 IO operation functions

This subsection provides a set of functions allowing to :

- Handle the interrupts.
- Handle the command sequence (regular and Hyperbus).
- Handle the Hyperbus configuration.
- Transmit data in blocking, interrupt or DMA mode.
- Receive data in blocking, interrupt or DMA mode.
- Manage the auto-polling functional mode.
- Manage the memory-mapped functional mode.

This section contains the following APIs:

- *HAL_OSPI_IRQHandler*
- *HAL_OSPI_Command*
- *HAL_OSPI_Command_IT*
- *HAL_OSPI_HyperbusCfg*
- *HAL_OSPI_HyperbusCmd*
- *HAL_OSPI_Transmit*
- *HAL_OSPI_Receive*
- *HAL_OSPI_Transmit_IT*
- *HAL_OSPI_Receive_IT*
- *HAL_OSPI_Transmit_DMA*
- *HAL_OSPI_Receive_DMA*
- *HAL_OSPI_AutoPolling*
- *HAL_OSPI_AutoPolling_IT*
- *HAL_OSPI_MemoryMapped*
- *HAL_OSPI_ErrorCallback*
- *HAL_OSPI_AbortCpltCallback*
- *HAL_OSPI_FifoThresholdCallback*
- *HAL_OSPI_CmdCpltCallback*
- *HAL_OSPI_RxCpltCallback*
- *HAL_OSPI_TxCpltCallback*
- *HAL_OSPI_RxHalfCpltCallback*
- *HAL_OSPI_TxHalfCpltCallback*
- *HAL_OSPI_StatusMatchCallback*
- *HAL_OSPI_TimeOutCallback*

49.2.4 Peripheral Control and State functions

This subsection provides a set of functions allowing to :

- Check in run-time the state of the driver.
- Check the error code set during last operation.
- Abort any operation.
- Manage the Fifo threshold.
- Configure the timeout duration used in the driver.

This section contains the following APIs:

- *HAL_OSPI_Abort*
- *HAL_OSPI_Abort_IT*
- *HAL_OSPI_SetFifoThreshold*

- *HAL_OSPI_GetFifoThreshold*
- *HAL_OSPI_SetTimeout*
- *HAL_OSPI_GetError*
- *HAL_OSPI_GetState*

49.2.5 IO Manager configuration function

This subsection provides a set of functions allowing to :

- Configure the IO manager.

This section contains the following APIs:

- *HAL_OSPIM_Config*

49.2.6 Detailed description of functions

`HAL_OSPI_Init`

Function name

HAL_StatusTypeDef HAL_OSPI_Init (OSPI_HandleTypeDef * hospi)

Function description

Initialize the OSPI mode according to the specified parameters in the OSPI_InitTypeDef and initialize the associated handle.

Parameters

- **hospi:** : OSPI handle

Return values

- **HAL:** status

`HAL_OSPI_MspInit`

Function name

void HAL_OSPI_MspInit (OSPI_HandleTypeDef * hospi)

Function description

Initialize the OSPI MSP.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_DeInit`

Function name

HAL_StatusTypeDef HAL_OSPI_DeInit (OSPI_HandleTypeDef * hospi)

Function description

De-Initialize the OSPI peripheral.

Parameters

- **hospi:** : OSPI handle

Return values

- **HAL:** status

HAL_OSPI_MspDeInit

Function name

void HAL_OSPI_MspDeInit (OSPI_HandleTypeDef * hospi)

Function description

DeInitialize the OSPI MSP.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

HAL_OSPI_IRQHandler

Function name

void HAL_OSPI_IRQHandler (OSPI_HandleTypeDef * hospi)

Function description

Handle OSPI interrupt request.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

HAL_OSPI_Command

Function name

HAL_StatusTypeDef HAL_OSPI_Command (OSPI_HandleTypeDef * hospi, OSPI_RegularCmdTypeDef * cmd, uint32_t Timeout)

Function description

Set the command configuration.

Parameters

- **hospi:** : OSPI handle
- **cmd:** : structure that contains the command configuration information
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

HAL_OSPI_Command_IT

Function name

HAL_StatusTypeDef HAL_OSPI_Command_IT (OSPI_HandleTypeDef * hospi, OSPI_RegularCmdTypeDef * cmd)

Function description

Set the command configuration in interrupt mode.

Parameters

- **hospi:** : OSPI handle
- **cmd:** : structure that contains the command configuration information

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Read or Write Modes

HAL_OSPI_HyperbusCfg

Function name

HAL_StatusTypeDef HAL_OSPI_HyperbusCfg (OSPI_HandleTypeDef * hospi, OSPI_HyperbusCfgTypeDef * cfg, uint32_t Timeout)

Function description

Configure the Hyperbus parameters.

Parameters

- **hospi:** : OSPI handle
- **cfg:** : Structure containing the Hyperbus configuration
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

HAL_OSPI_HyperbusCmd

Function name

HAL_StatusTypeDef HAL_OSPI_HyperbusCmd (OSPI_HandleTypeDef * hospi, OSPI_HyperbusCmdTypeDef * cmd, uint32_t Timeout)

Function description

Set the Hyperbus command configuration.

Parameters

- **hospi:** : OSPI handle
- **cmd:** : Structure containing the Hyperbus command
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

HAL_OSPI_Transmit

Function name

HAL_StatusTypeDef HAL_OSPI_Transmit (OSPI_HandleTypeDef * hospi, uint8_t * pData, uint32_t Timeout)

Function description

Transmit an amount of data in blocking mode.

Parameters

- **hospi:** : OSPI handle
- **pData:** : pointer to data buffer
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Write Mode

`HAL_OSPI_Receive`

Function name

HAL_StatusTypeDef HAL_OSPI_Receive (OSPI_HandleTypeDef * hospi, uint8_t * pData, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **hospi:** : OSPI handle
- **pData:** : pointer to data buffer
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Read Mode

`HAL_OSPI_Transmit_IT`

Function name

HAL_StatusTypeDef HAL_OSPI_Transmit_IT (OSPI_HandleTypeDef * hospi, uint8_t * pData)

Function description

Send an amount of data in non-blocking mode with interrupt.

Parameters

- **hospi:** : OSPI handle
- **pData:** : pointer to data buffer

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Write Mode

`HAL_OSPI_Receive_IT`

Function name

HAL_StatusTypeDef HAL_OSPI_Receive_IT (OSPI_HandleTypeDef * hospi, uint8_t * pData)

Function description

Receive an amount of data in non-blocking mode with interrupt.

Parameters

- **hospi:** : OSPI handle
- **pData:** : pointer to data buffer

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Read Mode

HAL_OSPI_Transmit_DMA

Function name

HAL_StatusTypeDef HAL_OSPI_Transmit_DMA (OSPI_HandleTypeDef * hospi, uint8_t * pData)

Function description

Send an amount of data in non-blocking mode with DMA.

Parameters

- **hospi:** : OSPI handle
- **pData:** : pointer to data buffer

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Write Mode
- If DMA peripheral access is configured as halfword, the number of data and the fifo threshold should be aligned on halfword
- If DMA peripheral access is configured as word, the number of data and the fifo threshold should be aligned on word

HAL_OSPI_Receive_DMA

Function name

HAL_StatusTypeDef HAL_OSPI_Receive_DMA (OSPI_HandleTypeDef * hospi, uint8_t * pData)

Function description

Receive an amount of data in non-blocking mode with DMA.

Parameters

- **hospi:** : OSPI handle
- **pData:** : pointer to data buffer.

Return values

- **HAL:** status

Notes

- This function is used only in Indirect Read Mode
- If DMA peripheral access is configured as halfword, the number of data and the fifo threshold should be aligned on halfword
- If DMA peripheral access is configured as word, the number of data and the fifo threshold should be aligned on word

HAL_OSPI_AutoPolling

Function name

HAL_StatusTypeDef HAL_OSPI_AutoPolling (OSPI_HandleTypeDef * hospi, OSPI_AutoPollingTypeDef * cfg, uint32_t Timeout)

Function description

Configure the OSPI Automatic Polling Mode in blocking mode.

Parameters

- **hospi:** : OSPI handle
- **cfg:** : structure that contains the polling configuration information.
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

Notes

- This function is used only in Automatic Polling Mode
- This function should not be used when the memory is in octal mode (see Errata Sheet)

HAL_OSPI_AutoPolling_IT

Function name

HAL_StatusTypeDef HAL_OSPI_AutoPolling_IT (OSPI_HandleTypeDef * hospi, OSPI_AutoPollingTypeDef * cfg)

Function description

Configure the OSPI Automatic Polling Mode in non-blocking mode.

Parameters

- **hospi:** : OSPI handle
- **cfg:** : structure that contains the polling configuration information.

Return values

- **HAL:** status

Notes

- This function is used only in Automatic Polling Mode
- This function should not be used when the memory is in octal mode (see Errata Sheet)

HAL_OSPI_MemoryMapped

Function name

HAL_StatusTypeDef HAL_OSPI_MemoryMapped (OSPI_HandleTypeDef * hospi, OSPI_MemoryMappedTypeDef * cfg)

Function description

Configure the Memory Mapped mode.

Parameters

- **hospi:** : OSPI handle
- **cfg:** : structure that contains the memory mapped configuration information.

Return values

- **HAL:** status

Notes

- This function is used only in Memory mapped Mode

`HAL_OSPI_ErrorCallback`

Function name

void HAL_OSPI_ErrorCallback (OSPI_HandleTypeDef * hospi)

Function description

Transfer Error callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_AbortCpltCallback`

Function name

void HAL_OSPI_AbortCpltCallback (OSPI_HandleTypeDef * hospi)

Function description

Abort completed callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_FifoThresholdCallback`

Function name

void HAL_OSPI_FifoThresholdCallback (OSPI_HandleTypeDef * hospi)

Function description

FIFO Threshold callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_CmdCpltCallback`

Function name

void HAL_OSPI_CmdCpltCallback (OSPI_HandleTypeDef * hospi)

Function description

Command completed callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_RxCpltCallback`

Function name

void HAL_OSPI_RxCpltCallback (OSPI_HandleTypeDef * hospi)

Function description

Rx Transfer completed callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_TxCpltCallback`

Function name

void HAL_OSPI_TxCpltCallback (OSPI_HandleTypeDef * hospi)

Function description

Tx Transfer completed callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_RxHalfCpltCallback`

Function name

void HAL_OSPI_RxHalfCpltCallback (OSPI_HandleTypeDef * hospi)

Function description

Rx Half Transfer completed callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_TxHalfCpltCallback`

Function name

void HAL_OSPI_TxHalfCpltCallback (OSPI_HandleTypeDef * hospi)

Function description

Tx Half Transfer completed callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_StatusMatchCallback`

Function name

void HAL_OSPI_StatusMatchCallback (OSPI_HandleTypeDef * hospi)

Function description

Status Match callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_TimeOutCallback`

Function name

void HAL_OSPI_TimeOutCallback (OSPI_HandleTypeDef * hospi)

Function description

Timeout callback.

Parameters

- **hospi:** : OSPI handle

Return values

- **None:**

`HAL_OSPI_Abort`

Function name

HAL_StatusTypeDef HAL_OSPI_Abort (OSPI_HandleTypeDef * hospi)

Function description

Abort the current transmission.

Parameters

- **hospi:** : OSPI handle

Return values

- **HAL:** status

`HAL_OSPI_Abort_IT`

Function name

HAL_StatusTypeDef HAL_OSPI_Abort_IT (OSPI_HandleTypeDef * hospi)

Function description

Abort the current transmission (non-blocking function)

Parameters

- **hospi:** : OSPI handle

Return values

- **HAL:** status

`HAL_OSPI_SetFifoThreshold`

Function name

HAL_StatusTypeDef HAL_OSPI_SetFifoThreshold (OSPI_HandleTypeDef * hospi, uint32_t Threshold)

Function description

Set OSPI Fifo threshold.

Parameters

- **hospi:** : OSPI handle.
- **Threshold:** : Threshold of the Fifo.

Return values

- **HAL:** status

`HAL_OSPI_GetFifoThreshold`

Function name

uint32_t HAL_OSPI_GetFifoThreshold (OSPI_HandleTypeDef * hospi)

Function description

Get OSPI Fifo threshold.

Parameters

- **hospi:** : OSPI handle.

Return values

- **Fifo:** threshold

`HAL_OSPI_SetTimeout`

Function name

HAL_StatusTypeDef HAL_OSPI_SetTimeout (OSPI_HandleTypeDef * hospi, uint32_t Timeout)

Function description

Set OSPI timeout.

Parameters

- **hospi:** : OSPI handle.
- **Timeout:** : Timeout for the memory access.

Return values

- **None:**

`HAL_OSPI_GetError`

Function name

uint32_t HAL_OSPI_GetError (OSPI_HandleTypeDef * hospi)

Function description

Return the OSPI error code.

Parameters

- **hospi:** : OSPI handle

Return values

- **OSPI:** Error Code

`HAL_OSPI_GetState`

Function name

uint32_t HAL_OSPI_GetState (OSPI_HandleTypeDef * hospi)

Function description

Return the OSPI handle state.

Parameters

- **hospi:** : OSPI handle

Return values

- **HAL:** state

`HAL_OSPIM_Config`

Function name

HAL_StatusTypeDef HAL_OSPIM_Config (OSPI_HandleTypeDef * hospi, OSPIM_CfgTypeDef * cfg, uint32_t Timeout)

Function description

Configure the OctoSPI IO manager.

Parameters

- **hospi:** : OSPI handle
- **cfg:** : Configuration of the IO Manager for the instance
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

49.3 OSPI Firmware driver defines

The following section lists the various define and macros of the module.

49.3.1 OSPI

OSPI

OSPI Address DTR Mode

HAL_OSPI_ADDRESS_DTR_DISABLE

DTR mode disabled for address phase

HAL_OSPI_ADDRESS_DTR_ENABLE

DTR mode enabled for address phase

OSPI Address Mode

HAL_OSPI_ADDRESS_NONE

No address

HAL_OSPI_ADDRESS_1_LINE

Address on a single line

HAL_OSPI_ADDRESS_2_LINES

Address on two lines

HAL_OSPI_ADDRESS_4_LINES

Address on four lines

HAL_OSPI_ADDRESS_8_LINES

Address on eight lines

OSPI Address Size

HAL_OSPI_ADDRESS_8_BITS

8-bit address

HAL_OSPI_ADDRESS_16_BITS

16-bit address

HAL_OSPI_ADDRESS_24_BITS

24-bit address

HAL_OSPI_ADDRESS_32_BITS

32-bit address

OSPI Hyperbus Address Space

HAL_OSPI_MEMORY_ADDRESS_SPACE

HyperBus memory mode

HAL_OSPI_REGISTER_ADDRESS_SPACE

HyperBus register mode

OSPI Alternate Bytes DTR Mode

HAL_OSPI_ALTERNATE_BYTES_DTR_DISABLE

DTR mode disabled for alternate bytes phase

HAL_OSPI_ALTERNATE_BYTES_DTR_ENABLE

DTR mode enabled for alternate bytes phase

OSPI Alternate Bytes Mode

HAL_OSPI_ALTERNATE_BYTES_NONE

No alternate bytes

HAL_OSPI_ALTERNATE_BYTES_1_LINE

Alternate bytes on a single line

HAL_OSPI_ALTERNATE_BYTES_2_LINES

Alternate bytes on two lines

HAL_OSPI_ALTERNATE_BYTES_4_LINES

Alternate bytes on four lines

HAL_OSPI_ALTERNATE_BYTES_8_LINES

Alternate bytes on eight lines

OSPI Alternate Bytes Size

HAL_OSPI_ALTERNATE_BYTES_8_BITS

8-bit alternate bytes

HAL_OSPI_ALTERNATE_BYTES_16_BITS

16-bit alternate bytes

HAL_OSPI_ALTERNATE_BYTES_24_BITS

24-bit alternate bytes

HAL_OSPI_ALTERNATE_BYTES_32_BITS

32-bit alternate bytes

OSPI Automatic Stop

HAL_OSPI_AUTOMATIC_STOP_DISABLE

AutoPolling stops only with abort or OSPI disabling

HAL_OSPI_AUTOMATIC_STOP_ENABLE

AutoPolling stops as soon as there is a match

OSPI Clock Mode

HAL_OSPI_CLOCK_MODE_0

CLK must stay low while nCS is high

HAL_OSPI_CLOCK_MODE_3

CLK must stay high while nCS is high

OSPI Data DTR Mode

HAL_OSPI_DATA_DTR_DISABLE

DTR mode disabled for data phase

HAL_OSPI_DATA_DTR_ENABLE

DTR mode enabled for data phase

OSPI Data Mode

HAL_OSPI_DATA_NONE

No data

HAL_OSPI_DATA_1_LINE

Data on a single line

HAL_OSPI_DATA_2_LINES

Data on two lines

HAL_OSPI_DATA_4_LINES

Data on four lines

HAL_OSPI_DATA_8_LINES

Data on eight lines

OSPI Delay Hold Quarter Cycle

HAL_OSPI_DHQC_DISABLE

No Delay

HAL_OSPI_DHQC_ENABLE

Delay Hold 1/4 cycle

OSPI DQS Mode

HAL_OSPI_DQS_DISABLE

DQS disabled

HAL_OSPI_DQS_ENABLE

DQS enabled

OSPI Dual-Quad

HAL_OSPI_DUALQUAD_DISABLE

Dual-Quad mode disabled

HAL_OSPI_DUALQUAD_ENABLE

Dual-Quad mode enabled

OSPI Error Code

HAL_OSPI_ERROR_NONE

No error

HAL_OSPI_ERROR_TIMEOUT

Timeout error

HAL_OSPI_ERROR_TRANSFER

Transfer error

HAL_OSPI_ERROR_DMA

DMA transfer error

HAL_OSPI_ERROR_INVALID_PARAM

Invalid parameters error

HAL_OSPI_ERROR_INVALID_SEQUENCE

Sequence of the state machine is incorrect

OSPI Exported Macros

__HAL_OSPI_RESET_HANDLE_STATE

Description:

- Reset OSPI handle state.

Parameters:

- __HANDLE__: OSPI handle.

Return value:

- None

__HAL_OSPI_ENABLE

Description:

- Enable the OSPI peripheral.

Parameters:

- __HANDLE__: specifies the OSPI Handle.

Return value:

- None

__HAL_OSPI_DISABLE

Description:

- Disable the OSPI peripheral.

Parameters:

- __HANDLE__: specifies the OSPI Handle.

Return value:

- None

__HAL_OSPI_ENABLE_IT

Description:

- Enable the specified OSPI interrupt.

Parameters:

- __HANDLE__: specifies the OSPI Handle.
- __INTERRUPT__: specifies the OSPI interrupt source to enable. This parameter can be one of the following values:
  - HAL_OSPI_IT_TO: OSPI Timeout interrupt
  - HAL_OSPI_IT_SM: OSPI Status match interrupt
  - HAL_OSPI_IT_FT: OSPI FIFO threshold interrupt
  - HAL_OSPI_IT_TC: OSPI Transfer complete interrupt
  - HAL_OSPI_IT_TE: OSPI Transfer error interrupt

Return value:

- None

__HAL_OSPI_DISABLE_IT

Description:

- Disable the specified OSPI interrupt.

Parameters:

- __HANDLE__: specifies the OSPI Handle.
- __INTERRUPT__: specifies the OSPI interrupt source to disable. This parameter can be one of the following values:
  - HAL_OSPI_IT_TO: OSPI Timeout interrupt
  - HAL_OSPI_IT_SM: OSPI Status match interrupt
  - HAL_OSPI_IT_FT: OSPI FIFO threshold interrupt
  - HAL_OSPI_IT_TC: OSPI Transfer complete interrupt
  - HAL_OSPI_IT_TE: OSPI Transfer error interrupt

Return value:

- None

__HAL_OSPI_GET_IT_SOURCE

Description:

- Check whether the specified OSPI interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the OSPI Handle.
- __INTERRUPT__: specifies the OSPI interrupt source to check. This parameter can be one of the following values:
  - HAL_OSPI_IT_TO: OSPI Timeout interrupt
  - HAL_OSPI_IT_SM: OSPI Status match interrupt
  - HAL_OSPI_IT_FT: OSPI FIFO threshold interrupt
  - HAL_OSPI_IT_TC: OSPI Transfer complete interrupt
  - HAL_OSPI_IT_TE: OSPI Transfer error interrupt

Return value:

- The: new state of __INTERRUPT__ (TRUE or FALSE).

__HAL_OSPI_GET_FLAG

Description:

- Check whether the selected OSPI flag is set or not.

Parameters:

- __HANDLE__: specifies the OSPI Handle.
- __FLAG__: specifies the OSPI flag to check. This parameter can be one of the following values:
  - HAL_OSPI_FLAG_BUSY: OSPI Busy flag
  - HAL_OSPI_FLAG_TO: OSPI Timeout flag
  - HAL_OSPI_FLAG_SM: OSPI Status match flag
  - HAL_OSPI_FLAG_FT: OSPI FIFO threshold flag
  - HAL_OSPI_FLAG_TC: OSPI Transfer complete flag
  - HAL_OSPI_FLAG_TE: OSPI Transfer error flag

Return value:

- None

__HAL_OSPI_CLEAR_FLAG

Description:

- Clears the specified OSPI's flag status.

Parameters:

- __HANDLE__: specifies the OSPI Handle.
- __FLAG__: specifies the OSPI clear register flag that needs to be set This parameter can be one of the following values:
  - HAL_OSPI_FLAG_TO: OSPI Timeout flag
  - HAL_OSPI_FLAG_SM: OSPI Status match flag
  - HAL_OSPI_FLAG_TC: OSPI Transfer complete flag
  - HAL_OSPI_FLAG_TE: OSPI Transfer error flag

Return value:

- None

OSPI Flags

HAL_OSPI_FLAG_BUSY

Busy flag: operation is ongoing

HAL_OSPI_FLAG_TO

Timeout flag: timeout occurs in memory-mapped mode

HAL_OSPI_FLAG_SM

Status match flag: received data matches in autopolling mode

HAL_OSPI_FLAG_FT

Fifo threshold flag: Fifo threshold reached or data left after read from memory is complete

HAL_OSPI_FLAG_TC

Transfer complete flag: programmed number of data have been transferred or the transfer has been aborted

HAL_OSPI_FLAG_TE

Transfer error flag: invalid address is being accessed

OSPI Flash Id

HAL_OSPI_FLASH_ID_1

FLASH 1 selected

HAL_OSPI_FLASH_ID_2

FLASH 2 selected

OSPI Free Running Clock

HAL_OSPI_FREERUNCLK_DISABLE

CLK is not free running

HAL_OSPI_FREERUNCLK_ENABLE

CLK is free running (always provided)

OSPI Instruction DTR Mode

HAL_OSPI_INSTRUCTION_DTR_DISABLE

DTR mode disabled for instruction phase

HAL_OSPI_INSTRUCTION_DTR_ENABLE

DTR mode enabled for instruction phase

OSPI Instruction Mode

HAL_OSPI_INSTRUCTION_NONE

No instruction

HAL_OSPI_INSTRUCTION_1_LINE

Instruction on a single line

HAL_OSPI_INSTRUCTION_2_LINES

Instruction on two lines

HAL_OSPI_INSTRUCTION_4_LINES

Instruction on four lines

HAL_OSPI_INSTRUCTION_8_LINES

Instruction on eight lines

OSPI Instruction Size

HAL_OSPI_INSTRUCTION_8_BITS

8-bit instruction

HAL_OSPI_INSTRUCTION_16_BITS

16-bit instruction

HAL_OSPI_INSTRUCTION_24_BITS

24-bit instruction

HAL_OSPI_INSTRUCTION_32_BITS

32-bit instruction

OSPI Interrupts

HAL_OSPI_IT_TO

Interrupt on the timeout flag

HAL_OSPI_IT_SM

Interrupt on the status match flag

HAL_OSPI_IT_FT

Interrupt on the fifo threshold flag

HAL_OSPI_IT_TC

Interrupt on the transfer complete flag

HAL_OSPI_IT_TE

Interrupt on the transfer error flag

OSPI Hyperbus Latency Mode

HAL_OSPI_VARIABLE_LATENCY

Variable initial latency

HAL_OSPI_FIXED_LATENCY

Fixed latency

OSPI Match Mode

HAL_OSPI_MATCH_MODE_AND

AND match mode between unmasked bits

HAL_OSPI_MATCH_MODE_OR

OR match mode between unmasked bits

OSPI Memory Type

HAL_OSPI_MEMTYPE_MICRON

Micron mode

HAL_OSPI_MEMTYPE_MACRONIX

Macronix mode

HAL_OSPI_MEMTYPE_MACRONIX_RAM

Macronix RAM mode

HAL_OSPI_MEMTYPE_HYPERBUS

Hyperbus mode

OSPI Operation Type

HAL_OSPI_OPTYPE_COMMON_CFG

Common configuration (indirect or auto-polling mode)

HAL_OSPI_OPTYPE_READ_CFG

Read configuration (memory-mapped mode)

HAL_OSPI_OPTYPE_WRITE_CFG

Write configuration (memory-mapped mode)

OSPI Sample Shifting

HAL_OSPI_SAMPLE_SHIFTING_NONE

No shift

HAL_OSPI_SAMPLE_SHIFTING_HALFCYCLE

1/2 cycle shift

OSPI SIOO Mode

HAL_OSPI_SIOO_INST_EVERY_CMD

Send instruction on every transaction

HAL_OSPI_SIOO_INST_ONLY_FIRST_CMD

Send instruction only for the first command

OSPI State

HAL_OSPI_STATE_RESET

Initial state

HAL_OSPI_STATE_HYPERBUS_INIT

Initialization done in hyperbus mode but timing configuration not done

HAL_OSPI_STATE_READY

Driver ready to be used

HAL_OSPI_STATE_CMD_CFG

Command (regular or hyperbus) configured, ready for an action

HAL_OSPI_STATE_READ_CMD_CFG

Read command configuration done, not the write command configuration

HAL_OSPI_STATE_WRITE_CMD_CFG

Write command configuration done, not the read command configuration

HAL_OSPI_STATE_BUSY_CMD

Command without data on-going

HAL_OSPI_STATE_BUSY_TX

Indirect Tx on-going

HAL_OSPI_STATE_BUSY_RX

Indirect Rx on-going

HAL_OSPI_STATE_BUSY_AUTO_POLLING

Auto-polling on-going

HAL_OSPI_STATE_BUSY_MEM_MAPPED

Memory-mapped on-going

HAL_OSPI_STATE_ABORT

Abort on-going

HAL_OSPI_STATE_ERROR

Blocking error, driver should be re-initialized

OSPI Timeout Activation

HAL_OSPI_TIMEOUT_COUNTER_DISABLE

Timeout counter disabled, nCS remains active

HAL_OSPI_TIMEOUT_COUNTER_ENABLE

Timeout counter enabled, nCS released when timeout expires

OSPI Timeout definition

HAL_OSPI_TIMEOUT_DEFAULT_VALUE

OSPI Wrap-Size

HAL_OSPI_WRAP_NOT_SUPPORTED

wrapped reads are not supported by the memory

HAL_OSPI_WRAP_16_BYTES

external memory supports wrap size of 16 bytes

HAL_OSPI_WRAP_32_BYTES

external memory supports wrap size of 32 bytes

HAL_OSPI_WRAP_64_BYTES

external memory supports wrap size of 64 bytes

HAL_OSPI_WRAP_128_BYTES

external memory supports wrap size of 128 bytes

OSPI Hyperbus Write Zero Latency Activation

HAL_OSPI_LATENCY_ON_WRITE

Latency on write accesses

HAL_OSPI_NO_LATENCY_ON_WRITE

No latency on write accesses

50 HAL PCD Generic Driver

50.1 PCD Firmware driver registers structures

50.1.1 PCD_HandleTypeDef

PCD_HandleTypeDef is defined in the stm32l4xx_hal_pcd.h

Data Fields

- ***PCD_TypeDef * Instance***
- ***PCD_InitTypeDef Init***
- ***__IO uint8_t USB_Address***
- ***PCD_EPTypeDef IN_ep***
- ***PCD_EPTypeDef OUT_ep***
- ***HAL_LockTypeDef Lock***
- ***__IO PCD_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***uint32_t Setup***
- ***PCD_LPM_StateTypeDef LPM_State***
- ***uint32_t BESL***
- ***uint32_t lpm_active***
- ***uint32_t battery_charging_active***
- ***void * pData***

Field Documentation

- ***PCD_TypeDef* PCD_HandleTypeDef::Instance***
  Register base address
- ***PCD_InitTypeDef PCD_HandleTypeDef::Init***
  PCD required parameters
- ***__IO uint8_t PCD_HandleTypeDef::USB_Address***
  USB Address
- ***PCD_EPTypeDef PCD_HandleTypeDef::IN_ep[16]***
  IN endpoint parameters
- ***PCD_EPTypeDef PCD_HandleTypeDef::OUT_ep[16]***
  OUT endpoint parameters
- ***HAL_LockTypeDef PCD_HandleTypeDef::Lock***
  PCD peripheral status
- ***__IO PCD_StateTypeDef PCD_HandleTypeDef::State***
  PCD communication state
- ***__IO uint32_t PCD_HandleTypeDef::ErrorCode***
  PCD Error code
- ***uint32_t PCD_HandleTypeDef::Setup[12]***
  Setup packet buffer
- ***PCD_LPM_StateTypeDef PCD_HandleTypeDef::LPM_State***
  LPM State
- ***uint32_t PCD_HandleTypeDef::BESL***
- ***uint32_t PCD_HandleTypeDef::lpm_active***
  Enable or disable the Link Power Management . This parameter can be set to ENABLE or DISABLE

- ***uint32_t PCD_HandleTypeDef::battery_charging_active***
  Enable or disable Battery charging. This parameter can be set to ENABLE or DISABLE
- ***void* PCD_HandleTypeDef::pData***
  Pointer to upper stack Handler

50.2 PCD Firmware driver API description

The following section lists the various functions of the PCD library.

50.2.1 How to use this driver

The PCD HAL driver can be used as follows:

1. Declare a PCD_HandleTypeDef handle structure, for example: PCD_HandleTypeDef hpcd;
2. Fill parameters of Init structure in HCD handle
3. Call HAL_PCD_Init() API to initialize the PCD peripheral (Core, Device core, ...)
4. Initialize the PCD low level resources through the HAL_PCD_MspInit() API:
   a. Enable the PCD/USB Low Level interface clock using
      ◦ __HAL_RCC_USB_CLK_ENABLE(); For USB Device only FS peripheral
   b. Initialize the related GPIO clocks
   c. Configure PCD pin-out
   d. Configure PCD NVIC interrupt
5. Associate the Upper USB device stack to the HAL PCD Driver:
   a. hpcd.pData = pdev;
6. Enable PCD transmission and reception:
   a. HAL_PCD_Start();

50.2.2 Initialization and de-initialization functions

This section provides functions allowing to:
This section contains the following APIs:

- ***HAL_PCD_Init***
- ***HAL_PCD_DeInit***
- ***HAL_PCD_MspInit***
- ***HAL_PCD_MspDeInit***

50.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the PCD data transfers.
This section contains the following APIs:

- ***HAL_PCD_Start***
- ***HAL_PCD_Stop***
- ***HAL_PCD_IRQHandler***
- ***HAL_PCD_DataOutStageCallback***
- ***HAL_PCD_DataInStageCallback***
- ***HAL_PCD_SetupStageCallback***
- ***HAL_PCD_SOFCallback***
- ***HAL_PCD_ResetCallback***
- ***HAL_PCD_SuspendCallback***
- ***HAL_PCD_ResumeCallback***
- ***HAL_PCD_ISOOUTIncompleteCallback***
- ***HAL_PCD_ISOINIncompleteCallback***
- ***HAL_PCD_ConnectCallback***
- ***HAL_PCD_DisconnectCallback***

50.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the PCD data transfers.

This section contains the following APIs:

- *HAL_PCD_DevConnect*
- *HAL_PCD_DevDisconnect*
- *HAL_PCD_SetAddress*
- *HAL_PCD_EP_Open*
- *HAL_PCD_EP_Close*
- *HAL_PCD_EP_Receive*
- *HAL_PCD_EP_GetRxCount*
- *HAL_PCD_EP_Transmit*
- *HAL_PCD_EP_SetStall*
- *HAL_PCD_EP_ClrStall*
- *HAL_PCD_EP_Flush*
- *HAL_PCD_ActivateRemoteWakeup*
- *HAL_PCD_DeActivateRemoteWakeup*

50.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- *HAL_PCD_GetState*

50.2.6 Detailed description of functions

`HAL_PCD_Init`

Function name

HAL_StatusTypeDef HAL_PCD_Init (PCD_HandleTypeDef * hpcd)

Function description

Initializes the PCD according to the specified parameters in the PCD_InitTypeDef and initialize the associated handle.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

`HAL_PCD_DeInit`

Function name

HAL_StatusTypeDef HAL_PCD_DeInit (PCD_HandleTypeDef * hpcd)

Function description

DeInitializes the PCD peripheral.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCD_MspInit

Function name

void HAL_PCD_MspInit (PCD_HandleTypeDef * hpcd)

Function description

Initializes the PCD MSP.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_MspDeInit

Function name

void HAL_PCD_MspDeInit (PCD_HandleTypeDef * hpcd)

Function description

DeInitializes PCD MSP.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_Start

Function name

HAL_StatusTypeDef HAL_PCD_Start (PCD_HandleTypeDef * hpcd)

Function description

Start the USB device.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCD_Stop

Function name

HAL_StatusTypeDef HAL_PCD_Stop (PCD_HandleTypeDef * hpcd)

Function description

Stop the USB device.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCD_IRQHandler

Function name

void HAL_PCD_IRQHandler (PCD_HandleTypeDef * hpcd)

Function description

Handles PCD interrupt request.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCD_SOFCallback

Function name

void HAL_PCD_SOFCallback (PCD_HandleTypeDef * hpcd)

Function description

USB Start Of Frame callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_SetupStageCallback

Function name

void HAL_PCD_SetupStageCallback (PCD_HandleTypeDef * hpcd)

Function description

Setup stage callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_ResetCallback

Function name

void HAL_PCD_ResetCallback (PCD_HandleTypeDef * hpcd)

Function description

USB Reset callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_SuspendCallback

Function name

void HAL_PCD_SuspendCallback (PCD_HandleTypeDef * hpcd)

Function description

Suspend event callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_ResumeCallback

Function name

void HAL_PCD_ResumeCallback (PCD_HandleTypeDef * hpcd)

Function description

Resume event callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_ConnectCallback

Function name

void HAL_PCD_ConnectCallback (PCD_HandleTypeDef * hpcd)

Function description

Connection event callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_DisconnectCallback

Function name

void HAL_PCD_DisconnectCallback (PCD_HandleTypeDef * hpcd)

Function description

Disconnection event callback.

Parameters

- **hpcd:** PCD handle

Return values

- **None:**

HAL_PCD_DataOutStageCallback

Function name

void HAL_PCD_DataOutStageCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)

Function description

Data OUT stage callback.

Parameters

- **hpcd:** PCD handle
- **epnum:** endpoint number

Return values

- **None:**

HAL_PCD_DataInStageCallback

Function name

void HAL_PCD_DataInStageCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)

Function description

Data IN stage callback.

Parameters

- **hpcd:** PCD handle
- **epnum:** endpoint number

Return values

- **None:**

HAL_PCD_ISOOUTIncompleteCallback

Function name

void HAL_PCD_ISOOUTIncompleteCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)

Function description

Incomplete ISO OUT callback.

Parameters

- **hpcd:** PCD handle
- **epnum:** endpoint number

Return values

- **None:**

HAL_PCD_ISOINIncompleteCallback

Function name

void HAL_PCD_ISOINIncompleteCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)

Function description

Incomplete ISO IN callback.

Parameters

- **hpcd:** PCD handle
- **epnum:** endpoint number

Return values

- **None:**

`HAL_PCD_DevConnect`

Function name

HAL_StatusTypeDef HAL_PCD_DevConnect (PCD_HandleTypeDef * hpcd)

Function description

Connect the USB device.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

`HAL_PCD_DevDisconnect`

Function name

HAL_StatusTypeDef HAL_PCD_DevDisconnect (PCD_HandleTypeDef * hpcd)

Function description

Disconnect the USB device.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

`HAL_PCD_SetAddress`

Function name

HAL_StatusTypeDef HAL_PCD_SetAddress (PCD_HandleTypeDef * hpcd, uint8_t address)

Function description

Set the USB Device address.

Parameters

- **hpcd:** PCD handle
- **address:** new device address

Return values

- **HAL:** status

`HAL_PCD_EP_Open`

Function name

HAL_StatusTypeDef HAL_PCD_EP_Open (PCD_HandleTypeDef * hpcd, uint8_t ep_addr, uint16_t ep_mps, uint8_t ep_type)

Function description

Open and configure an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address
- **ep_mps:** endpoint max packet size
- **ep_type:** endpoint type

Return values

- **HAL:** status

`HAL_PCD_EP_Close`

Function name

HAL_StatusTypeDef HAL_PCD_EP_Close (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)

Function description

Deactivate an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address

Return values

- **HAL:** status

`HAL_PCD_EP_Receive`

Function name

HAL_StatusTypeDef HAL_PCD_EP_Receive (PCD_HandleTypeDef * hpcd, uint8_t ep_addr, uint8_t * pBuf, uint32_t len)

Function description

Receive an amount of data.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address
- **pBuf:** pointer to the reception buffer
- **len:** amount of data to be received

Return values

- **HAL:** status

`HAL_PCD_EP_Transmit`

Function name

HAL_StatusTypeDef HAL_PCD_EP_Transmit (PCD_HandleTypeDef * hpcd, uint8_t ep_addr, uint8_t * pBuf, uint32_t len)

Function description

Send an amount of data.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address
- **pBuf:** pointer to the transmission buffer
- **len:** amount of data to be sent

Return values

- **HAL:** status

`HAL_PCD_EP_GetRxCount`

Function name

uint32_t HAL_PCD_EP_GetRxCount (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)

Function description

Get Received Data Size.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address

Return values

- **Data:** Size

`HAL_PCD_EP_SetStall`

Function name

HAL_StatusTypeDef HAL_PCD_EP_SetStall (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)

Function description

Set a STALL condition over an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address

Return values

- **HAL:** status

`HAL_PCD_EP_ClrStall`

Function name

HAL_StatusTypeDef HAL_PCD_EP_ClrStall (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)

Function description

Clear a STALL condition over in an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address

Return values

- **HAL:** status

HAL_PCD_EP_Flush

Function name

HAL_StatusTypeDef HAL_PCD_EP_Flush (PCD_HandleTypeDef * hpcd, uint8_t ep_addr)

Function description

Flush an endpoint.

Parameters

- **hpcd:** PCD handle
- **ep_addr:** endpoint address

Return values

- **HAL:** status

HAL_PCD_ActivateRemoteWakeup

Function name

HAL_StatusTypeDef HAL_PCD_ActivateRemoteWakeup (PCD_HandleTypeDef * hpcd)

Function description

Activate remote wakeup signalling.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCD_DeActivateRemoteWakeup

Function name

HAL_StatusTypeDef HAL_PCD_DeActivateRemoteWakeup (PCD_HandleTypeDef * hpcd)

Function description

De-activate remote wakeup signalling.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCD_GetState

Function name

PCD_StateTypeDef HAL_PCD_GetState (PCD_HandleTypeDef * hpcd)

Function description

Return the PCD handle state.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** state

50.3 PCD Firmware driver defines

The following section lists the various define and macros of the module.

50.3.1 PCD

PCD

PCD Exported Macros

__HAL_PCD_ENABLE

__HAL_PCD_DISABLE

__HAL_PCD_GET_FLAG

__HAL_PCD_CLEAR_FLAG

__HAL_PCD_IS_INVALID_INTERRUPT

__HAL_PCD_UNGATE_PHYCLOCK

__HAL_PCD_GATE_PHYCLOCK

__HAL_PCD_IS_PHY_SUSPENDED

__HAL_USB_OTG_FS_WAKEUP_EXTI_ENABLE_IT

__HAL_USB_OTG_FS_WAKEUP_EXTI_DISABLE_IT

PCD PHY Module

PCD_PHY_ULPI

PCD_PHY_EMBEDDED

PCD_PHY_UTMI

PCD Speed

PCD_SPEED_FULL

51 HAL PCD Extension Driver

51.1 PCDEx Firmware driver API description

The following section lists the various functions of the PCDEx library.

51.1.1 Extended features functions

This section provides functions allowing to:

- Update FIFO configuration

This section contains the following APIs:

- ***HAL_PCDEx_SetTxFiFo***
- ***HAL_PCDEx_SetRxFiFo***
- ***HAL_PCDEx_ActivateLPM***
- ***HAL_PCDEx_DeActivateLPM***
- ***HAL_PCDEx_BCD_VBUSDetect***
- ***HAL_PCDEx_ActivateBCD***
- ***HAL_PCDEx_DeActivateBCD***
- ***HAL_PCDEx_LPM_Callback***
- ***HAL_PCDEx_BCD_Callback***

51.1.2 Detailed description of functions

`HAL_PCDEx_SetTxFiFo`

Function name

HAL_StatusTypeDef HAL_PCDEx_SetTxFiFo (PCD_HandleTypeDef * hpcd, uint8_t fifo, uint16_t size)

Function description

Set Tx FIFO.

Parameters

- **hpcd:** PCD handle
- **fifo:** The number of Tx fifo
- **size:** Fifo size

Return values

- **HAL:** status

`HAL_PCDEx_SetRxFiFo`

Function name

HAL_StatusTypeDef HAL_PCDEx_SetRxFiFo (PCD_HandleTypeDef * hpcd, uint16_t size)

Function description

Set Rx FIFO.

Parameters

- **hpcd:** PCD handle
- **size:** Size of Rx fifo

Return values

- **HAL:** status

HAL_PCDEx_ActivateLPM

Function name

HAL_StatusTypeDef HAL_PCDEx_ActivateLPM (PCD_HandleTypeDef * hpcd)

Function description

Activate LPM feature.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCDEx_DeActivateLPM

Function name

HAL_StatusTypeDef HAL_PCDEx_DeActivateLPM (PCD_HandleTypeDef * hpcd)

Function description

Deactivate LPM feature.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCDEx_ActivateBCD

Function name

HAL_StatusTypeDef HAL_PCDEx_ActivateBCD (PCD_HandleTypeDef * hpcd)

Function description

Activate BatteryCharging feature.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCDEx_DeActivateBCD

Function name

HAL_StatusTypeDef HAL_PCDEx_DeActivateBCD (PCD_HandleTypeDef * hpcd)

Function description

Deactivate BatteryCharging feature.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCDEx_BCD_VBUSDetect

Function name

void HAL_PCDEx_BCD_VBUSDetect (PCD_HandleTypeDef * hpcd)

Function description

Handle BatteryCharging Process.

Parameters

- **hpcd:** PCD handle

Return values

- **HAL:** status

HAL_PCDEx_LPM_Callback

Function name

void HAL_PCDEx_LPM_Callback (PCD_HandleTypeDef * hpcd, PCD_LPM_MsgTypeDef msg)

Function description

Send LPM message to user layer callback.

Parameters

- **hpcd:** PCD handle
- **msg:** LPM message

Return values

- **HAL:** status

HAL_PCDEx_BCD_Callback

Function name

void HAL_PCDEx_BCD_Callback (PCD_HandleTypeDef * hpcd, PCD_BCD_MsgTypeDef msg)

Function description

Send BatteryCharging message to user layer callback.

Parameters

- **hpcd:** PCD handle
- **msg:** LPM message

Return values

- **HAL:** status

52 HAL PKA Generic Driver

52.1 PKA Firmware driver registers structures

52.1.1 PKA_HandleTypeDef

PKA_HandleTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***PKA_TypeDef * Instance***
- ***__IO HAL_PKA_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***PKA_TypeDef* PKA_HandleTypeDef::Instance***
  Register base address
- ***__IO HAL_PKA_StateTypeDef PKA_HandleTypeDef::State***
  PKA state
- ***__IO uint32_t PKA_HandleTypeDef::ErrorCode***
  PKA Error code

52.1.2 PKA_ECCMulFastModeInTypeDef

PKA_ECCMulFastModeInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t scalarMulSize***
- ***uint32_t modulusSize***
- ***uint32_t coefSign***
- ***const uint8_t * coefA***
- ***const uint8_t * modulus***
- ***const uint8_t * pointX***
- ***const uint8_t * pointY***
- ***const uint8_t * scalarMul***
- ***const uint32_t * pMontgomeryParam***

Field Documentation

- ***uint32_t PKA_ECCMulFastModeInTypeDef::scalarMulSize***
  Number of element in scalarMul array
- ***uint32_t PKA_ECCMulFastModeInTypeDef::modulusSize***
  Number of element in modulus, coefA, pointX and pointY arrays
- ***uint32_t PKA_ECCMulFastModeInTypeDef::coefSign***
  Curve coefficient a sign
- ***const uint8_t* PKA_ECCMulFastModeInTypeDef::coefA***
  Pointer to curve coefficient |a| (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulFastModeInTypeDef::modulus***
  Pointer to curve modulus value p (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulFastModeInTypeDef::pointX***
  Pointer to point P coordinate xP (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulFastModeInTypeDef::pointY***
  Pointer to point P coordinate yP (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulFastModeInTypeDef::scalarMul***
  Pointer to scalar multiplier k (Array of scalarMulSize elements)

- ***const uint32_t* PKA_ECCMulFastModeInTypeDef::pMontgomeryParam***
  Pointer to Montgomery parameter (Array of modulusSize/4 elements)

52.1.3 PKA_ECCMulInTypeDef

PKA_ECCMulInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t scalarMulSize***
- ***uint32_t modulusSize***
- ***uint32_t coefSign***
- ***const uint8_t * coefA***
- ***const uint8_t * modulus***
- ***const uint8_t * pointX***
- ***const uint8_t * pointY***
- ***const uint8_t * scalarMul***

Field Documentation

- ***uint32_t PKA_ECCMulInTypeDef::scalarMulSize***
  Number of element in scalarMul array
- ***uint32_t PKA_ECCMulInTypeDef::modulusSize***
  Number of element in modulus, coefA, pointX and pointY arrays
- ***uint32_t PKA_ECCMulInTypeDef::coefSign***
  Curve coefficient a sign
- ***const uint8_t* PKA_ECCMulInTypeDef::coefA***
  Pointer to curve coefficient |a| (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulInTypeDef::modulus***
  Pointer to curve modulus value p (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulInTypeDef::pointX***
  Pointer to point P coordinate xP (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulInTypeDef::pointY***
  Pointer to point P coordinate yP (Array of modulusSize elements)
- ***const uint8_t* PKA_ECCMulInTypeDef::scalarMul***
  Pointer to scalar multiplier k (Array of scalarMulSize elements)

52.1.4 PKA_PointCheckInTypeDef

PKA_PointCheckInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t modulusSize***
- ***uint32_t coefSign***
- ***const uint8_t * coefA***
- ***const uint8_t * coefB***
- ***const uint8_t * modulus***
- ***const uint8_t * pointX***
- ***const uint8_t * pointY***

Field Documentation

- ***uint32_t PKA_PointCheckInTypeDef::modulusSize***
  Number of element in coefA, coefB, modulus, pointX and pointY arrays
- ***uint32_t PKA_PointCheckInTypeDef::coefSign***
  Curve coefficient a sign
- ***const uint8_t* PKA_PointCheckInTypeDef::coefA***
  Pointer to curve coefficient |a| (Array of modulusSize elements)

- ***const uint8_t* PKA_PointCheckInTypeDef::coefB***
  Pointer to curve coefficient b (Array of modulusSize elements)
- ***const uint8_t* PKA_PointCheckInTypeDef::modulus***
  Pointer to curve modulus value p (Array of modulusSize elements)
- ***const uint8_t* PKA_PointCheckInTypeDef::pointX***
  Pointer to point P coordinate xP (Array of modulusSize elements)
- ***const uint8_t* PKA_PointCheckInTypeDef::pointY***
  Pointer to point P coordinate yP (Array of modulusSize elements)

52.1.5 PKA_RSACRTExpInTypeDef

PKA_RSACRTExpInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t size***
- ***const uint8_t * pOpDp***
- ***const uint8_t * pOpDq***
- ***const uint8_t * pOpQinv***
- ***const uint8_t * pPrimeP***
- ***const uint8_t * pPrimeQ***
- ***const uint8_t * popA***

Field Documentation

- ***uint32_t PKA_RSACRTExpInTypeDef::size***
  Number of element in popA array
- ***const uint8_t* PKA_RSACRTExpInTypeDef::pOpDp***
  Pointer to operand dP (Array of size/2 elements)
- ***const uint8_t* PKA_RSACRTExpInTypeDef::pOpDq***
  Pointer to operand dQ (Array of size/2 elements)
- ***const uint8_t* PKA_RSACRTExpInTypeDef::pOpQinv***
  Pointer to operand qinv (Array of size/2 elements)
- ***const uint8_t* PKA_RSACRTExpInTypeDef::pPrimeP***
  Pointer to prime p (Array of size/2 elements)
- ***const uint8_t* PKA_RSACRTExpInTypeDef::pPrimeQ***
  Pointer to prime Q (Array of size/2 elements)
- ***const uint8_t* PKA_RSACRTExpInTypeDef::popA***
  Pointer to operand A (Array of size elements)

52.1.6 PKA_ECDSAVerifInTypeDef

PKA_ECDSAVerifInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t primeOrderSize***
- ***uint32_t modulusSize***
- ***uint32_t coefSign***
- ***const uint8_t * coef***
- ***const uint8_t * modulus***
- ***const uint8_t * basePointX***
- ***const uint8_t * basePointY***
- ***const uint8_t * pPubKeyCurvePtX***
- ***const uint8_t * pPubKeyCurvePtY***
- ***const uint8_t * RSign***
- ***const uint8_t * SSign***
- ***const uint8_t * hash***

- ***const uint8_t * primeOrder***

Field Documentation

- ***uint32_t PKA_ECDSAVerifInTypeDef::primeOrderSize***
  Number of element in primeOrder array
- ***uint32_t PKA_ECDSAVerifInTypeDef::modulusSize***
  Number of element in modulus array
- ***uint32_t PKA_ECDSAVerifInTypeDef::coefSign***
  Curve coefficient a sign
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::coef***
  Pointer to curve coefficient |a| (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::modulus***
  Pointer to curve modulus value p (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::basePointX***
  Pointer to curve base point xG (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::basePointY***
  Pointer to curve base point yG (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::pPubKeyCurvePtX***
  Pointer to public-key curve point xQ (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::pPubKeyCurvePtY***
  Pointer to public-key curve point yQ (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::RSign***
  Pointer to signature part r (Array of primeOrderSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::SSign***
  Pointer to signature part s (Array of primeOrderSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::hash***
  Pointer to hash of the message e (Array of primeOrderSize elements)
- ***const uint8_t* PKA_ECDSAVerifInTypeDef::primeOrder***
  Pointer to order of the curve n (Array of primeOrderSize elements)

52.1.7 PKA_ECDSASignInTypeDef

PKA_ECDSASignInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t primeOrderSize***
- ***uint32_t modulusSize***
- ***uint32_t coefSign***
- ***const uint8_t * coef***
- ***const uint8_t * modulus***
- ***const uint8_t * integer***
- ***const uint8_t * basePointX***
- ***const uint8_t * basePointY***
- ***const uint8_t * hash***
- ***const uint8_t * privateKey***
- ***const uint8_t * primeOrder***

Field Documentation

- ***uint32_t PKA_ECDSASignInTypeDef::primeOrderSize***
  Number of element in primeOrder array
- ***uint32_t PKA_ECDSASignInTypeDef::modulusSize***
  Number of element in modulus array

- ***uint32_t PKA_ECDSASignInTypeDef::coefSign***
  Curve coefficient a sign
- ***const uint8_t* PKA_ECDSASignInTypeDef::coef***
  Pointer to curve coefficient |a| (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::modulus***
  Pointer to curve modulus value p (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::integer***
  Pointer to random integer k (Array of primeOrderSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::basePointX***
  Pointer to curve base point xG (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::basePointY***
  Pointer to curve base point yG (Array of modulusSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::hash***
  Pointer to hash of the message (Array of primeOrderSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::privateKey***
  Pointer to private key d (Array of primeOrderSize elements)
- ***const uint8_t* PKA_ECDSASignInTypeDef::primeOrder***
  Pointer to order of the curve n (Array of primeOrderSize elements)

52.1.8 PKA_ECDSASignOutTypeDef

PKA_ECDSASignOutTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint8_t * RSign***
- ***uint8_t * SSign***

Field Documentation

- ***uint8_t* PKA_ECDSASignOutTypeDef::RSign***
  Pointer to signature part r (Array of modulusSize elements)
- ***uint8_t* PKA_ECDSASignOutTypeDef::SSign***
  Pointer to signature part s (Array of modulusSize elements)

52.1.9 PKA_ECDSASignOutExtParamTypeDef

PKA_ECDSASignOutExtParamTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint8_t * ptX***
- ***uint8_t * ptY***

Field Documentation

- ***uint8_t* PKA_ECDSASignOutExtParamTypeDef::ptX***
  Pointer to point P coordinate xP (Array of modulusSize elements)
- ***uint8_t* PKA_ECDSASignOutExtParamTypeDef::ptY***
  Pointer to point P coordinate yP (Array of modulusSize elements)

52.1.10 PKA_ModExpInTypeDef

PKA_ModExpInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t expSize***
- ***uint32_t OpSize***
- ***const uint8_t * pExp***
- ***const uint8_t * pOp1***
- ***const uint8_t * pMod***

Field Documentation

- ***uint32_t PKA_ModExpInTypeDef::expSize***
  Number of element in pExp array
- ***uint32_t PKA_ModExpInTypeDef::OpSize***
  Number of element in pOp1 and pMod arrays
- ***const uint8_t* PKA_ModExpInTypeDef::pExp***
  Pointer to Exponent (Array of expSize elements)
- ***const uint8_t* PKA_ModExpInTypeDef::pOp1***
  Pointer to Operand (Array of OpSize elements)
- ***const uint8_t* PKA_ModExpInTypeDef::pMod***
  Pointer to modulus (Array of OpSize elements)

52.1.11 PKA_ModExpFastModeInTypeDef

PKA_ModExpFastModeInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t expSize***
- ***uint32_t OpSize***
- ***const uint8_t * pExp***
- ***const uint8_t * pOp1***
- ***const uint8_t * pMod***
- ***const uint32_t * pMontgomeryParam***

Field Documentation

- ***uint32_t PKA_ModExpFastModeInTypeDef::expSize***
  Number of element in pExp and pMontgomeryParam arrays
- ***uint32_t PKA_ModExpFastModeInTypeDef::OpSize***
  Number of element in pOp1 and pMod arrays
- ***const uint8_t* PKA_ModExpFastModeInTypeDef::pExp***
  Pointer to Exponent (Array of expSize elements)
- ***const uint8_t* PKA_ModExpFastModeInTypeDef::pOp1***
  Pointer to Operand (Array of OpSize elements)
- ***const uint8_t* PKA_ModExpFastModeInTypeDef::pMod***
  Pointer to modulus (Array of OpSize elements)
- ***const uint32_t* PKA_ModExpFastModeInTypeDef::pMontgomeryParam***
  Pointer to Montgomery parameter (Array of expSize/4 elements)

52.1.12 PKA_MontgomeryParamInTypeDef

PKA_MontgomeryParamInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t size***
- ***const uint8_t * pOp1***

Field Documentation

- ***uint32_t PKA_MontgomeryParamInTypeDef::size***
  Number of element in pOp1 array
- ***const uint8_t* PKA_MontgomeryParamInTypeDef::pOp1***
  Pointer to Operand (Array of size elements)

52.1.13 PKA_AddInTypeDef

PKA_AddInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t size***
- ***const uint32_t * pOp1***

- ***const uint32_t * pOp2***

Field Documentation

- ***uint32_t PKA_AddInTypeDef::size***
  Number of element in pOp1 and pOp2 arrays
- ***const uint32_t* PKA_AddInTypeDef::pOp1***
  Pointer to Operand 1 (Array of size elements)
- ***const uint32_t* PKA_AddInTypeDef::pOp2***
  Pointer to Operand 2 (Array of size elements)

52.1.14 PKA_ModInvInTypeDef

PKA_ModInvInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t size***
- ***const uint32_t * pOp1***
- ***const uint8_t * pMod***

Field Documentation

- ***uint32_t PKA_ModInvInTypeDef::size***
  Number of element in pOp1 array
- ***const uint32_t* PKA_ModInvInTypeDef::pOp1***
  Pointer to Operand 1 (Array of size elements)
- ***const uint8_t* PKA_ModInvInTypeDef::pMod***
  Pointer to modulus value n (Array of size*4 elements)

52.1.15 PKA_ModRedInTypeDef

PKA_ModRedInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t OpSize***
- ***uint32_t modSize***
- ***const uint32_t * pOp1***
- ***const uint8_t * pMod***

Field Documentation

- ***uint32_t PKA_ModRedInTypeDef::OpSize***
  Number of element in pOp1 array
- ***uint32_t PKA_ModRedInTypeDef::modSize***
  Number of element in pMod array
- ***const uint32_t* PKA_ModRedInTypeDef::pOp1***
  Pointer to Operand 1 (Array of OpSize elements)
- ***const uint8_t* PKA_ModRedInTypeDef::pMod***
  Pointer to modulus value n (Array of modSize elements)

52.1.16 PKA_ModAddInTypeDef

PKA_ModAddInTypeDef is defined in the stm32l4xx_hal_pka.h

Data Fields

- ***uint32_t size***
- ***const uint32_t * pOp1***
- ***const uint32_t * pOp2***
- ***const uint8_t * pOp3***

Field Documentation

- ***uint32_t PKA_ModAddInTypeDef::size***
  Number of element in pOp1 and pOp2 arrays

- ***const uint32_t* PKA_ModAddInTypeDef::pOp1***
  Pointer to Operand 1 (Array of size elements)
- ***const uint32_t* PKA_ModAddInTypeDef::pOp2***
  Pointer to Operand 2 (Array of size elements)
- ***const uint8_t* PKA_ModAddInTypeDef::pOp3***
  Pointer to Operand 3 (Array of size*4 elements)

52.2 PKA Firmware driver API description

The following section lists the various functions of the PCD library.

52.2.1 How to use this driver

The PKA HAL driver can be used as follows:

1. Declare a PKA_HandleTypeDef handle structure, for example: PKA_HandleTypeDef hpka;
2. Initialize the PKA low level resources by implementing the HAL_PKA_MspInit() API:
   a. Enable the PKA interface clock
   b. NVIC configuration if you need to use interrupt process
      - Configure the PKA interrupt priority
      - Enable the NVIC PKA IRQ Channel
3. Initialize the PKA registers by calling the HAL_PKA_Init() API which trig HAL_PKA_MspInit().
4. Fill entirely the input structure corresponding to your operation: For instance: PKA_ModExpInTypeDef for HAL_PKA_ModExp().
5. Execute the operation (in polling or interrupt) and check the returned value.
6. Retrieve the result of the operation (For instance, HAL_PKA_ModExp_GetResult for HAL_PKA_ModExp operation). The function to gather the result is different for each kind of operation. The correspondence can be found in the following section.
7. Call the function HAL_PKA_DeInit() to restore the default configuration which trig HAL_PKA_MspDeInit().

High level operation

- Input structure requires buffers as uint8_t array.
- Output structure requires buffers as uint8_t array.
- Modular exponentiation using:
  – HAL_PKA_ModExp().
  – HAL_PKA_ModExp_IT().
  – HAL_PKA_ModExpFastMode().
  – HAL_PKA_ModExpFastMode_IT().
  – HAL_PKA_ModExp_GetResult() to retrieve the result of the operation.
- RSA Chinese Remainder Theorem (CRT) using:
  – HAL_PKA_RSACRTExp().
  – HAL_PKA_RSACRTExp_IT().
  – HAL_PKA_RSACRTExp_GetResult() to retrieve the result of the operation.
- ECC Point Check using:
  – HAL_PKA_PointCheck().
  – HAL_PKA_PointCheck_IT().
  – HAL_PKA_PointCheck_IsOnCurve() to retrieve the result of the operation.
- ECDSA Sign
  – HAL_PKA_ECDSASign().
  – HAL_PKA_ECDSASign_IT().
  – HAL_PKA_ECDSASign_GetResult() to retrieve the result of the operation.

- ECDSA Verify
  - HAL_PKA_ECDSAVerif().
  - HAL_PKA_ECDSAVerif_IT().
  - HAL_PKA_ECDSAVerif_IsValidSignature() to retrieve the result of the operation.
- ECC Scalar Multiplication using:
  - HAL_PKA_ECCMul().
  - HAL_PKA_ECCMul_IT().
  - HAL_PKA_ECCMulFastMode().
  - HAL_PKA_ECCMulFastMode_IT().
  - HAL_PKA_ECCMul_GetResult() to retrieve the result of the operation.

Low level operation

- Input structure requires buffers as uint32_t array.
- Output structure requires buffers as uint32_t array.
- Arithmetic addition using:
  - HAL_PKA_Add().
  - HAL_PKA_Add_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation. The resulting size can be the input parameter or the input parameter size + 1 (overflow).
- Arithmetic substraction using:
  - HAL_PKA_Sub().
  - HAL_PKA_Sub_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.
- Arithmetic multiplication using:
  - HAL_PKA_Mul().
  - HAL_PKA_Mul_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.
- Comparison using:
  - HAL_PKA_Cmp().
  - HAL_PKA_Cmp_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.
- Modular addition using:
  - HAL_PKA_ModAdd().
  - HAL_PKA_ModAdd_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.
- Modular substraction using:
  - HAL_PKA_ModSub().
  - HAL_PKA_ModSub_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.
- Modular inversion using:
  - HAL_PKA_ModInv().
  - HAL_PKA_ModInv_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.
- Modular reduction using:
  - HAL_PKA_ModRed().
  - HAL_PKA_ModRed_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.

- Montgomery multiplication using:
  - HAL_PKA_MontgomeryMul().
  - HAL_PKA_MontgomeryMul_IT().
  - HAL_PKA_Arithmetic_GetResult() to retrieve the result of the operation.

Montgomery parameter

Polling mode operation

- When an operation is started in polling mode, the function returns when:
  - A timeout is encounter.
  - The operation is completed.

Interrupt mode operation

- Add HAL_PKA_IRQHandler to the IRQHandler of PKA.
- Enable the IRQ using HAL_NVIC_EnableIRQ().
- When an operation is started in interrupt mode, the function returns immediatly.
- When the operation is completed, the callback HAL_PKA_OperationCpltCallback is called.
- When an error is encountered, the callback HAL_PKA_ErrorCallback is called.
- To stop any operation in interrupt mode, use HAL_PKA_Abort().

Utilities

- To clear the PKA RAM, use HAL_PKA_RAMReset().
- To get current state, use HAL_PKA_GetState().
- To get current error, use HAL_PKA_GetError().

Callback registration

The compilation flag USE_HAL_PKA_REGISTER_CALLBACKS, when set to 1, allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_PKA_RegisterCallback() to register an interrupt callback.

Function @ref HAL_PKA_RegisterCallback() allows to register following callbacks:

- OperationCpltCallback : callback for End of operation.
- ErrorCallback : callback for error detection.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_PKA_UnRegisterCallback to reset a callback to the default weak function.

@ref HAL_PKA_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- OperationCpltCallback : callback for End of operation.
- ErrorCallback : callback for error detection.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit.

By default, after the @ref HAL_PKA_Init() and when the state is @ref HAL_PKA_STATE_RESET all callbacks are set to the corresponding weak functions: examples @ref HAL_PKA_OperationCpltCallback(), @ref HAL_PKA_ErrorCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the @ref HAL_PKA_Init()/ @ref HAL_PKA_DeInit() only when these callbacks are null (not registered beforehand).

If MspInit or MspDeInit are not null, the @ref HAL_PKA_Init()/ @ref HAL_PKA_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state.

Callbacks can be registered/unregistered in @ref HAL_PKA_STATE_READY state only. Exception done MspInit/MspDeInit functions that can be registered/unregistered in @ref HAL_PKA_STATE_READY or @ref HAL_PKA_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit.

Then, the user first registers the MspInit/MspDeInit user callbacks using @ref HAL_PKA_RegisterCallback() before calling @ref HAL_PKA_DeInit() or @ref HAL_PKA_Init() function.

When the compilation flag USE_HAL_PKA_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

52.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and deinitialize the PKAx peripheral:

- User must implement HAL_PKA_MspInit() function in which he configures all related peripherals resources (CLOCK, IT and NVIC).
- Call the function HAL_PKA_Init() to configure the selected device with the selected configuration:
  - Security level
- Call the function HAL_PKA_DeInit() to restore the default configuration of the selected PKAx peripheral.

This section contains the following APIs:

- ***HAL_PKA_Init***
- ***HAL_PKA_DeInit***
- ***HAL_PKA_MspInit***
- ***HAL_PKA_MspDeInit***

52.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the PKA operations.

1. There are two modes of operation:
   - Blocking mode : The operation is performed in the polling mode. These functions return when data operation is completed.
   - No-Blocking mode : The operation is performed using Interrupts. These functions return immediatly. The end of the operation is indicated by HAL_PKA_ErrorCallback in case of error. The end of the operation is indicated by HAL_PKA_OperationCpltCallback in case of success. To stop any operation in interrupt mode, use HAL_PKA_Abort().

2. Blocking mode functions are :
   - HAL_PKA_ModExp()
   - HAL_PKA_ModExpFastMode()
   - HAL_PKA_ModExp_GetResult();
   - HAL_PKA_ECDSASign()
   - HAL_PKA_ECDSASign_GetResult();
   - HAL_PKA_ECDSAVerif()
   - HAL_PKA_ECDSAVerif_IsValidSignature();
   - HAL_PKA_RSACRTExp()
   - HAL_PKA_RSACRTExp_GetResult();
   - HAL_PKA_PointCheck()
   - HAL_PKA_PointCheck_IsOnCurve();
   - HAL_PKA_ECCMul()
   - HAL_PKA_ECCMulFastMode()
   - HAL_PKA_ECCMul_GetResult();
   - HAL_PKA_Add()
   - HAL_PKA_Sub()
   - HAL_PKA_Cmp()
   - HAL_PKA_Mul()
   - HAL_PKA_ModAdd()
   - HAL_PKA_ModSub()
   - HAL_PKA_ModInv()
   - HAL_PKA_ModRed()
   - HAL_PKA_MontgomeryMul()
   - HAL_PKA_Arithmetic_GetResult(P);
   - HAL_PKA_MontgomeryParam()
   - HAL_PKA_MontgomeryParam_GetResult();

3. No-Blocking mode functions with Interrupt are :
   - HAL_PKA_ModExp_IT();
   - HAL_PKA_ModExpFastMode_IT();
   - HAL_PKA_ModExp_GetResult();
   - HAL_PKA_ECDSASign_IT();
   - HAL_PKA_ECDSASign_GetResult();
   - HAL_PKA_ECDSAVerif_IT();
   - HAL_PKA_ECDSAVerif_IsValidSignature();
   - HAL_PKA_RSACRTExp_IT();
   - HAL_PKA_RSACRTExp_GetResult();
   - HAL_PKA_PointCheck_IT();
   - HAL_PKA_PointCheck_IsOnCurve();
   - HAL_PKA_ECCMul_IT();
   - HAL_PKA_ECCMulFastMode_IT();
   - HAL_PKA_ECCMul_GetResult();
   - HAL_PKA_Add_IT();
   - HAL_PKA_Sub_IT();
   - HAL_PKA_Cmp_IT();
   - HAL_PKA_Mul_IT();
   - HAL_PKA_ModAdd_IT();
   - HAL_PKA_ModSub_IT();
   - HAL_PKA_ModInv_IT();
   - HAL_PKA_ModRed_IT();
   - HAL_PKA_MontgomeryMul_IT();
   - HAL_PKA_Arithmetic_GetResult();
   - HAL_PKA_MontgomeryParam_IT();
   - HAL_PKA_MontgomeryParam_GetResult();
   - HAL_PKA_Abort();

This section contains the following APIs:

- ***HAL_PKA_ModExp***
- ***HAL_PKA_ModExp_IT***
- ***HAL_PKA_ModExpFastMode***
- ***HAL_PKA_ModExpFastMode_IT***
- ***HAL_PKA_ModExp_GetResult***
- ***HAL_PKA_ECDSASign***
- ***HAL_PKA_ECDSASign_IT***
- ***HAL_PKA_ECDSASign_GetResult***
- ***HAL_PKA_ECDSAVerif***
- ***HAL_PKA_ECDSAVerif_IT***
- ***HAL_PKA_ECDSAVerif_IsValidSignature***
- ***HAL_PKA_RSACRTExp***
- ***HAL_PKA_RSACRTExp_IT***
- ***HAL_PKA_RSACRTExp_GetResult***
- ***HAL_PKA_PointCheck***
- ***HAL_PKA_PointCheck_IT***
- ***HAL_PKA_PointCheck_IsOnCurve***
- ***HAL_PKA_ECCMul***
- ***HAL_PKA_ECCMul_IT***

- *HAL_PKA_ECCMulFastMode*
- *HAL_PKA_ECCMulFastMode_IT*
- *HAL_PKA_ECCMul_GetResult*
- *HAL_PKA_Add*
- *HAL_PKA_Add_IT*
- *HAL_PKA_Sub*
- *HAL_PKA_Sub_IT*
- *HAL_PKA_Mul*
- *HAL_PKA_Mul_IT*
- *HAL_PKA_Cmp*
- *HAL_PKA_Cmp_IT*
- *HAL_PKA_ModAdd*
- *HAL_PKA_ModAdd_IT*
- *HAL_PKA_ModInv*
- *HAL_PKA_ModInv_IT*
- *HAL_PKA_ModSub*
- *HAL_PKA_ModSub_IT*
- *HAL_PKA_ModRed*
- *HAL_PKA_ModRed_IT*
- *HAL_PKA_MontgomeryMul*
- *HAL_PKA_MontgomeryMul_IT*
- *HAL_PKA_Arithmetic_GetResult*
- *HAL_PKA_MontgomeryParam*
- *HAL_PKA_MontgomeryParam_IT*
- *HAL_PKA_MontgomeryParam_GetResult*
- *HAL_PKA_Abort*
- *HAL_PKA_RAMReset*
- *HAL_PKA_IRQHandler*
- *HAL_PKA_OperationCpltCallback*
- *HAL_PKA_ErrorCallback*

52.2.4 Peripheral State and Error functions

This subsection permit to get in run-time the status of the peripheral.

This section contains the following APIs:

- *HAL_PKA_GetState*
- *HAL_PKA_GetError*

52.2.5 Detailed description of functions

`HAL_PKA_Init`

Function name

HAL_StatusTypeDef HAL_PKA_Init (PKA_HandleTypeDef * hpka)

Function description

Initialize the PKA according to the specified parameters in the PKA_InitTypeDef and initialize the associated handle.

Parameters

- **hpka:** PKA handle

Return values

- **HAL:** status

`HAL_PKA_DeInit`

Function name

HAL_StatusTypeDef HAL_PKA_DeInit (PKA_HandleTypeDef * hpka)

Function description

DeInitialize the PKA peripheral.

Parameters

- **hpka:** PKA handle

Return values

- **HAL:** status

`HAL_PKA_MspInit`

Function name

void HAL_PKA_MspInit (PKA_HandleTypeDef * hpka)

Function description

Initialize the PKA MSP.

Parameters

- **hpka:** PKA handle

Return values

- **None:**

`HAL_PKA_MspDeInit`

Function name

void HAL_PKA_MspDeInit (PKA_HandleTypeDef * hpka)

Function description

DeInitialize the PKA MSP.

Parameters

- **hpka:** PKA handle

Return values

- **None:**

`HAL_PKA_ModExp`

Function name

HAL_StatusTypeDef HAL_PKA_ModExp (PKA_HandleTypeDef * hpka, PKA_ModExpInTypeDef * in, uint32_t Timeout)

Function description

Modular exponentiation in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ModExp_IT

Function name

HAL_StatusTypeDef HAL_PKA_ModExp_IT (PKA_HandleTypeDef * hpka, PKA_ModExpInTypeDef * in)

Function description

Modular exponentiation in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ModExpFastMode

Function name

HAL_StatusTypeDef HAL_PKA_ModExpFastMode (PKA_HandleTypeDef * hpka, PKA_ModExpFastModeInTypeDef * in, uint32_t Timeout)

Function description

Modular exponentiation in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ModExpFastMode_IT

Function name

HAL_StatusTypeDef HAL_PKA_ModExpFastMode_IT (PKA_HandleTypeDef * hpka, PKA_ModExpFastModeInTypeDef * in)

Function description

Modular exponentiation in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ModExp_GetResult

Function name

void HAL_PKA_ModExp_GetResult (PKA_HandleTypeDef * hpka, uint8_t * pRes)

Function description

Retrieve operation result.

Parameters

- **hpka:** PKA handle
- **pRes:** Output buffer

Return values

- **HAL:** status

HAL_PKA_ECDSASign

Function name

HAL_StatusTypeDef HAL_PKA_ECDSASign (PKA_HandleTypeDef * hpka, PKA_ECDSASignInTypeDef * in, uint32_t Timeout)

Function description

Sign a message using elliptic curves over prime fields in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ECDSASign_IT

Function name

HAL_StatusTypeDef HAL_PKA_ECDSASign_IT (PKA_HandleTypeDef * hpka, PKA_ECDSASignInTypeDef * in)

Function description

Sign a message using elliptic curves over prime fields in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ECDSASign_GetResult

Function name

void HAL_PKA_ECDSASign_GetResult (PKA_HandleTypeDef * hpka, PKA_ECDSASignOutTypeDef * out, PKA_ECDSASignOutExtParamTypeDef * outExt)

Function description

Retrieve operation result.

Parameters

- **hpka:** PKA handle
- **out:** Output information
- **outExt:** Additional Output information (facultative)

`HAL_PKA_ECDSAVerif`

Function name

HAL_StatusTypeDef HAL_PKA_ECDSAVerif (PKA_HandleTypeDef * hpka, PKA_ECDSAVerifInTypeDef * in, uint32_t Timeout)

Function description

Verify the validity of a signature using elliptic curves over prime fields in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_PKA_ECDSAVerif_IT`

Function name

HAL_StatusTypeDef HAL_PKA_ECDSAVerif_IT (PKA_HandleTypeDef * hpka, PKA_ECDSAVerifInTypeDef * in)

Function description

Verify the validity of a signature using elliptic curves over prime fields in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

`HAL_PKA_ECDSAVerif_IsValidSignature`

Function name

uint32_t HAL_PKA_ECDSAVerif_IsValidSignature (PKA_HandleTypeDef const *const hpka)

Function description

Return the result of the ECDSA verification operation.

Parameters

- **hpka:** PKA handle

Return values

- **1:** if signature is verified, 0 in other case

HAL_PKA_RSACRTExp

Function name

HAL_StatusTypeDef HAL_PKA_RSACRTExp (PKA_HandleTypeDef * hpka, PKA_RSACRTExpInTypeDef * in, uint32_t Timeout)

Function description

RSA CRT exponentiation in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_RSACRTExp_IT

Function name

HAL_StatusTypeDef HAL_PKA_RSACRTExp_IT (PKA_HandleTypeDef * hpka, PKA_RSACRTExpInTypeDef * in)

Function description

RSA CRT exponentiation in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_RSACRTExp_GetResult

Function name

void HAL_PKA_RSACRTExp_GetResult (PKA_HandleTypeDef * hpka, uint8_t * pRes)

Function description

Retrieve operation result.

Parameters

- **hpka:** PKA handle
- **pRes:** Pointer to memory location to receive the result of the operation

Return values

- **HAL:** status

HAL_PKA_PointCheck

Function name

HAL_StatusTypeDef HAL_PKA_PointCheck (PKA_HandleTypeDef * hpka, PKA_PointCheckInTypeDef * in, uint32_t Timeout)

Function description

Point on elliptic curve check in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_PointCheck_IT

Function name

HAL_StatusTypeDef HAL_PKA_PointCheck_IT (PKA_HandleTypeDef * hpka, PKA_PointCheckInTypeDef * in)

Function description

Point on elliptic curve check in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_PointCheck_IsOnCurve

Function name

uint32_t HAL_PKA_PointCheck_IsOnCurve (PKA_HandleTypeDef const *const hpka)

Function description

Return the result of the point check operation.

Parameters

- **hpka:** PKA handle

Return values

- **1:** if point is on curve, 0 in other case

HAL_PKA_ECCMul

Function name

HAL_StatusTypeDef HAL_PKA_ECCMul (PKA_HandleTypeDef * hpka, PKA_ECCMulInTypeDef * in, uint32_t Timeout)

Function description

ECC scalar multiplication in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ECCMul_IT

Function name

HAL_StatusTypeDef HAL_PKA_ECCMul_IT (PKA_HandleTypeDef * hpka, PKA_ECCMulInTypeDef * in)

Function description

ECC scalar multiplication in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ECCMulFastMode

Function name

HAL_StatusTypeDef HAL_PKA_ECCMulFastMode (PKA_HandleTypeDef * hpka, PKA_ECCMulFastModeInTypeDef * in, uint32_t Timeout)

Function description

ECC scalar multiplication in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ECCMulFastMode_IT

Function name

HAL_StatusTypeDef HAL_PKA_ECCMulFastMode_IT (PKA_HandleTypeDef * hpka, PKA_ECCMulFastModeInTypeDef * in)

Function description

ECC scalar multiplication in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ECCMul_GetResult

Function name

void HAL_PKA_ECCMul_GetResult (PKA_HandleTypeDef * hpka, PKA_ECCMulOutTypeDef * out)

Function description

Retrieve operation result.

Parameters

- **hpka:** PKA handle
- **out:** Output information

Return values

- **HAL:** status

`HAL_PKA_Add`

Function name

HAL_StatusTypeDef HAL_PKA_Add (PKA_HandleTypeDef * hpka, PKA_AddInTypeDef * in, uint32_t Timeout)

Function description

Arithmetic addition in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_PKA_Add_IT`

Function name

HAL_StatusTypeDef HAL_PKA_Add_IT (PKA_HandleTypeDef * hpka, PKA_AddInTypeDef * in)

Function description

Arithmetic addition in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

`HAL_PKA_Sub`

Function name

HAL_StatusTypeDef HAL_PKA_Sub (PKA_HandleTypeDef * hpka, PKA_SubInTypeDef * in, uint32_t Timeout)

Function description

Arithmetic substraction in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_Sub_IT

Function name

HAL_StatusTypeDef HAL_PKA_Sub_IT (PKA_HandleTypeDef * hpka, PKA_SubInTypeDef * in)

Function description

Arithmetic substraction in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_Cmp

Function name

HAL_StatusTypeDef HAL_PKA_Cmp (PKA_HandleTypeDef * hpka, PKA_CmpInTypeDef * in, uint32_t Timeout)

Function description

Comparison in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_Cmp_IT

Function name

HAL_StatusTypeDef HAL_PKA_Cmp_IT (PKA_HandleTypeDef * hpka, PKA_CmpInTypeDef * in)

Function description

Comparison in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_Mul

Function name

HAL_StatusTypeDef HAL_PKA_Mul (PKA_HandleTypeDef * hpka, PKA_MulInTypeDef * in, uint32_t Timeout)

Function description

Arithmetic multiplication in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_PKA_Mul_IT`

Function name

HAL_StatusTypeDef HAL_PKA_Mul_IT (PKA_HandleTypeDef * hpka, PKA_MulInTypeDef * in)

Function description

Arithmetic multiplication in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

`HAL_PKA_ModAdd`

Function name

HAL_StatusTypeDef HAL_PKA_ModAdd (PKA_HandleTypeDef * hpka, PKA_ModAddInTypeDef * in, uint32_t Timeout)

Function description

Modular addition in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_PKA_ModAdd_IT`

Function name

HAL_StatusTypeDef HAL_PKA_ModAdd_IT (PKA_HandleTypeDef * hpka, PKA_ModAddInTypeDef * in)

Function description

Modular addition in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ModSub

Function name

HAL_StatusTypeDef HAL_PKA_ModSub (PKA_HandleTypeDef * hpka, PKA_ModSubInTypeDef * in, uint32_t Timeout)

Function description

Modular substraction in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ModSub_IT

Function name

HAL_StatusTypeDef HAL_PKA_ModSub_IT (PKA_HandleTypeDef * hpka, PKA_ModSubInTypeDef * in)

Function description

Modular substraction in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ModInv

Function name

HAL_StatusTypeDef HAL_PKA_ModInv (PKA_HandleTypeDef * hpka, PKA_ModInvInTypeDef * in, uint32_t Timeout)

Function description

Modular inversion in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ModInv_IT

Function name

HAL_StatusTypeDef HAL_PKA_ModInv_IT (PKA_HandleTypeDef * hpka, PKA_ModInvInTypeDef * in)

Function description

Modular inversion in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_ModRed

Function name

HAL_StatusTypeDef HAL_PKA_ModRed (PKA_HandleTypeDef * hpka, PKA_ModRedInTypeDef * in, uint32_t Timeout)

Function description

Modular reduction in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PKA_ModRed_IT

Function name

HAL_StatusTypeDef HAL_PKA_ModRed_IT (PKA_HandleTypeDef * hpka, PKA_ModRedInTypeDef * in)

Function description

Modular reduction in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

HAL_PKA_MontgomeryMul

Function name

HAL_StatusTypeDef HAL_PKA_MontgomeryMul (PKA_HandleTypeDef * hpka, PKA_MontgomeryMulInTypeDef * in, uint32_t Timeout)

Function description

Montgomery multiplication in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_PKA_MontgomeryMul_IT`

Function name

HAL_StatusTypeDef HAL_PKA_MontgomeryMul_IT (PKA_HandleTypeDef * hpka, PKA_MontgomeryMulInTypeDef * in)

Function description

Montgomery multiplication in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

`HAL_PKA_Arithmetic_GetResult`

Function name

void HAL_PKA_Arithmetic_GetResult (PKA_HandleTypeDef * hpka, uint32_t * pRes)

Function description

Retrieve operation result.

Parameters

- **hpka:** PKA handle
- **pRes:** Pointer to memory location to receive the result of the operation

`HAL_PKA_MontgomeryParam`

Function name

HAL_StatusTypeDef HAL_PKA_MontgomeryParam (PKA_HandleTypeDef * hpka, PKA_MontgomeryParamInTypeDef * in, uint32_t Timeout)

Function description

Montgomery parameter computation in blocking mode.

Parameters

- **hpka:** PKA handle
- **in:** Input information
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_PKA_MontgomeryParam_IT`

Function name

HAL_StatusTypeDef HAL_PKA_MontgomeryParam_IT (PKA_HandleTypeDef * hpka, PKA_MontgomeryParamInTypeDef * in)

Function description

Montgomery parameter computation in non-blocking mode with Interrupt.

Parameters

- **hpka:** PKA handle
- **in:** Input information

Return values

- **HAL:** status

`HAL_PKA_MontgomeryParam_GetResult`

Function name

void HAL_PKA_MontgomeryParam_GetResult (PKA_HandleTypeDef * hpka, uint32_t * pRes)

Function description

Retrieve operation result.

Parameters

- **hpka:** PKA handle
- **pRes:** pointer to buffer where the result will be copied

Return values

- **HAL:** status

`HAL_PKA_Abort`

Function name

HAL_StatusTypeDef HAL_PKA_Abort (PKA_HandleTypeDef * hpka)

Function description

Abort any ongoing operation.

Parameters

- **hpka:** PKA handle

Return values

- **HAL:** status

`HAL_PKA_RAMReset`

Function name

void HAL_PKA_RAMReset (PKA_HandleTypeDef * hpka)

Function description

Reset the PKA RAM.

Parameters

- **hpka:** PKA handle

Return values

- **None:**

`HAL_PKA_OperationCpltCallback`

Function name

void HAL_PKA_OperationCpltCallback (PKA_HandleTypeDef * hpka)

Function description

Process completed callback.

Parameters

- **hpka:** PKA handle

Return values

- **None:**

`HAL_PKA_ErrorCallback`

Function name

void HAL_PKA_ErrorCallback (PKA_HandleTypeDef * hpka)

Function description

Error callback.

Parameters

- **hpka:** PKA handle

Return values

- **None:**

`HAL_PKA_IRQHandler`

Function name

void HAL_PKA_IRQHandler (PKA_HandleTypeDef * hpka)

Function description

This function handles PKA event interrupt request.

Parameters

- **hpka:** PKA handle

Return values

- **None:**

`HAL_PKA_GetState`

Function name

HAL_PKA_StateTypeDef HAL_PKA_GetState (PKA_HandleTypeDef * hpka)

Function description

Return the PKA handle state.

Parameters

- **hpka:** PKA handle

Return values

- **HAL:** status

`HAL_PKA_GetError`

Function name

uint32_t HAL_PKA_GetError (PKA_HandleTypeDef * hpka)

Function description

Return the PKA error code.

Parameters

- **hpka:** PKA handle

Return values

- **PKA:** error code

52.3 PKA Firmware driver defines

The following section lists the various define and macros of the module.

52.3.1 PKA

PKA

PKA Error Code definition

HAL_PKA_ERROR_NONE

HAL_PKA_ERROR_ADDRERR

HAL_PKA_ERROR_RAMERR

HAL_PKA_ERROR_TIMEOUT

HAL_PKA_ERROR_OPERATION

PKA Exported Macros

__HAL_PKA_RESET_HANDLE_STATE

Description:

- Reset PKA handle state.

Parameters:

- __HANDLE__: specifies the PKA Handle

Return value:

- None

__HAL_PKA_ENABLE_IT

Description:

- Enable the specified PKA interrupt.

Parameters:

- __HANDLE__: specifies the PKA Handle
- __INTERRUPT__: specifies the interrupt source to enable. This parameter can be one of the following values:
  - PKA_IT_PROCEND End Of Operation interrupt enable
  - PKA_IT_ADDRERR Address error interrupt enable
  - PKA_IT_RAMERR RAM error interrupt enable

Return value:

- None

__HAL_PKA_DISABLE_IT

Description:

- Disable the specified PKA interrupt.

Parameters:

- __HANDLE__: specifies the PKA Handle
- __INTERRUPT__: specifies the interrupt source to disable. This parameter can be one of the following values:
  - PKA_IT_PROCEND End Of Operation interrupt enable
  - PKA_IT_ADDRERR Address error interrupt enable
  - PKA_IT_RAMERR RAM error interrupt enable

Return value:

- None

__HAL_PKA_GET_IT_SOURCE

Description:

- Check whether the specified PKA interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the PKA Handle
- __INTERRUPT__: specifies the PKA interrupt source to check. This parameter can be one of the following values:
  - PKA_IT_PROCEND End Of Operation interrupt enable
  - PKA_IT_ADDRERR Address error interrupt enable
  - PKA_IT_RAMERR RAM error interrupt enable

Return value:

- The: new state of __INTERRUPT__ (SET or RESET)

__HAL_PKA_GET_FLAG

Description:

- Check whether the specified PKA flag is set or not.

Parameters:

- __HANDLE__: specifies the PKA Handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - PKA_FLAG_PROCEND End Of Operation
  - PKA_FLAG_ADDRERR Address error
  - PKA_FLAG_RAMERR RAM error

Return value:

- The: new state of __FLAG__ (SET or RESET)

__HAL_PKA_CLEAR_FLAG

Description:

- Clear the PKA pending flags which are cleared by writing 1 in a specific bit.

Parameters:

- __HANDLE__: specifies the PKA Handle
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - PKA_FLAG_PROCEND End Of Operation
  - PKA_FLAG_ADDRERR Address error
  - PKA_FLAG_RAMERR RAM error

Return value:

- None

__HAL_PKA_ENABLE

Description:

- Enable the specified PKA peripheral.

Parameters:

- __HANDLE__: specifies the PKA Handle

Return value:

- None

__HAL_PKA_DISABLE

Description:

- Disable the specified PKA peripheral.

Parameters:

- __HANDLE__: specifies the PKA Handle

Return value:

- None

__HAL_PKA_START

Description:

- Start a PKA operation.

Parameters:

- __HANDLE__: specifies the PKA Handle

Return value:

- None

PKA Flag definition

PKA_FLAG_PROCEND

PKA_FLAG_ADDRERR

PKA_FLAG_RAMERR

PKA Interrupt configuration definition

PKA_IT_PROCEND

PKA_IT_ADDRERR

PKA_IT_RAMERR

PKA mode

PKA_MODE_MONTGOMERY_PARAM

PKA_MODE_MODULAR_EXP

PKA_MODE_MODULAR_EXP_FAST_MODE

PKA_MODE_ECC_MUL

PKA_MODE_ECC_MUL_FAST_MODE

PKA_MODE_ECDSA_SIGNATURE

PKA_MODE_ECDSA_VERIFICATION

PKA_MODE_POINT_CHECK

PKA_MODE_RSA_CRT_EXP

PKA_MODE_MODULAR_INV

PKA_MODE_ARITHMETIC_ADD

PKA_MODE_ARITHMETIC_SUB

PKA_MODE_ARITHMETIC_MUL

PKA_MODE_COMPARISON

PKA_MODE_MODULAR_RED

PKA_MODE_MODULAR_ADD

PKA_MODE_MODULAR_SUB

PKA_MODE_MONTGOMERY_MUL

53 HAL PSSI Generic Driver

53.1 PSSI Firmware driver registers structures

53.1.1 PSSI_InitTypeDef

PSSI_InitTypeDef is defined in the stm32l4xx_hal_pssi.h

Data Fields

- ***uint32_t DataWidth***
- ***uint32_t BusWidth***
- ***uint32_t ControlSignal***
- ***uint32_t ClockPolarity***
- ***uint32_t DataEnablePolarity***
- ***uint32_t ReadyPolarity***

Field Documentation

- ***uint32_t PSSI_InitTypeDef::DataWidth***
- ***uint32_t PSSI_InitTypeDef::BusWidth***
- ***uint32_t PSSI_InitTypeDef::ControlSignal***
- ***uint32_t PSSI_InitTypeDef::ClockPolarity***
- ***uint32_t PSSI_InitTypeDef::DataEnablePolarity***
- ***uint32_t PSSI_InitTypeDef::ReadyPolarity***

53.1.2 __PSSI_HandleTypeDef

__PSSI_HandleTypeDef is defined in the stm32l4xx_hal_pssi.h

Data Fields

- ***PSSI_TypeDef * Instance***
- ***PSSI_InitTypeDef Init***
- ***uint32_t * pBuffPtr***
- ***uint32_t XferCount***
- ***uint32_t XferSize***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***void(* TxCpltCallback***
- ***void(* RxCpltCallback***
- ***void(* ErrorCallback***
- ***void(* AbortCpltCallback***
- ***void(* MspInitCallback***
- ***void(* MspDeInitCallback***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_PSSI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***PSSI_TypeDef* __PSSI_HandleTypeDef::Instance***
  PSSI register base address
- ***PSSI_InitTypeDef __PSSI_HandleTypeDef::Init***
  PSSI Initialization Structure

- ***uint32_t* __PSSI_HandleTypeDef::pBuffPtr***
  PSSI Data buffer
- ***uint32_t __PSSI_HandleTypeDef::XferCount***
  PSSI transfer count
- ***uint32_t __PSSI_HandleTypeDef::XferSize***
  PSSI transfer size
- ***DMA_HandleTypeDef* __PSSI_HandleTypeDef::hdmatx***
  PSSI Tx DMA Handle parameters
- ***DMA_HandleTypeDef* __PSSI_HandleTypeDef::hdmarx***
  PSSI Rx DMA Handle parameters
- ***void(* __PSSI_HandleTypeDef::TxCpltCallback)(struct __PSSI_HandleTypeDef *hpssi)***
  PSSI transfer complete callback
- ***void(* __PSSI_HandleTypeDef::RxCpltCallback)(struct __PSSI_HandleTypeDef *hpssi)***
  PSSI transfer complete callback
- ***void(* __PSSI_HandleTypeDef::ErrorCallback)(struct __PSSI_HandleTypeDef *hpssi)***
  PSSI transfer complete callback
- ***void(* __PSSI_HandleTypeDef::AbortCpltCallback)(struct __PSSI_HandleTypeDef *hpssi)***
  PSSI transfer error callback
- ***void(* __PSSI_HandleTypeDef::MspInitCallback)(struct __PSSI_HandleTypeDef *hpssi)***
  PSSI Msp Init callback
- ***void(* __PSSI_HandleTypeDef::MspDeInitCallback)(struct __PSSI_HandleTypeDef *hpssi)***
  PSSI Msp DeInit callback
- ***HAL_LockTypeDef __PSSI_HandleTypeDef::Lock***
  PSSI lock
- ***__IO HAL_PSSI_StateTypeDef __PSSI_HandleTypeDef::State***
  PSSI transfer state
- ***__IO uint32_t __PSSI_HandleTypeDef::ErrorCode***
  PSSI error code

53.2 PSSI Firmware driver API description

The following section lists the various functions of the PSSI library.

53.2.1 How to use this driver

The PSSI HAL driver can be used as follows:

1. Declare a PSSI_HandleTypeDef handle structure, for example: PSSI_HandleTypeDef hpssi;

2. Initialize the PSSI low level resources by implementing the @ref HAL_PSSI_MspInit() API:
   a. Enable the PSSIx interface clock
   b. PSSI pins configuration
      - Enable the clock for the PSSI GPIOs
      - Configure PSSI pins as alternate function open-drain
   c. NVIC configuration if you need to use interrupt process
      - Configure the PSSIx interrupt priority
      - Enable the NVIC PSSI IRQ Channel
   d. DMA Configuration if you need to use DMA process
      - Declare DMA_HandleTypeDef handles structure for the transmit and receive
      - Enable the DMAx interface clock
      - Configure the DMA handle parameters
      - Configure the DMA Tx and Rx
      - Associate the initialized DMA handle to the hpssi DMA Tx and Rx handle
      - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx and Rx
3. Configure the Communication Bus Width, Control Signals, Input Polarity and Output Polarity in the hpssi Init structure.
4. Initialize the PSSI registers by calling the @ref HAL_PSSI_Init(), configure also the low level Hardware (GPIO, CLOCK, NVIC...etc) by calling the customized @ref HAL_PSSI_MspInit(&hpssi) API.
5. For PSSI IO operations, two operation modes are available within this driver :

Polling mode IO operation

- Transmit an amount of data by byte in blocking mode using @ref HAL_PSSI_Transmit()
- Receive an amount of data by byte in blocking mode using @ref HAL_PSSI_Receive()

DMA mode IO operation

- Transmit an amount of data in non-blocking mode (DMA) using @ref HAL_PSSI_Transmit_DMA()
- At transmission end of transfer, @ref HAL_PSSI_TxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_PSSI_TxCpltCallback()
- Receive an amount of data in non-blocking mode (DMA) using @ref HAL_PSSI_Receive_DMA()
- At reception end of transfer, @ref HAL_PSSI_RxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_PSSI_RxCpltCallback()
- In case of transfer Error, @ref HAL_PSSI_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_PSSI_ErrorCallback()
- Abort a PSSI process communication with Interrupt using @ref HAL_PSSI_Abort_IT()
- End of abort process, @ref HAL_PSSI_AbortCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_PSSI_AbortCpltCallback()

PSSI HAL driver macros list

Below the list of most used macros in PSSI HAL driver.

- @ref HAL_PSSI_ENABLE : Enable the PSSI peripheral
- @ref HAL_PSSI_DISABLE : Disable the PSSI peripheral
- @ref HAL_PSSI_GET_FLAG : Check whether the specified PSSI flag is set or not
- @ref HAL_PSSI_CLEAR_FLAG : Clear the specified PSSI pending flag
- @ref HAL_PSSI_ENABLE_IT : Enable the specified PSSI interrupt
- @ref HAL_PSSI_DISABLE_IT : Disable the specified PSSI interrupt

Callback registration

Note: You can refer to the PSSI HAL driver header file for more useful macros

53.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the PSSIx peripheral:

- User must implement HAL_PSSI_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_PSSI_Init() to configure the selected device with the selected configuration:
  - Data Width
  - Control Signals
  - Input Clock polarity
  - Output Clock polarity
- Call the function HAL_PSSI_DeInit() to restore the default configuration of the selected PSSIx peripheral.

This section contains the following APIs:

- ***HAL_PSSI_Init***
- ***HAL_PSSI_DeInit***
- ***HAL_PSSI_MspInit***
- ***HAL_PSSI_MspDeInit***
- ***HAL_PSSI_RegisterCallback***
- ***HAL_PSSI_UnRegisterCallback***

53.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the PSSI data transfers.

1. There are two modes of transfer:
   - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
   - No-Blocking mode : The communication is performed using DMA. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated DMA IRQ .
2. Blocking mode functions are :
   - HAL_PSSI_Transmit()
   - HAL_PSSI_Receive()
3. No-Blocking mode functions with DMA are :
   - HAL_PSSI_Transmit_DMA()
   - HAL_PSSI_Receive_DMA()
4. A set of callbacks are provided in non Blocking mode:
   - HAL_PSSI_TxCpltCallback()
   - HAL_PSSI_RxCpltCallback()
   - HAL_PSSI_ErrorCallback()
   - HAL_PSSI_AbortCpltCallback()

This section contains the following APIs:

- ***HAL_PSSI_Transmit***
- ***HAL_PSSI_Receive***
- ***HAL_PSSI_Transmit_DMA***
- ***HAL_PSSI_Receive_DMA***
- ***HAL_PSSI_Abort_DMA***
- ***HAL_PSSI_IRQHandler***

53.2.4 Peripheral State, Mode and Error functions

This subsection permit to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- ***HAL_PSSI_GetState***
- ***HAL_PSSI_GetError***

- *HAL_PSSI_TxCpltCallback*
- *HAL_PSSI_RxCpltCallback*
- *HAL_PSSI_ErrorCallback*
- *HAL_PSSI_AbortCpltCallback*

53.2.5 Detailed description of functions

`HAL_PSSI_Init`

Function name

HAL_StatusTypeDef HAL_PSSI_Init (PSSI_HandleTypeDef * hpssi)

Function description

Initializes the PSSI according to the specified parameters in the PSSI_InitTypeDef and initializes the associated handle.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **HAL:** status

`HAL_PSSI_DeInit`

Function name

HAL_StatusTypeDef HAL_PSSI_DeInit (PSSI_HandleTypeDef * hpssi)

Function description

De-Initialize the PSSI peripheral.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **HAL:** status

`HAL_PSSI_MspInit`

Function name

void HAL_PSSI_MspInit (PSSI_HandleTypeDef * hpssi)

Function description

Initialize the PSSI MSP.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

`HAL_PSSI_MspDeInit`

Function name

void HAL_PSSI_MspDeInit (PSSI_HandleTypeDef * hpssi)

Function description

De-Initialize the PSSI MSP.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

`HAL_PSSI_RegisterCallback`

Function name

HAL_StatusTypeDef HAL_PSSI_RegisterCallback (PSSI_HandleTypeDef * hpssi, HAL_PSSI_CallbackIDTypeDef CallbackID, pPSSI_CallbackTypeDef pCallback)

Function description

Register a User PSSI Callback To be used instead of the weak predefined callback.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.
- **CallbackID:** ID of the callback to be registered This parameter can be one of the following values:
  - HAL_PSSI_TX_COMPLETE_CB_ID Tx Transfer completed callback ID
  - HAL_PSSI_RX_COMPLETE_CB_ID Rx Transfer completed callback ID
  - HAL_PSSI_ERROR_CB_ID Error callback ID
  - HAL_PSSI_ABORT_CB_ID Abort callback ID
  - HAL_PSSI_MSPINIT_CB_ID MspInit callback ID
  - HAL_PSSI_MSPDEINIT_CB_ID MspDeInit callback ID
- **pCallback:** pointer to the Callback function

Return values

- **HAL:** status

`HAL_PSSI_UnRegisterCallback`

Function name

HAL_StatusTypeDef HAL_PSSI_UnRegisterCallback (PSSI_HandleTypeDef * hpssi, HAL_PSSI_CallbackIDTypeDef CallbackID)

Function description

Unregister a PSSI Callback PSSI callback is redirected to the weak predefined callback.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.
- **CallbackID:** ID of the callback to be unregistered This parameter can be one of the following values:
  - HAL_PSSI_TX_COMPLETE_CB_ID Tx Transfer completed callback ID
  - HAL_PSSI_RX_COMPLETE_CB_ID Rx Transfer completed callback ID
  - HAL_PSSI_ERROR_CB_ID Error callback ID
  - HAL_PSSI_ABORT_CB_ID Abort callback ID
  - HAL_PSSI_MSPINIT_CB_ID MspInit callback ID
  - HAL_PSSI_MSPDEINIT_CB_ID MspDeInit callback ID

Return values

- **HAL:** status

HAL_PSSI_Transmit

Function name

HAL_StatusTypeDef HAL_PSSI_Transmit (PSSI_HandleTypeDef * hpssi, uint8_t * pData, uint32_t Size, uint32_t Timeout)

Function description

Transmits in master mode an amount of data in blocking mode.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent (in bytes)
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PSSI_Receive

Function name

HAL_StatusTypeDef HAL_PSSI_Receive (PSSI_HandleTypeDef * hpssi, uint8_t * pData, uint32_t Size, uint32_t Timeout)

Function description

Receives an amount of data in blocking mode.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received (in bytes)
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_PSSI_Transmit_DMA

Function name

HAL_StatusTypeDef HAL_PSSI_Transmit_DMA (PSSI_HandleTypeDef * hpssi, uint32_t * pData, uint32_t Size)

Function description

Transmit an amount of data in non-blocking mode with DMA.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent (in bytes)

Return values

- **HAL:** status

`HAL_PSSI_Receive_DMA`

Function name

HAL_StatusTypeDef HAL_PSSI_Receive_DMA (PSSI_HandleTypeDef * hpssi, uint32_t * pData, uint32_t Size)

Function description

Receive an amount of data in non-blocking mode with DMA.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received (in bytes)

Return values

- **HAL:** status

`HAL_PSSI_Abort_DMA`

Function name

HAL_StatusTypeDef HAL_PSSI_Abort_DMA (PSSI_HandleTypeDef * hpssi)

Function description

Abort a DMA process communication with Interrupt.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **HAL:** status

`HAL_PSSI_IRQHandler`

Function name

void HAL_PSSI_IRQHandler (PSSI_HandleTypeDef * hpssi)

Function description

This function handles PSSI event interrupt request.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

`HAL_PSSI_TxCpltCallback`

Function name

void HAL_PSSI_TxCpltCallback (PSSI_HandleTypeDef * hpssi)

Function description

Tx Transfer complete callback.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

HAL_PSSI_RxCpltCallback

Function name

void HAL_PSSI_RxCpltCallback (PSSI_HandleTypeDef * hpssi)

Function description

Rx Transfer complete callback.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

HAL_PSSI_ErrorCallback

Function name

void HAL_PSSI_ErrorCallback (PSSI_HandleTypeDef * hpssi)

Function description

PSSI error callback.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

HAL_PSSI_AbortCpltCallback

Function name

void HAL_PSSI_AbortCpltCallback (PSSI_HandleTypeDef * hpssi)

Function description

PSSI abort callback.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **None:**

`HAL_PSSI_GetState`

Function name

HAL_PSSI_StateTypeDef HAL_PSSI_GetState (PSSI_HandleTypeDef * hpssi)

Function description

Return the PSSI handle state.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **HAL:** state

`HAL_PSSI_GetError`

Function name

uint32_t HAL_PSSI_GetError (PSSI_HandleTypeDef * hpssi)

Function description

Return the PSSI error code.

Parameters

- **hpssi:** Pointer to a PSSI_HandleTypeDef structure that contains the configuration information for the specified PSSI.

Return values

- **PSSI:** Error Code

53.3 PSSI Firmware driver defines

The following section lists the various define and macros of the module.

53.3.1 PSSI

PSSI

PSSI Bus Width

HAL_PSSI_8LINES

8 data lines

HAL_PSSI_16LINES

16 data lines

PSSI Clock Polarity

HAL_PSSI_FALLING_EDGE

Falling Edge

HAL_PSSI_RISING_EDGE

Rising Edge

PSSI Control Signal Configuration

HAL_PSSI_DE_RDY_DISABLE

Neither DE nor RDY are enabled

HAL_PSSI_RDY_ENABLE

Only RDY enabled

HAL_PSSI_DE_ENABLE

Only DE enabled

HAL_PSSI_DE_RDY_ALT_ENABLE

Both RDY and DE alternate functions enabled

HAL_PSSI_MAP_RDY_BIDIR_ENABLE

Bi-directional on RDY pin

HAL_PSSI_RDY_MAP_ENABLE

Only RDY enabled, mapped to DE pin

HAL_PSSI_DE_MAP_ENABLE

Only DE enabled, mapped to RDY pin

HAL_PSSI_MAP_DE_BIDIR_ENABLE

Bi-directional on DE pin

PSSI Data Enable Polarity

HAL_PSSI_DEPOL_ACTIVE_LOW

Active Low

HAL_PSSI_DEPOL_ACTIVE_HIGH

Active High

PSSI Data Width

HAL_PSSI_8BITS

8 Bits

HAL_PSSI_16BITS

16 Bits

HAL_PSSI_32BITS

32 Bits

PSSI definitions

PSSI_MAX_NBYTE_SIZE

PSSI_TIMEOUT_TRANSMIT

Timeout Value

PSSI_CR_OUTEN_INPUT

Input Mode

PSSI_CR_OUTEN_OUTPUT

Output Mode

PSSI_CR_DMA_ENABLE

DMA Mode Enable

PSSI_CR_DMA_DISABLE

DMA Mode Disble

PSSI_CR_16BITS

16 Lines Mode

PSSI_CR_8BITS

8 Lines Mode

PSSI_FLAG_RTT1B

1 Byte Fifo Flag

PSSI_FLAG_RTT4B

4 Bytes Fifo Flag

PSSI Error Code

HAL_PSSI_ERROR_NONE

No error

HAL_PSSI_ERROR_NOT_SUPPORTED

Not supported operation

HAL_PSSI_ERROR_UNDER_RUN

FIFO Under-run error

HAL_PSSI_ERROR_OVER_RUN

FIFO Over-run error

HAL_PSSI_ERROR_DMA

Dma error

HAL_PSSI_ERROR_TIMEOUT

Timeout error

HAL_PSSI_ERROR_INVALID_CALLBACK

Invalid callback error

PSSI Exported Macros

HAL_PSSI_RESET_HANDLE_STATE

Description:

- Reset PSSI handle state.

Parameters:

- __HANDLE__: specifies the PSSI handle.

Return value:

- None

HAL_PSSI_ENABLE

Description:

- Enable the PSSI.

Parameters:

- __HANDLE__: PSSI handle

Return value:

- None.

HAL_PSSI_DISABLE

Description:

- Disable the PSSI.

Parameters:

- __HANDLE__: PSSI handle

Return value:

- None.

HAL_PSSI_GET_STATUS

Description:

- Get the PSSI pending flags.

Parameters:

- __HANDLE__: PSSI handle
- __FLAG__: flag to check. This parameter can be any combination of the following values:
  - PSSI_FLAG_RTT1B: FIFO is ready to transfer one byte
  - PSSI_FLAG_RTT4B: FIFO is ready to transfer four bytes

Return value:

- The: state of FLAG.

HAL_PSSI_GET_FLAG

Description:

- Get the PSSI pending flags.

Parameters:

- __HANDLE__: PSSI handle
- __FLAG__: flag to check. This parameter can be any combination of the following values:
  - PSSI_FLAG_OVR_RIS: Data Buffer overrun/underrun error flag

Return value:

- The: state of FLAG.

HAL_PSSI_CLEAR_FLAG

Description:

- Clear the PSSI pending flags.

Parameters:

- __HANDLE__: PSSI handle
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - PSSI_FLAG_OVR_RIS: Data Buffer overrun/underrun error flag

Return value:

- None

HAL_PSSI_ENABLE_IT

Description:

- Enable the specified PSSI interrupts.

Parameters:

- __HANDLE__: PSSI handle
- __INTERRUPT__: specifies the PSSI interrupt sources to be enabled. This parameter can be any combination of the following values:
  - PSSI_FLAG_OVR_RIS: Configuration error mask

Return value:

- None

HAL_PSSI_DISABLE_IT

Description:

- Disable the specified PSSI interrupts.

Parameters:

- __HANDLE__: PSSI handle
- __INTERRUPT__: specifies the PSSI interrupt sources to be disabled. This parameter can be any combination of the following values:
  - PSSI_IT_OVR_IE: Configuration error mask

Return value:

- None

HAL_PSSI_GET_IT_SOURCE

Description:

- Check whether the specified PSSI interrupt source is enabled or not.

Parameters:

- __HANDLE__: PSSI handle
- __INTERRUPT__: specifies the PSSI interrupt source to check. This parameter can be one of the following values:
  - PSSI_IT_OVR_IE: Data Buffer overrun/underrun error interrupt mask

Return value:

- The: state of INTERRUPT source.

IS_PSSI_CONTROL_SIGNAL

Description:

- Check whether the PSSI Control signal is valid.

Parameters:

- __CONTROL__: Control signals configuration

Return value:

- Valid: or not.

IS_PSSI_BUSWIDTH

Description:

- Check whether the PSSI Bus Width is valid.

Parameters:

- __BUSWIDTH__: PSSI Bush width

Return value:

- Valid: or not.

IS_PSSI_CLOCK_POLARITY

Description:

- Check whether the PSSI Clock Polarity is valid.

Parameters:

- __CLOCKPOL__: PSSI Clock Polarity

Return value:

- Valid: or not.

IS_PSSI_DE_POLARITY

Description:

- Check whether the PSSI Data Enable Polarity is valid.

Parameters:

- __DEPOL__: PSSI DE Polarity

Return value:

- Valid: or not.

IS_PSSI_RDY_POLARITY

Description:

- Check whether the PSSI Ready Polarity is valid.

Parameters:

- __RDYPOL__: PSSI RDY Polarity

Return value:

- Valid: or not.

PSSI Interrupts

PSSI_FLAG_OVR_RIS

Overrun, Underrun errors flag

PSSI_FLAG_MASK

Overrun, Underrun errors Mask

PSSI_FLAG_OVR_MIS

Overrun, Underrun masked errors flag

PSSI mode

HAL_PSSI_UNIDIRECTIONAL

Uni-directional mode

HAL_PSSI_BIDIRECTIONAL

Bi-directional mode

PSSI Ready Polarity

HAL_PSSI_RDYPOL_ACTIVE_LOW

Active Low

HAL_PSSI_RDYPOL_ACTIVE_HIGH

Active High

54 HAL PWR Generic Driver

54.1 PWR Firmware driver registers structures

54.1.1 PWR_PVDTypeDef

PWR_PVDTypeDef is defined in the stm32l4xx_hal_pwr.h

Data Fields

- ***uint32_t PVDLevel***
- ***uint32_t Mode***

Field Documentation

- ***uint32_t PWR_PVDTypeDef::PVDLevel***
  PVDLevel: Specifies the PVD detection level. This parameter can be a value of ***PWR_PVD_detection_level***.
- ***uint32_t PWR_PVDTypeDef::Mode***
  Mode: Specifies the operating mode for the selected pins. This parameter can be a value of ***PWR_PVD_Mode***.

54.2 PWR Firmware driver API description

The following section lists the various functions of the PWR library.

54.2.1 Initialization and de-initialization functions

This section contains the following APIs:

- ***HAL_PWR_DeInit***
- ***HAL_PWR_EnableBkUpAccess***
- ***HAL_PWR_DisableBkUpAccess***

54.2.2 Peripheral Control functions

PVD configuration

- The PVD is used to monitor the VDD power supply by comparing it to a threshold selected by the PVD Level (PLS[2:0] bits in PWR_CR2 register).
- PVDO flag is available to indicate if VDD/VDDA is higher or lower than the PVD threshold. This event is internally connected to the EXTI line16 and can generate an interrupt if enabled. This is done through __HAL_PVD_EXTI_ENABLE_IT() macro.
- The PVD is stopped in Standby mode.

WakeUp pin configuration

- WakeUp pins are used to wakeup the system from Standby mode or Shutdown mode. The polarity of these pins can be set to configure event detection on high level (rising edge) or low level (falling edge).

Low Power modes configuration

The devices feature 8 low-power modes:

- Low-power Run mode: core and peripherals are running, main regulator off, low power regulator on.
- Sleep mode: Cortex-M4 core stopped, peripherals kept running, main and low power regulators on.
- Low-power Sleep mode: Cortex-M4 core stopped, peripherals kept running, main regulator off, low power regulator on.
- Stop 0 mode: all clocks are stopped except LSI and LSE, main and low power regulators on.
- Stop 1 mode: all clocks are stopped except LSI and LSE, main regulator off, low power regulator on.

- Stop 2 mode: all clocks are stopped except LSI and LSE, main regulator off, low power regulator on, reduced set of waking up IPs compared to Stop 1 mode.
- Standby mode with SRAM2: all clocks are stopped except LSI and LSE, SRAM2 content preserved, main regulator off, low power regulator on.
- Standby mode without SRAM2: all clocks are stopped except LSI and LSE, main and low power regulators off.
- Shutdown mode: all clocks are stopped except LSE, main and low power regulators off.

Low-power run mode

- Entry: (from main run mode)
  - set LPR bit with HAL_PWREx_EnableLowPowerRunMode() API after having decreased the system clock below 2 MHz.
- Exit:
  - clear LPR bit then wait for REGLP bit to be reset with HAL_PWREx_DisableLowPowerRunMode() API. Only then can the system clock frequency be increased above 2 MHz.

Sleep mode / Low-power sleep mode

- Entry: The Sleep mode / Low-power Sleep mode is entered thru HAL_PWR_EnterSLEEPMode() API in specifying whether or not the regulator is forced to low-power mode and if exit is interrupt or event-triggered.
  - PWR_MAINREGULATOR_ON: Sleep mode (regulator in main mode).
  - PWR_LOWPOWERREGULATOR_ON: Low-power sleep (regulator in low power mode). In the latter case, the system clock frequency must have been decreased below 2 MHz beforehand.
  - PWR_SLEEPENTRY_WFI: enter SLEEP mode with WFI instruction
  - PWR_SLEEPENTRY_WFE: enter SLEEP mode with WFE instruction
- WFI Exit:
  - Any peripheral interrupt acknowledged by the nested vectored interrupt controller (NVIC) or any wake-up event.
- WFE Exit:
  - Any wake-up event such as an EXTI line configured in event mode.

When exiting the Low-power sleep mode by issuing an interrupt or a wakeup event, the MCU is in Low-power Run mode.

Stop 0, Stop 1 and Stop 2 modes

- Entry: The Stop 0, Stop 1 or Stop 2 modes are entered thru the following API's:
  - HAL_PWREx_EnterSTOP0Mode() for mode 0 or HAL_PWREx_EnterSTOP1Mode() for mode 1 or for porting reasons HAL_PWR_EnterSTOPMode().
  - HAL_PWREx_EnterSTOP2Mode() for mode 2.
- Regulator setting (applicable to HAL_PWR_EnterSTOPMode() only):
  - PWR_MAINREGULATOR_ON
  - PWR_LOWPOWERREGULATOR_ON
- Exit (interrupt or event-triggered, specified when entering STOP mode):
  - PWR_STOPENTRY_WFI: enter Stop mode with WFI instruction
  - PWR_STOPENTRY_WFE: enter Stop mode with WFE instruction
- WFI Exit:
  - Any EXTI Line (Internal or External) configured in Interrupt mode.
  - Some specific communication peripherals (USART, LPUART, I2C) interrupts when programmed in wakeup mode.
- WFE Exit:
  - Any EXTI Line (Internal or External) configured in Event mode.

When exiting Stop 0 and Stop 1 modes, the MCU is either in Run mode or in Low-power Run mode depending on the LPR bit setting. When exiting Stop 2 mode, the MCU is in Run mode.

Standby mode

The Standby mode offers two options:

- option a) all clocks off except LSI and LSE, RRS bit set (keeps voltage regulator in low power mode). SRAM and registers contents are lost except for the SRAM2 content, the RTC registers, RTC backup registers and Standby circuitry.
- option b) all clocks off except LSI and LSE, RRS bit cleared (voltage regulator then disabled). SRAM and register contents are lost except for the RTC registers, RTC backup registers and Standby circuitry.
  - Entry:
    - The Standby mode is entered thru HAL_PWR_EnterSTANDBYMode() API. SRAM1 and register contents are lost except for registers in the Backup domain and Standby circuitry. SRAM2 content can be preserved if the bit RRS is set in PWR_CR3 register. To enable this feature, the user can resort to HAL_PWREx_EnableSRAM2ContentRetention() API to set RRS bit.
  - Exit:
    - WKUP pin rising edge, RTC alarm or wakeup, tamper event, time-stamp event, external reset in NRST pin, IWDG reset.

After waking up from Standby mode, program execution restarts in the same way as after a Reset.

Shutdown mode

In Shutdown mode, voltage regulator is disabled, all clocks are off except LSE, RRS bit is cleared. SRAM and registers contents are lost except for backup domain registers.

- Entry: The Shutdown mode is entered thru HAL_PWREx_EnterSHUTDOWNMode() API.
- Exit:
  - WKUP pin rising edge, RTC alarm or wakeup, tamper event, time-stamp event, external reset in NRST pin.

After waking up from Shutdown mode, program execution restarts in the same way as after a Reset.

Auto-wakeup (AWU) from low-power mode

The MCU can be woken up from low-power mode by an RTC Alarm event, an RTC Wakeup event, a tamper event or a time-stamp event, without depending on an external interrupt (Auto-wakeup mode).

- RTC auto-wakeup (AWU) from the Stop, Standby and Shutdown modes
  - To wake up from the Stop mode with an RTC alarm event, it is necessary to configure the RTC to generate the RTC alarm using the HAL_RTC_SetAlarm_IT() function.
  - To wake up from the Stop mode with an RTC Tamper or time stamp event, it is necessary to configure the RTC to detect the tamper or time stamp event using the HAL_RTCEx_SetTimeStamp_IT() or HAL_RTCEx_SetTamper_IT() functions.
  - To wake up from the Stop mode with an RTC WakeUp event, it is necessary to configure the RTC to generate the RTC WakeUp event using the HAL_RTCEx_SetWakeUpTimer_IT() function.

This section contains the following APIs:

- ***HAL_PWR_ConfigPVD***
- ***HAL_PWR_EnablePVD***
- ***HAL_PWR_DisablePVD***
- ***HAL_PWR_EnableWakeUpPin***
- ***HAL_PWR_DisableWakeUpPin***
- ***HAL_PWR_EnterSLEEPMode***
- ***HAL_PWR_EnterSTOPMode***
- ***HAL_PWR_EnterSTANDBYMode***
- ***HAL_PWR_EnableSleepOnExit***
- ***HAL_PWR_DisableSleepOnExit***
- ***HAL_PWR_EnableSEVOnPend***

- *HAL_PWR_DisableSEVOnPend*
- *HAL_PWR_PVDCallback*

54.2.3 Detailed description of functions

`HAL_PWR_DeInit`

Function name

void HAL_PWR_DeInit (void)

Function description

Deinitialize the HAL PWR peripheral registers to their default reset values.

Return values

- **None:**

`HAL_PWR_EnableBkUpAccess`

Function name

void HAL_PWR_EnableBkUpAccess (void)

Function description

Enable access to the backup domain (RTC registers, RTC backup data registers).

Return values

- **None:**

Notes

- After reset, the backup domain is protected against possible unwanted write accesses.
- RTCSEL that sets the RTC clock source selection is in the RTC back-up domain. In order to set or modify the RTC clock, the backup domain access must be disabled.
- LSEON bit that switches on and off the LSE crystal belongs as well to the back-up domain.

`HAL_PWR_DisableBkUpAccess`

Function name

void HAL_PWR_DisableBkUpAccess (void)

Function description

Disable access to the backup domain (RTC registers, RTC backup data registers).

Return values

- **None:**

`HAL_PWR_ConfigPVD`

Function name

HAL_StatusTypeDef HAL_PWR_ConfigPVD (PWR_PVDTypeDef * sConfigPVD)

Function description

Configure the voltage threshold detected by the Power Voltage Detector (PVD).

Parameters

- **sConfigPVD:** pointer to a PWR_PVDTypeDef structure that contains the PVD configuration information.

Return values

- **None:**

Notes

- Refer to the electrical characteristics of your device datasheet for more details about the voltage thresholds corresponding to each detection level.

`HAL_PWR_EnablePVD`

Function name

void HAL_PWR_EnablePVD (void)

Function description

Enable the Power Voltage Detector (PVD).

Return values

- **None:**

`HAL_PWR_DisablePVD`

Function name

void HAL_PWR_DisablePVD (void)

Function description

Disable the Power Voltage Detector (PVD).

Return values

- **None:**

`HAL_PWR_EnableWakeUpPin`

Function name

void HAL_PWR_EnableWakeUpPin (uint32_t WakeUpPinPolarity)

Function description

Enable the WakeUp PINx functionality.

Parameters

- **WakeUpPinPolarity:** Specifies which Wake-Up pin to enable. This parameter can be one of the following legacy values which set the default polarity i.e. detection on high level (rising edge):
  - PWR_WAKEUP_PIN1, PWR_WAKEUP_PIN2, PWR_WAKEUP_PIN3, PWR_WAKEUP_PIN4, PWR_WAKEUP_PIN5

  or one of the following value where the user can explicitly specify the enabled pin and the chosen polarity:
  - PWR_WAKEUP_PIN1_HIGH or PWR_WAKEUP_PIN1_LOW
  - PWR_WAKEUP_PIN2_HIGH or PWR_WAKEUP_PIN2_LOW
  - PWR_WAKEUP_PIN3_HIGH or PWR_WAKEUP_PIN3_LOW
  - PWR_WAKEUP_PIN4_HIGH or PWR_WAKEUP_PIN4_LOW
  - PWR_WAKEUP_PIN5_HIGH or PWR_WAKEUP_PIN5_LOW

Return values

- **None:**

Notes

- PWR_WAKEUP_PINx and PWR_WAKEUP_PINx_HIGH are equivalent.

`HAL_PWR_DisableWakeUpPin`

Function name

void HAL_PWR_DisableWakeUpPin (uint32_t WakeUpPinx)

Function description

Disable the WakeUp PINx functionality.

Parameters

- **WakeUpPinx:** Specifies the Power Wake-Up pin to disable. This parameter can be one of the following values:
  - PWR_WAKEUP_PIN1, PWR_WAKEUP_PIN2, PWR_WAKEUP_PIN3, PWR_WAKEUP_PIN4, PWR_WAKEUP_PIN5

Return values

- **None:**

HAL_PWR_EnterSLEEPMode

Function name

void HAL_PWR_EnterSLEEPMode (uint32_t Regulator, uint8_t SLEEPEntry)

Function description

Enter Sleep or Low-power Sleep mode.

Parameters

- **Regulator:** Specifies the regulator state in Sleep/Low-power Sleep mode. This parameter can be one of the following values:
  - PWR_MAINREGULATOR_ON Sleep mode (regulator in main mode)
  - PWR_LOWPOWERREGULATOR_ON Low-power Sleep mode (regulator in low-power mode)
- **SLEEPEntry:** Specifies if Sleep mode is entered with WFI or WFE instruction. This parameter can be one of the following values:
  - PWR_SLEEPENTRY_WFI enter Sleep or Low-power Sleep mode with WFI instruction
  - PWR_SLEEPENTRY_WFE enter Sleep or Low-power Sleep mode with WFE instruction

Return values

- **None:**

Notes

- In Sleep/Low-power Sleep mode, all I/O pins keep the same state as in Run mode.
- Low-power Sleep mode is entered from Low-power Run mode. Therefore, if not yet in Low-power Run mode before calling HAL_PWR_EnterSLEEPMode() with Regulator set to PWR_LOWPOWERREGULATOR_ON, the user can optionally configure the Flash in power-down monde in setting the SLEEP_PD bit in FLASH_ACR register. Additionally, the clock frequency must be reduced below 2 MHz. Setting SLEEP_PD in FLASH_ACR then appropriately reducing the clock frequency must be done before calling HAL_PWR_EnterSLEEPMode() API.
- When exiting Low-power Sleep mode, the MCU is in Low-power Run mode. To move in Run mode, the user must resort to HAL_PWREx_DisableLowPowerRunMode() API.
- When WFI entry is used, tick interrupt have to be disabled if not desired as the interrupt wake up source.

HAL_PWR_EnterSTOPMode

Function name

void HAL_PWR_EnterSTOPMode (uint32_t Regulator, uint8_t STOPEntry)

Function description

Enter Stop mode.

Parameters

- **Regulator:** Specifies the regulator state in Stop mode. This parameter can be one of the following values:
  - PWR_MAINREGULATOR_ON Stop 0 mode (main regulator ON)
  - PWR_LOWPOWERREGULATOR_ON Stop 1 mode (low power regulator ON)
- **STOPEntry:** Specifies Stop 0 or Stop 1 mode is entered with WFI or WFE instruction. This parameter can be one of the following values:
  - PWR_STOPENTRY_WFI Enter Stop 0 or Stop 1 mode with WFI instruction.
  - PWR_STOPENTRY_WFE Enter Stop 0 or Stop 1 mode with WFE instruction.

Return values

- **None:**

Notes

- This API is named HAL_PWR_EnterSTOPMode to ensure compatibility with legacy code running on devices where only "Stop mode" is mentioned with main or low power regulator ON.
- In Stop mode, all I/O pins keep the same state as in Run mode.
- All clocks in the VCORE domain are stopped; the PLL, the MSI, the HSI and the HSE oscillators are disabled. Some peripherals with the wakeup capability (I2Cx, USARTx and LPUART) can switch on the HSI to receive a frame, and switch off the HSI after receiving the frame if it is not a wakeup frame. In this case, the HSI clock is propagated only to the peripheral requesting it. SRAM1, SRAM2 and register contents are preserved. The BOR is available. The voltage regulator can be configured either in normal (Stop 0) or low-power mode (Stop 1).
- When exiting Stop 0 or Stop 1 mode by issuing an interrupt or a wakeup event, the HSI RC oscillator is selected as system clock if STOPWUCK bit in RCC_CFGR register is set; the MSI oscillator is selected if STOPWUCK is cleared.
- When the voltage regulator operates in low power mode (Stop 1), an additional startup delay is incurred when waking up. By keeping the internal regulator ON during Stop mode (Stop 0), the consumption is higher although the startup time is reduced.

HAL_PWR_EnterSTANDBYMode

Function name

void HAL_PWR_EnterSTANDBYMode (void)

Function description

Enter Standby mode.

Return values

- **None:**

Notes

- In Standby mode, the PLL, the HSI, the MSI and the HSE oscillators are switched off. The voltage regulator is disabled, except when SRAM2 content is preserved in which case the regulator is in low-power mode. SRAM1 and register contents are lost except for registers in the Backup domain and Standby circuitry. SRAM2 content can be preserved if the bit RRS is set in PWR_CR3 register. To enable this feature, the user can resort to HAL_PWREx_EnableSRAM2ContentRetention() API to set RRS bit. The BOR is available.
- The I/Os can be configured either with a pull-up or pull-down or can be kept in analog state. HAL_PWREx_EnableGPIOPullUp() and HAL_PWREx_EnableGPIOPullDown() respectively enable Pull Up and Pull Down state, HAL_PWREx_DisableGPIOPullUp() and HAL_PWREx_DisableGPIOPullDown() disable the same. These states are effective in Standby mode only if APC bit is set through HAL_PWREx_EnablePullUpPullDownConfig() API.

HAL_PWR_EnableSleepOnExit

Function name

void HAL_PWR_EnableSleepOnExit (void)

Function description

Indicate Sleep-On-Exit when returning from Handler mode to Thread mode.

Return values

- **None:**

Notes

- Set SLEEPONEXIT bit of SCR register. When this bit is set, the processor re-enters SLEEP mode when an interruption handling is over. Setting this bit is useful when the processor is expected to run only on interruptions handling.

HAL_PWR_DisableSleepOnExit

Function name

void HAL_PWR_DisableSleepOnExit (void)

Function description

Disable Sleep-On-Exit feature when returning from Handler mode to Thread mode.

Return values

- **None:**

Notes

- Clear SLEEPONEXIT bit of SCR register. When this bit is set, the processor re-enters SLEEP mode when an interruption handling is over.

HAL_PWR_EnableSEVOnPend

Function name

void HAL_PWR_EnableSEVOnPend (void)

Function description

Enable CORTEX M4 SEVONPEND bit.

Return values

- **None:**

Notes

- Set SEVONPEND bit of SCR register. When this bit is set, this causes WFE to wake up when an interrupt moves from inactive to pended.

HAL_PWR_DisableSEVOnPend

Function name

void HAL_PWR_DisableSEVOnPend (void)

Function description

Disable CORTEX M4 SEVONPEND bit.

Return values

- **None:**

Notes

- Clear SEVONPEND bit of SCR register. When this bit is set, this causes WFE to wake up when an interrupt moves from inactive to pended.

`HAL_PWR_PVDCallback`

Function name

void HAL_PWR_PVDCallback (void)

Function description

PWR PVD interrupt callback.

Return values

- **None:**

54.3 PWR Firmware driver defines

The following section lists the various define and macros of the module.

54.3.1 PWR

PWR

PWR Exported Macros

__HAL_PWR_GET_FLAG

Description:

- Check whether or not a specific PWR flag is set.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - PWR_FLAG_WUF1 Wake Up Flag 1. Indicates that a wakeup event was received from the WKUP pin 1.
  - PWR_FLAG_WUF2 Wake Up Flag 2. Indicates that a wakeup event was received from the WKUP pin 2.
  - PWR_FLAG_WUF3 Wake Up Flag 3. Indicates that a wakeup event was received from the WKUP pin 3.
  - PWR_FLAG_WUF4 Wake Up Flag 4. Indicates that a wakeup event was received from the WKUP pin 4.
  - PWR_FLAG_WUF5 Wake Up Flag 5. Indicates that a wakeup event was received from the WKUP pin 5.
  - PWR_FLAG_SB StandBy Flag. Indicates that the system entered StandBy mode.
  - PWR_FLAG_EXT_SMPS External SMPS Ready Flag. When available on device, indicates that external switch can be closed to connect to the external SMPS, when the Range 2 of internal regulator is ready.
  - PWR_FLAG_WUFI Wake-Up Flag Internal. Set when a wakeup is detected on the internal wakeup line.
  - PWR_FLAG_REGLPS Low Power Regulator Started. Indicates whether or not the low-power regulator is ready.
  - PWR_FLAG_REGLPF Low Power Regulator Flag. Indicates whether the regulator is ready in main mode or is in low-power mode.
  - PWR_FLAG_VOSF Voltage Scaling Flag. Indicates whether the regulator is ready in the selected voltage range or is still changing to the required voltage level.
  - PWR_FLAG_PVDO Power Voltage Detector Output. Indicates whether VDD voltage is below or above the selected PVD threshold.
  - PWR_FLAG_PVMO1 Peripheral Voltage Monitoring Output 1. Indicates whether VDDUSB voltage is is below or above PVM1 threshold (applicable when USB feature is supported).
  - PWR_FLAG_PVMO3 Peripheral Voltage Monitoring Output 3. Indicates whether VDDA voltage is is below or above PVM3 threshold.
  - PWR_FLAG_PVMO4 Peripheral Voltage Monitoring Output 4. Indicates whether VDDA voltage is is below or above PVM4 threshold.

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_PWR_CLEAR_FLAG

Description:

- Clear a specific PWR flag.

Parameters:

- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - PWR_FLAG_WUF1 Wake Up Flag 1. Indicates that a wakeup event was received from the WKUP pin 1.
  - PWR_FLAG_WUF2 Wake Up Flag 2. Indicates that a wakeup event was received from the WKUP pin 2.
  - PWR_FLAG_WUF3 Wake Up Flag 3. Indicates that a wakeup event was received from the WKUP pin 3.
  - PWR_FLAG_WUF4 Wake Up Flag 4. Indicates that a wakeup event was received from the WKUP pin 4.
  - PWR_FLAG_WUF5 Wake Up Flag 5. Indicates that a wakeup event was received from the WKUP pin 5.
  - PWR_FLAG_WU Encompasses all five Wake Up Flags.
  - PWR_FLAG_SB Standby Flag. Indicates that the system entered Standby mode.

Return value:

- None

__HAL_PWR_PVD_EXTI_ENABLE_IT

Description:

- Enable the PVD Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVD_EXTI_DISABLE_IT

Description:

- Disable the PVD Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVD_EXTI_ENABLE_EVENT

Description:

- Enable the PVD Event Line.

Return value:

- None

__HAL_PWR_PVD_EXTI_DISABLE_EVENT

Description:

- Disable the PVD Event Line.

Return value:

- None

__HAL_PWR_PVD_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the PVD Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVD_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the PVD Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVD_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the PVD Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVD_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the PVD Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVD_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable the PVD Extended Interrupt Rising & Falling Trigger.

Return value:

- None

__HAL_PWR_PVD_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the PVD Extended Interrupt Rising & Falling Trigger.

Return value:

- None

__HAL_PWR_PVD_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on selected EXTI line.

Return value:

- None

__HAL_PWR_PVD_EXTI_GET_FLAG

Description:

- Check whether or not the PVD EXTI interrupt flag is set.

Return value:

- EXTI: PVD Line Status.

__HAL_PWR_PVD_EXTI_CLEAR_FLAG

Description:

- Clear the PVD EXTI interrupt flag.

Return value:

- None

Programmable Voltage Detection levels

PWR_PVDLEVEL_0

PVD threshold around 2.0 V

PWR_PVDLEVEL_1

PVD threshold around 2.2 V

PWR_PVDLEVEL_2

PVD threshold around 2.4 V

PWR_PVDLEVEL_3

PVD threshold around 2.5 V

PWR_PVDLEVEL_4

PVD threshold around 2.6 V

PWR_PVDLEVEL_5

PVD threshold around 2.8 V

PWR_PVDLEVEL_6

PVD threshold around 2.9 V

PWR_PVDLEVEL_7

External input analog voltage (compared internally to VREFINT)

PWR PVD event line

PWR_EVENT_LINE_PVD

Event line 16 Connected to the PVD Event Line

PWR PVD external interrupt line

PWR_EXTI_LINE_PVD

External interrupt line 16 Connected to the PVD EXTI Line

PWR PVD interrupt and event mode

PWR_PVD_MODE_NORMAL

Basic mode is used

PWR_PVD_MODE_IT_RISING

External Interrupt Mode with Rising edge trigger detection

PWR_PVD_MODE_IT_FALLING

External Interrupt Mode with Falling edge trigger detection

PWR_PVD_MODE_IT_RISING_FALLING

External Interrupt Mode with Rising/Falling edge trigger detection

PWR_PVD_MODE_EVENT_RISING

Event Mode with Rising edge trigger detection

PWR_PVD_MODE_EVENT_FALLING

Event Mode with Falling edge trigger detection

PWR_PVD_MODE_EVENT_RISING_FALLING

Event Mode with Rising/Falling edge trigger detection

PWR PVD Mode Mask

PVD_MODE_IT

Mask for interruption yielded by PVD threshold crossing

PVD_MODE_EVT

Mask for event yielded by PVD threshold crossing

PVD_RISING_EDGE

Mask for rising edge set as PVD trigger

PVD_FALLING_EDGE

Mask for falling edge set as PVD trigger

PWR regulator mode

PWR_MAINREGULATOR_ON

Regulator in main mode

PWR_LOWPOWERREGULATOR_ON

Regulator in low-power mode

PWR SLEEP mode entry

PWR_SLEEPENTRY_WFI

Wait For Interruption instruction to enter Sleep mode

PWR_SLEEPENTRY_WFE

Wait For Event instruction to enter Sleep mode

PWR STOP mode entry

PWR_STOPENTRY_WFI

Wait For Interruption instruction to enter Stop mode

PWR_STOPENTRY_WFE

Wait For Event instruction to enter Stop mode

55 HAL PWR Extension Driver

55.1 PWREx Firmware driver registers structures

55.1.1 PWR_PVMTypeDef

PWR_PVMTypeDef is defined in the stm32l4xx_hal_pwr_ex.h

Data Fields

- ***uint32_t PVMType***
- ***uint32_t Mode***

Field Documentation

- ***uint32_t PWR_PVMTypeDef::PVMType***

  PVMType: Specifies which voltage is monitored and against which threshold. This parameter can be a value of ***PWREx_PVM_Type***.
  - **PWR_PVM_1** Peripheral Voltage Monitoring 1 enable: VDDUSB versus 1.2 V (applicable when USB feature is supported).
  - **PWR_PVM_3** Peripheral Voltage Monitoring 3 enable: VDDA versus 1.62 V.
  - **PWR_PVM_4** Peripheral Voltage Monitoring 4 enable: VDDA versus 2.2 V.
- ***uint32_t PWR_PVMTypeDef::Mode***

  Mode: Specifies the operating mode for the selected pins. This parameter can be a value of ***PWREx_PVM_Mode***.

55.2 PWREx Firmware driver API description

The following section lists the various functions of the PWREx library.

55.2.1 Extended Peripheral Initialization and de-initialization functions

This section contains the following APIs:

- ***HAL_PWREx_GetVoltageRange***
- ***HAL_PWREx_ControlVoltageScaling***
- ***HAL_PWREx_EnableBatteryCharging***
- ***HAL_PWREx_DisableBatteryCharging***
- ***HAL_PWREx_EnableVddUSB***
- ***HAL_PWREx_DisableVddUSB***
- ***HAL_PWREx_EnableVddIO2***
- ***HAL_PWREx_DisableVddIO2***
- ***HAL_PWREx_EnableInternalWakeUpLine***
- ***HAL_PWREx_DisableInternalWakeUpLine***
- ***HAL_PWREx_EnableGPIOPullUp***
- ***HAL_PWREx_DisableGPIOPullUp***
- ***HAL_PWREx_EnableGPIOPullDown***
- ***HAL_PWREx_DisableGPIOPullDown***
- ***HAL_PWREx_EnablePullUpPullDownConfig***
- ***HAL_PWREx_DisablePullUpPullDownConfig***
- ***HAL_PWREx_EnableSRAM2ContentRetention***
- ***HAL_PWREx_DisableSRAM2ContentRetention***
- ***HAL_PWREx_SetSRAM2ContentRetention***
- ***HAL_PWREx_EnableSRAM3ContentRetention***

- *HAL_PWREx_DisableSRAM3ContentRetention*
- *HAL_PWREx_EnableDSIPinsPDActivation*
- *HAL_PWREx_DisableDSIPinsPDActivation*
- *HAL_PWREx_EnablePVM1*
- *HAL_PWREx_DisablePVM1*
- *HAL_PWREx_EnablePVM2*
- *HAL_PWREx_DisablePVM2*
- *HAL_PWREx_EnablePVM3*
- *HAL_PWREx_DisablePVM3*
- *HAL_PWREx_EnablePVM4*
- *HAL_PWREx_DisablePVM4*
- *HAL_PWREx_ConfigPVM*
- *HAL_PWREx_EnableLowPowerRunMode*
- *HAL_PWREx_DisableLowPowerRunMode*
- *HAL_PWREx_EnterSTOP0Mode*
- *HAL_PWREx_EnterSTOP1Mode*
- *HAL_PWREx_EnterSTOP2Mode*
- *HAL_PWREx_EnterSHUTDOWNMode*
- *HAL_PWREx_PVD_PVM_IRQHandler*
- *HAL_PWREx_PVM1Callback*
- *HAL_PWREx_PVM2Callback*
- *HAL_PWREx_PVM3Callback*
- *HAL_PWREx_PVM4Callback*

55.2.2 Detailed description of functions

`HAL_PWREx_GetVoltageRange`

Function name

uint32_t HAL_PWREx_GetVoltageRange (void)

Function description

Return Voltage Scaling Range.

Return values

- **VOS:** bit field (PWR_REGULATOR_VOLTAGE_SCALE1 or PWR_REGULATOR_VOLTAGE_SCALE2 or PWR_REGULATOR_VOLTAGE_SCALE1_BOOST when applicable)

`HAL_PWREx_ControlVoltageScaling`

Function name

HAL_StatusTypeDef HAL_PWREx_ControlVoltageScaling (uint32_t VoltageScaling)

Function description

Configure the main internal regulator output voltage.

Parameters

- **VoltageScaling:** specifies the regulator output voltage to achieve a tradeoff between performance and power consumption. This parameter can be one of the following values:
  - PWR_REGULATOR_VOLTAGE_SCALE1_BOOST when available, Regulator voltage output range 1 boost mode, typical output voltage at 1.2 V, system frequency up to 120 MHz.
  - PWR_REGULATOR_VOLTAGE_SCALE1 Regulator voltage output range 1 mode, typical output voltage at 1.2 V, system frequency up to 80 MHz.
  - PWR_REGULATOR_VOLTAGE_SCALE2 Regulator voltage output range 2 mode, typical output voltage at 1.0 V, system frequency up to 26 MHz.

Return values

- **HAL:** Status

Notes

- When moving from Range 1 to Range 2, the system frequency must be decreased to a value below 26 MHz before calling HAL_PWREx_ControlVoltageScaling() API. When moving from Range 2 to Range 1, the system frequency can be increased to a value up to 80 MHz after calling HAL_PWREx_ControlVoltageScaling() API. For some devices, the system frequency can be increased up to 120 MHz.
- When moving from Range 2 to Range 1, the API waits for VOSF flag to be cleared before returning the status. If the flag is not cleared within 50 microseconds, HAL_TIMEOUT status is reported.

HAL_PWREx_EnableBatteryCharging

Function name

void HAL_PWREx_EnableBatteryCharging (uint32_t ResistorSelection)

Function description

Enable battery charging.

Parameters

- **ResistorSelection:** specifies the resistor impedance. This parameter can be one of the following values:
  - PWR_BATTERY_CHARGING_RESISTOR_5 5 kOhms resistor
  - PWR_BATTERY_CHARGING_RESISTOR_1_5 1.5 kOhms resistor

Return values

- **None:**

HAL_PWREx_DisableBatteryCharging

Function name

void HAL_PWREx_DisableBatteryCharging (void)

Function description

Disable battery charging.

Return values

- **None:**

HAL_PWREx_EnableVddUSB

Function name

void HAL_PWREx_EnableVddUSB (void)

Function description

Enable VDDUSB supply.

Return values

- **None:**

Notes

- Remove VDDUSB electrical and logical isolation, once VDDUSB supply is present.

`HAL_PWREx_DisableVddUSB`

Function name

void HAL_PWREx_DisableVddUSB (void)

Function description

Disable VDDUSB supply.

Return values

- **None:**

`HAL_PWREx_EnableVddIO2`

Function name

void HAL_PWREx_EnableVddIO2 (void)

Function description

Enable VDDIO2 supply.

Return values

- **None:**

Notes

- Remove VDDIO2 electrical and logical isolation, once VDDIO2 supply is present.

`HAL_PWREx_DisableVddIO2`

Function name

void HAL_PWREx_DisableVddIO2 (void)

Function description

Disable VDDIO2 supply.

Return values

- **None:**

`HAL_PWREx_EnableInternalWakeUpLine`

Function name

void HAL_PWREx_EnableInternalWakeUpLine (void)

Function description

Enable Internal Wake-up Line.

Return values

- **None:**

`HAL_PWREx_DisableInternalWakeUpLine`

Function name

void HAL_PWREx_DisableInternalWakeUpLine (void)

Function description

Disable Internal Wake-up Line.

Return values

- **None:**

`HAL_PWREx_EnableGPIOPullUp`

Function name

HAL_StatusTypeDef HAL_PWREx_EnableGPIOPullUp (uint32_t GPIO, uint32_t GPIONumber)

Function description

Enable GPIO pull-up state in Standby and Shutdown modes.

Parameters

- **GPIO:** Specify the IO port. This parameter can be PWR_GPIO_A, ..., PWR_GPIO_H (or PWR_GPIO_I depending on the devices) to select the GPIO peripheral.
- **GPIONumber:** Specify the I/O pins numbers. This parameter can be one of the following values: PWR_GPIO_BIT_0, ..., PWR_GPIO_BIT_15 (except for the port where less I/O pins are available) or the logical OR of several of them to set several bits for a given port in a single API call.

Return values

- **HAL:** Status

Notes

- Set the relevant PUy bits of PWR_PUCRx register to configure the I/O in pull-up state in Standby and Shutdown modes.
- This state is effective in Standby and Shutdown modes only if APC bit is set through HAL_PWREx_EnablePullUpPullDownConfig() API.
- The configuration is lost when exiting the Shutdown mode due to the power-on reset, maintained when exiting the Standby mode.
- To avoid any conflict at Standby and Shutdown modes exits, the corresponding PDy bit of PWR_PDCRx register is cleared unless it is reserved.
- Even if a PUy bit to set is reserved, the other PUy bits entered as input parameter at the same time are set.

`HAL_PWREx_DisableGPIOPullUp`

Function name

HAL_StatusTypeDef HAL_PWREx_DisableGPIOPullUp (uint32_t GPIO, uint32_t GPIONumber)

Function description

Disable GPIO pull-up state in Standby mode and Shutdown modes.

Parameters

- **GPIO:** Specifies the IO port. This parameter can be PWR_GPIO_A, ..., PWR_GPIO_H (or PWR_GPIO_I depending on the devices) to select the GPIO peripheral.
- **GPIONumber:** Specify the I/O pins numbers. This parameter can be one of the following values: PWR_GPIO_BIT_0, ..., PWR_GPIO_BIT_15 (except for the port where less I/O pins are available) or the logical OR of several of them to reset several bits for a given port in a single API call.

Return values

- **HAL:** Status

Notes

- Reset the relevant PUy bits of PWR_PUCRx register used to configure the I/O in pull-up state in Standby and Shutdown modes.
- Even if a PUy bit to reset is reserved, the other PUy bits entered as input parameter at the same time are reset.

HAL_PWREx_EnableGPIOPullDown

Function name

HAL_StatusTypeDef HAL_PWREx_EnableGPIOPullDown (uint32_t GPIO, uint32_t GPIONumber)

Function description

Enable GPIO pull-down state in Standby and Shutdown modes.

Parameters

- **GPIO:** Specify the IO port. This parameter can be PWR_GPIO_A..PWR_GPIO_H (or PWR_GPIO_I depending on the devices) to select the GPIO peripheral.
- **GPIONumber:** Specify the I/O pins numbers. This parameter can be one of the following values: PWR_GPIO_BIT_0, ..., PWR_GPIO_BIT_15 (except for the port where less I/O pins are available) or the logical OR of several of them to set several bits for a given port in a single API call.

Return values

- **HAL:** Status

Notes

- Set the relevant PDy bits of PWR_PDCRx register to configure the I/O in pull-down state in Standby and Shutdown modes.
- This state is effective in Standby and Shutdown modes only if APC bit is set through HAL_PWREx_EnablePullUpPullDownConfig() API.
- The configuration is lost when exiting the Shutdown mode due to the power-on reset, maintained when exiting the Standby mode.
- To avoid any conflict at Standby and Shutdown modes exits, the corresponding PUy bit of PWR_PUCRx register is cleared unless it is reserved.
- Even if a PDy bit to set is reserved, the other PDy bits entered as input parameter at the same time are set.

HAL_PWREx_DisableGPIOPullDown

Function name

HAL_StatusTypeDef HAL_PWREx_DisableGPIOPullDown (uint32_t GPIO, uint32_t GPIONumber)

Function description

Disable GPIO pull-down state in Standby and Shutdown modes.

Parameters

- **GPIO:** Specifies the IO port. This parameter can be PWR_GPIO_A..PWR_GPIO_H (or PWR_GPIO_I depending on the devices) to select the GPIO peripheral.
- **GPIONumber:** Specify the I/O pins numbers. This parameter can be one of the following values: PWR_GPIO_BIT_0, ..., PWR_GPIO_BIT_15 (except for the port where less I/O pins are available) or the logical OR of several of them to reset several bits for a given port in a single API call.

Return values

- **HAL:** Status

Notes

- Reset the relevant PDy bits of PWR_PDCRx register used to configure the I/O in pull-down state in Standby and Shutdown modes.
- Even if a PDy bit to reset is reserved, the other PDy bits entered as input parameter at the same time are reset.

`HAL_PWREx_EnablePullUpPullDownConfig`

Function name

void HAL_PWREx_EnablePullUpPullDownConfig (void)

Function description

Enable pull-up and pull-down configuration.

Return values

- **None:**

Notes

- When APC bit is set, the I/O pull-up and pull-down configurations defined in PWR_PUCRx and PWR_PDCRx registers are applied in Standby and Shutdown modes.
- Pull-up set by PUy bit of PWR_PUCRx register is not activated if the corresponding PDy bit of PWR_PDCRx register is also set (pull-down configuration priority is higher). HAL_PWREx_EnableGPIOPullUp() and HAL_PWREx_EnableGPIOPullDown() API's ensure there is no conflict when setting PUy or PDy bit.

`HAL_PWREx_DisablePullUpPullDownConfig`

Function name

void HAL_PWREx_DisablePullUpPullDownConfig (void)

Function description

Disable pull-up and pull-down configuration.

Return values

- **None:**

Notes

- When APC bit is cleared, the I/O pull-up and pull-down configurations defined in PWR_PUCRx and PWR_PDCRx registers are not applied in Standby and Shutdown modes.

`HAL_PWREx_EnableSRAM2ContentRetention`

Function name

void HAL_PWREx_EnableSRAM2ContentRetention (void)

Function description

Enable Full SRAM2 content retention in Standby mode.

Return values

- **None:**

`HAL_PWREx_DisableSRAM2ContentRetention`

Function name

void HAL_PWREx_DisableSRAM2ContentRetention (void)

Function description

Disable SRAM2 content retention in Standby mode.

Return values

- **None:**

HAL_PWREx_SetSRAM2ContentRetention

Function name

HAL_StatusTypeDef HAL_PWREx_SetSRAM2ContentRetention (uint32_t SRAM2Size)

Function description

Enable SRAM2 content retention in Standby mode.

Parameters

- **SRAM2Size:** specifies the SRAM2 size kept in Standby mode This parameter can be one of the following values:
  - PWR_NO_SRAM2_RETENTION SRAM2 is powered off in Standby mode (SRAM2 content is lost)
  - PWR_FULL_SRAM2_RETENTION Full SRAM2 is powered by the low-power regulator in Standby mode
  - PWR_4KBYTES_SRAM2_RETENTION Only 4 Kbytes of SRAM2 is powered by the low-power regulator in Standby mode

Return values

- **HAL:** Status

Notes

- PWR_4KBYTES_SRAM2_RETENTION parameter is not available on all devices

HAL_PWREx_EnableSRAM3ContentRetention

Function name

void HAL_PWREx_EnableSRAM3ContentRetention (void)

Function description

Enable SRAM3 content retention in Stop 2 mode.

Return values

- **None:**

Notes

- When RRSTP bit is set, SRAM3 is powered by the low-power regulator in Stop 2 mode and its content is kept.

HAL_PWREx_DisableSRAM3ContentRetention

Function name

void HAL_PWREx_DisableSRAM3ContentRetention (void)

Function description

Disable SRAM3 content retention in Stop 2 mode.

Return values

- **None:**

Notes

- When RRSTP bit is reset, SRAM3 is powered off in Stop 2 mode and its content is lost.

HAL_PWREx_EnableDSIPinsPDActivation

Function name

void HAL_PWREx_EnableDSIPinsPDActivation (void)

Function description

Enable pull-down activation on DSI pins.

Return values

- **None:**

HAL_PWREx_DisableDSIPinsPDActivation

Function name

void HAL_PWREx_DisableDSIPinsPDActivation (void)

Function description

Disable pull-down activation on DSI pins.

Return values

- **None:**

HAL_PWREx_EnablePVM1

Function name

void HAL_PWREx_EnablePVM1 (void)

Function description

Enable the Power Voltage Monitoring 1: VDDUSB versus 1.2V.

Return values

- **None:**

HAL_PWREx_DisablePVM1

Function name

void HAL_PWREx_DisablePVM1 (void)

Function description

Disable the Power Voltage Monitoring 1: VDDUSB versus 1.2V.

Return values

- **None:**

HAL_PWREx_EnablePVM2

Function name

void HAL_PWREx_EnablePVM2 (void)

Function description

Enable the Power Voltage Monitoring 2: VDDIO2 versus 0.9V.

Return values

- **None:**

HAL_PWREx_DisablePVM2

Function name

void HAL_PWREx_DisablePVM2 (void)

Function description

Disable the Power Voltage Monitoring 2: VDDIO2 versus 0.9V.

Return values

- None:

HAL_PWREx_EnablePVM3

Function name

void HAL_PWREx_EnablePVM3 (void)

Function description

Enable the Power Voltage Monitoring 3: VDDA versus 1.62V.

Return values

- None:

HAL_PWREx_DisablePVM3

Function name

void HAL_PWREx_DisablePVM3 (void)

Function description

Disable the Power Voltage Monitoring 3: VDDA versus 1.62V.

Return values

- None:

HAL_PWREx_EnablePVM4

Function name

void HAL_PWREx_EnablePVM4 (void)

Function description

Enable the Power Voltage Monitoring 4: VDDA versus 2.2V.

Return values

- None:

HAL_PWREx_DisablePVM4

Function name

void HAL_PWREx_DisablePVM4 (void)

Function description

Disable the Power Voltage Monitoring 4: VDDA versus 2.2V.

Return values

- None:

HAL_PWREx_ConfigPVM

Function name

HAL_StatusTypeDef HAL_PWREx_ConfigPVM (PWR_PVMTypeDef * sConfigPVM)

Function description

Configure the Peripheral Voltage Monitoring (PVM).

Parameters

- **sConfigPVM:** pointer to a PWR_PVMTypeDef structure that contains the PVM configuration information.

Return values

- **HAL:** status

Notes

- The API configures a single PVM according to the information contained in the input structure. To configure several PVMs, the API must be singly called for each PVM used.
- Refer to the electrical characteristics of your device datasheet for more details about the voltage thresholds corresponding to each detection level and to each monitored supply.

HAL_PWREx_EnableLowPowerRunMode

Function name

void HAL_PWREx_EnableLowPowerRunMode (void)

Function description

Enter Low-power Run mode.

Return values

- **None:**

Notes

- In Low-power Run mode, all I/O pins keep the same state as in Run mode.
- When Regulator is set to PWR_LOWPOWERREGULATOR_ON, the user can optionally configure the Flash in power-down monde in setting the RUN_PD bit in FLASH_ACR register. Additionally, the clock frequency must be reduced below 2 MHz. Setting RUN_PD in FLASH_ACR then appropriately reducing the clock frequency must be done before calling HAL_PWREx_EnableLowPowerRunMode() API.

HAL_PWREx_DisableLowPowerRunMode

Function name

HAL_StatusTypeDef HAL_PWREx_DisableLowPowerRunMode (void)

Function description

Exit Low-power Run mode.

Return values

- **HAL:** Status

Notes

- Before HAL_PWREx_DisableLowPowerRunMode() completion, the function checks that REGLPF has been properly reset (otherwise, HAL_PWREx_DisableLowPowerRunMode returns HAL_TIMEOUT status). The system clock frequency can then be increased above 2 MHz.

HAL_PWREx_EnterSTOP0Mode

Function name

void HAL_PWREx_EnterSTOP0Mode (uint8_t STOPEntry)

Function description

Enter Stop 0 mode.

Parameters

- **STOPEntry:** specifies if Stop mode in entered with WFI or WFE instruction. This parameter can be one of the following values:
  - PWR_STOPENTRY_WFI Enter Stop mode with WFI instruction
  - PWR_STOPENTRY_WFE Enter Stop mode with WFE instruction

Return values

- **None:**

Notes

- In Stop 0 mode, main and low voltage regulators are ON.
- In Stop 0 mode, all I/O pins keep the same state as in Run mode.
- All clocks in the VCORE domain are stopped; the PLL, the MSI, the HSI and the HSE oscillators are disabled. Some peripherals with the wakeup capability (I2Cx, USARTx and LPUART) can switch on the HSI to receive a frame, and switch off the HSI after receiving the frame if it is not a wakeup frame. In this case, the HSI clock is propagated only to the peripheral requesting it. SRAM1, SRAM2 and register contents are preserved. The BOR is available.
- When exiting Stop 0 mode by issuing an interrupt or a wakeup event, the HSI RC oscillator is selected as system clock if STOPWUCK bit in RCC_CFGR register is set; the MSI oscillator is selected if STOPWUCK is cleared.
- By keeping the internal regulator ON during Stop 0 mode, the consumption is higher although the startup time is reduced.

HAL_PWREx_EnterSTOP1Mode

Function name

void HAL_PWREx_EnterSTOP1Mode (uint8_t STOPEntry)

Function description

Enter Stop 1 mode.

Parameters

- **STOPEntry:** specifies if Stop mode in entered with WFI or WFE instruction. This parameter can be one of the following values:
  - PWR_STOPENTRY_WFI Enter Stop mode with WFI instruction
  - PWR_STOPENTRY_WFE Enter Stop mode with WFE instruction

Return values

- **None:**

Notes

- In Stop 1 mode, only low power voltage regulator is ON.
- In Stop 1 mode, all I/O pins keep the same state as in Run mode.
- All clocks in the VCORE domain are stopped; the PLL, the MSI, the HSI and the HSE oscillators are disabled. Some peripherals with the wakeup capability (I2Cx, USARTx and LPUART) can switch on the HSI to receive a frame, and switch off the HSI after receiving the frame if it is not a wakeup frame. In this case, the HSI clock is propagated only to the peripheral requesting it. SRAM1, SRAM2 and register contents are preserved. The BOR is available.
- When exiting Stop 1 mode by issuing an interrupt or a wakeup event, the HSI RC oscillator is selected as system clock if STOPWUCK bit in RCC_CFGR register is set; the MSI oscillator is selected if STOPWUCK is cleared.
- Due to low power mode, an additional startup delay is incurred when waking up from Stop 1 mode.

`HAL_PWREx_EnterSTOP2Mode`

Function name

void HAL_PWREx_EnterSTOP2Mode (uint8_t STOPEntry)

Function description

Enter Stop 2 mode.

Parameters

- **STOPEntry:** specifies if Stop mode in entered with WFI or WFE instruction. This parameter can be one of the following values:
  - PWR_STOPENTRY_WFI Enter Stop mode with WFI instruction
  - PWR_STOPENTRY_WFE Enter Stop mode with WFE instruction

Return values

- **None:**

Notes

- In Stop 2 mode, only low power voltage regulator is ON.
- In Stop 2 mode, all I/O pins keep the same state as in Run mode.
- All clocks in the VCORE domain are stopped, the PLL, the MSI, the HSI and the HSE oscillators are disabled. Some peripherals with wakeup capability (LCD, LPTIM1, I2C3 and LPUART) can switch on the HSI to receive a frame, and switch off the HSI after receiving the frame if it is not a wakeup frame. In this case the HSI clock is propagated only to the peripheral requesting it. SRAM1, SRAM2 and register contents are preserved. The BOR is available. The voltage regulator is set in low-power mode but LPR bit must be cleared to enter stop 2 mode. Otherwise, Stop 1 mode is entered.
- When exiting Stop 2 mode by issuing an interrupt or a wakeup event, the HSI RC oscillator is selected as system clock if STOPWUCK bit in RCC_CFGR register is set; the MSI oscillator is selected if STOPWUCK is cleared.

`HAL_PWREx_EnterSHUTDOWNMode`

Function name

void HAL_PWREx_EnterSHUTDOWNMode (void)

Function description

Enter Shutdown mode.

Return values

- **None:**

Notes

- In Shutdown mode, the PLL, the HSI, the MSI, the LSI and the HSE oscillators are switched off. The voltage regulator is disabled and Vcore domain is powered off. SRAM1, SRAM2 and registers contents are lost except for registers in the Backup domain. The BOR is not available.
- The I/Os can be configured either with a pull-up or pull-down or can be kept in analog state.

`HAL_PWREx_PVD_PVM_IRQHandler`

Function name

void HAL_PWREx_PVD_PVM_IRQHandler (void)

Function description

This function handles the PWR PVD/PVMx interrupt request.

Return values

- **None:**

Notes

- This API should be called under the PVD_PVM_IRQHandler().

`HAL_PWREx_PVM1Callback`

Function name

void HAL_PWREx_PVM1Callback (void)

Function description

PWR PVM1 interrupt callback.

Return values

- **None:**

`HAL_PWREx_PVM2Callback`

Function name

void HAL_PWREx_PVM2Callback (void)

Function description

PWR PVM2 interrupt callback.

Return values

- **None:**

`HAL_PWREx_PVM3Callback`

Function name

void HAL_PWREx_PVM3Callback (void)

Function description

PWR PVM3 interrupt callback.

Return values

- **None:**

`HAL_PWREx_PVM4Callback`

Function name

void HAL_PWREx_PVM4Callback (void)

Function description

PWR PVM4 interrupt callback.

Return values

- **None:**

55.3 PWREx Firmware driver defines

The following section lists the various define and macros of the module.

55.3.1 PWREx

PWREx

PWR Extended Exported Macros

__HAL_PWR_PVM1_EXTI_ENABLE_IT

Description:

- Enable the PVM1 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM1_EXTI_DISABLE_IT

Description:

- Disable the PVM1 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM1_EXTI_ENABLE_EVENT

Description:

- Enable the PVM1 Event Line.

Return value:

- None

__HAL_PWR_PVM1_EXTI_DISABLE_EVENT

Description:

- Disable the PVM1 Event Line.

Return value:

- None

__HAL_PWR_PVM1_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the PVM1 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM1_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the PVM1 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM1_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the PVM1 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM1_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the PVM1 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM1_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- PVM1 EXTI line configuration: set rising & falling edge trigger.

Return value:

- None

__HAL_PWR_PVM1_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the PVM1 Extended Interrupt Rising & Falling Trigger.

Return value:

- None

__HAL_PWR_PVM1_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on selected EXTI line.

Return value:

- None

__HAL_PWR_PVM1_EXTI_GET_FLAG

Description:

- Check whether the specified PVM1 EXTI interrupt flag is set or not.

Return value:

- EXTI: PVM1 Line Status.

__HAL_PWR_PVM1_EXTI_CLEAR_FLAG

Description:

- Clear the PVM1 EXTI flag.

Return value:

- None

__HAL_PWR_PVM2_EXTI_ENABLE_IT

Description:

- Enable the PVM2 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM2_EXTI_DISABLE_IT

Description:

- Disable the PVM2 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM2_EXTI_ENABLE_EVENT

Description:

- Enable the PVM2 Event Line.

Return value:

- None

__HAL_PWR_PVM2_EXTI_DISABLE_EVENT

Description:

- Disable the PVM2 Event Line.

Return value:

- None

__HAL_PWR_PVM2_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the PVM2 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM2_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the PVM2 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM2_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the PVM2 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM2_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the PVM2 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM2_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- PVM2 EXTI line configuration: set rising & falling edge trigger.

Return value:

- None

__HAL_PWR_PVM2_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the PVM2 Extended Interrupt Rising & Falling Trigger.

Return value:

- None

__HAL_PWR_PVM2_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on selected EXTI line.

Return value:

- None

__HAL_PWR_PVM2_EXTI_GET_FLAG

Description:

- Check whether the specified PVM2 EXTI interrupt flag is set or not.

Return value:

- EXTI: PVM2 Line Status.

__HAL_PWR_PVM2_EXTI_CLEAR_FLAG

Description:

- Clear the PVM2 EXTI flag.

Return value:

- None

__HAL_PWR_PVM3_EXTI_ENABLE_IT

Description:

- Enable the PVM3 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM3_EXTI_DISABLE_IT

Description:

- Disable the PVM3 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM3_EXTI_ENABLE_EVENT

Description:

- Enable the PVM3 Event Line.

Return value:

- None

__HAL_PWR_PVM3_EXTI_DISABLE_EVENT

Description:

- Disable the PVM3 Event Line.

Return value:

- None

__HAL_PWR_PVM3_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the PVM3 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM3_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the PVM3 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM3_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the PVM3 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM3_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the PVM3 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM3_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- PVM3 EXTI line configuration: set rising & falling edge trigger.

Return value:

- None

__HAL_PWR_PVM3_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the PVM3 Extended Interrupt Rising & Falling Trigger.

Return value:

- None

__HAL_PWR_PVM3_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on selected EXTI line.

Return value:

- None

__HAL_PWR_PVM3_EXTI_GET_FLAG

Description:

- Check whether the specified PVM3 EXTI interrupt flag is set or not.

Return value:

- EXTI: PVM3 Line Status.

__HAL_PWR_PVM3_EXTI_CLEAR_FLAG

Description:

- Clear the PVM3 EXTI flag.

Return value:

- None

__HAL_PWR_PVM4_EXTI_ENABLE_IT

Description:

- Enable the PVM4 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM4_EXTI_DISABLE_IT

Description:

- Disable the PVM4 Extended Interrupt Line.

Return value:

- None

__HAL_PWR_PVM4_EXTI_ENABLE_EVENT

Description:

- Enable the PVM4 Event Line.

Return value:

- None

__HAL_PWR_PVM4_EXTI_DISABLE_EVENT

Description:

- Disable the PVM4 Event Line.

Return value:

- None

__HAL_PWR_PVM4_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the PVM4 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM4_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the PVM4 Extended Interrupt Rising Trigger.

Return value:

- None

__HAL_PWR_PVM4_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the PVM4 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM4_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the PVM4 Extended Interrupt Falling Trigger.

Return value:

- None

__HAL_PWR_PVM4_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- PVM4 EXTI line configuration: set rising & falling edge trigger.

Return value:

- None

__HAL_PWR_PVM4_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the PVM4 Extended Interrupt Rising & Falling Trigger.

Return value:

- None

__HAL_PWR_PVM4_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on selected EXTI line.

Return value:

- None

__HAL_PWR_PVM4_EXTI_GET_FLAG

Description:

- Check whether or not the specified PVM4 EXTI interrupt flag is set.

Return value:

- EXTI: PVM4 Line Status.

__HAL_PWR_PVM4_EXTI_CLEAR_FLAG

Description:

- Clear the PVM4 EXTI flag.

Return value:

- None

__HAL_PWR_VOLTAGESCALING_CONFIG

Description:

- Configure the main internal regulator output voltage.

Parameters:

- __REGULATOR__: specifies the regulator output voltage to achieve a tradeoff between performance and power consumption. This parameter can be one of the following values:
  - PWR_REGULATOR_VOLTAGE_SCALE1 Regulator voltage output range 1 mode, typical output voltage at 1.2 V, system frequency up to 80 MHz.
  - PWR_REGULATOR_VOLTAGE_SCALE2 Regulator voltage output range 2 mode, typical output voltage at 1.0 V, system frequency up to 26 MHz.

Return value:

- None

Notes:

- This macro is similar to HAL_PWREx_ControlVoltageScaling() API but doesn't check whether or not VOSF flag is cleared when moving from range 2 to range 1. User may resort to __HAL_PWR_GET_FLAG() macro to check VOSF bit resetting.

PWR Status Flags

PWR_FLAG_WUF1

Wakeup event on wakeup pin 1

PWR_FLAG_WUF2

Wakeup event on wakeup pin 2

PWR_FLAG_WUF3

Wakeup event on wakeup pin 3

PWR_FLAG_WUF4

Wakeup event on wakeup pin 4

PWR_FLAG_WUF5

Wakeup event on wakeup pin 5

PWR_FLAG_WU

Encompass wakeup event on all wakeup pins

PWR_FLAG_SB

Standby flag

PWR_FLAG_WUFI

Wakeup on internal wakeup line

PWR_FLAG_REGLPS

Low-power regulator start flag

PWR_FLAG_REGLPF

Low-power regulator flag

PWR_FLAG_VOSF

Voltage scaling flag

PWR_FLAG_PVDO

Power Voltage Detector output flag

PWR_FLAG_PVMO1

Power Voltage Monitoring 1 output flag

PWR_FLAG_PVMO2

Power Voltage Monitoring 2 output flag

PWR_FLAG_PVMO3

Power Voltage Monitoring 3 output flag

PWR_FLAG_PVMO4

Power Voltage Monitoring 4 output flag

GPIO port

PWR_GPIO_A

GPIO port A

PWR_GPIO_B

GPIO port B

PWR_GPIO_C

GPIO port C

PWR_GPIO_D

GPIO port D

PWR_GPIO_E

GPIO port E

PWR_GPIO_F

GPIO port F

PWR_GPIO_G

GPIO port G

PWR_GPIO_H

GPIO port H

PWR_GPIO_I

GPIO port I

GPIO bit number for I/O setting in standby/shutdown mode

PWR_GPIO_BIT_0

GPIO port I/O pin 0

PWR_GPIO_BIT_1

GPIO port I/O pin 1

PWR_GPIO_BIT_2

GPIO port I/O pin 2

PWR_GPIO_BIT_3

GPIO port I/O pin 3

PWR_GPIO_BIT_4

GPIO port I/O pin 4

PWR_GPIO_BIT_5

GPIO port I/O pin 5

PWR_GPIO_BIT_6

GPIO port I/O pin 6

PWR_GPIO_BIT_7

GPIO port I/O pin 7

PWR_GPIO_BIT_8

GPIO port I/O pin 8

PWR_GPIO_BIT_9

GPIO port I/O pin 9

PWR_GPIO_BIT_10

GPIO port I/O pin 10

PWR_GPIO_BIT_11

GPIO port I/O pin 11

PWR_GPIO_BIT_12

GPIO port I/O pin 12

PWR_GPIO_BIT_13

GPIO port I/O pin 13

PWR_GPIO_BIT_14

GPIO port I/O pin 14

PWR_GPIO_BIT_15

GPIO port I/O pin 15

PWR PVM event lines

PWR_EVENT_LINE_PVM1

Event line 35 Connected to the PVM1 EXTI Line

PWR_EVENT_LINE_PVM2

Event line 36 Connected to the PVM2 EXTI Line

PWR_EVENT_LINE_PVM3

Event line 37 Connected to the PVM3 EXTI Line

PWR_EVENT_LINE_PVM4

Event line 38 Connected to the PVM4 EXTI Line

PWR PVM external interrupts lines

PWR_EXTI_LINE_PVM1

External interrupt line 35 Connected to the PVM1 EXTI Line

PWR_EXTI_LINE_PVM2

External interrupt line 36 Connected to the PVM2 EXTI Line

PWR_EXTI_LINE_PVM3

External interrupt line 37 Connected to the PVM3 EXTI Line

PWR_EXTI_LINE_PVM4

External interrupt line 38 Connected to the PVM4 EXTI Line

PWR PVM interrupt and event mode

PWR_PVM_MODE_NORMAL

basic mode is used

PWR_PVM_MODE_IT_RISING

External Interrupt Mode with Rising edge trigger detection

PWR_PVM_MODE_IT_FALLING

External Interrupt Mode with Falling edge trigger detection

PWR_PVM_MODE_IT_RISING_FALLING

External Interrupt Mode with Rising/Falling edge trigger detection

PWR_PVM_MODE_EVENT_RISING

Event Mode with Rising edge trigger detection

PWR_PVM_MODE_EVENT_FALLING

Event Mode with Falling edge trigger detection

PWR_PVM_MODE_EVENT_RISING_FALLING

Event Mode with Rising/Falling edge trigger detection

PWR PVM Mode Mask

PVM_MODE_IT

Mask for interruption yielded by PVM threshold crossing

PVM_MODE_EVT

Mask for event yielded by PVM threshold crossing

PVM_RISING_EDGE

Mask for rising edge set as PVM trigger

PVM_FALLING_EDGE

Mask for falling edge set as PVM trigger

Peripheral Voltage Monitoring type

PWR_PVM_1

Peripheral Voltage Monitoring 1 enable: VDDUSB versus 1.2 V (applicable when USB feature is supported)

PWR_PVM_2

Peripheral Voltage Monitoring 2 enable: VDDIO2 versus 0.9 V (applicable when VDDIO2 is present on device)

PWR_PVM_3

Peripheral Voltage Monitoring 3 enable: VDDA versus 1.62 V

PWR_PVM_4

Peripheral Voltage Monitoring 4 enable: VDDA versus 2.2 V

PWR Regulator voltage scale

PWR_REGULATOR_VOLTAGE_SCALE1_BOOST

Voltage scaling range 1 boost mode

PWR_REGULATOR_VOLTAGE_SCALE1

Voltage scaling range 1 normal mode

PWR_REGULATOR_VOLTAGE_SCALE2

Voltage scaling range 2

PWR SRAM2 Retention in Standby mode

PWR_NO_SRAM2_RETENTION

SRAM2 is powered off in Standby mode (SRAM2 content is lost)

PWR_FULL_SRAM2_RETENTION

Full SRAM2 is powered by the low-power regulator in Standby mode

PWR Extended Flag Setting Time Out Value

PWR_FLAG_SETTING_DELAY_US

Time out value for REGLPF and VOSF flags setting

PWR battery charging

PWR_BATTERY_CHARGING_DISABLE

PWR_BATTERY_CHARGING_ENABLE

PWR battery charging resistor selection

PWR_BATTERY_CHARGING_RESISTOR_5

VBAT charging through a 5 kOhms resistor

PWR_BATTERY_CHARGING_RESISTOR_1_5

VBAT charging through a 1.5 kOhms resistor

PWR wake-up pins

PWR_WAKEUP_PIN1

Wakeup pin 1 (with high level polarity)

PWR_WAKEUP_PIN2

Wakeup pin 2 (with high level polarity)

PWR_WAKEUP_PIN3

Wakeup pin 3 (with high level polarity)

PWR_WAKEUP_PIN4

Wakeup pin 4 (with high level polarity)

PWR_WAKEUP_PIN5

Wakeup pin 5 (with high level polarity)

PWR_WAKEUP_PIN1_HIGH

Wakeup pin 1 (with high level polarity)

PWR_WAKEUP_PIN2_HIGH

Wakeup pin 2 (with high level polarity)

PWR_WAKEUP_PIN3_HIGH

Wakeup pin 3 (with high level polarity)

PWR_WAKEUP_PIN4_HIGH

Wakeup pin 4 (with high level polarity)

PWR_WAKEUP_PIN5_HIGH

Wakeup pin 5 (with high level polarity)

PWR_WAKEUP_PIN1_LOW

Wakeup pin 1 (with low level polarity)

PWR_WAKEUP_PIN2_LOW

Wakeup pin 2 (with low level polarity)

PWR_WAKEUP_PIN3_LOW

Wakeup pin 3 (with low level polarity)

PWR_WAKEUP_PIN4_LOW

Wakeup pin 4 (with low level polarity)

PWR_WAKEUP_PIN5_LOW

Wakeup pin 5 (with low level polarity)

Shift to apply to retrieve polarity information from PWR_WAKEUP_PINy_xxx constants

PWR_WUP_POLARITY_SHIFT

Internal constant used to retrieve wakeup pin polariry

56 HAL QSPI Generic Driver

56.1 QSPI Firmware driver registers structures

56.1.1 QSPI_InitTypeDef

QSPI_InitTypeDef is defined in the stm32l4xx_hal_qspi.h

Data Fields

- ***uint32_t ClockPrescaler***
- ***uint32_t FifoThreshold***
- ***uint32_t SampleShifting***
- ***uint32_t FlashSize***
- ***uint32_t ChipSelectHighTime***
- ***uint32_t ClockMode***
- ***uint32_t FlashID***
- ***uint32_t DualFlash***

Field Documentation

- ***uint32_t QSPI_InitTypeDef::ClockPrescaler***
- ***uint32_t QSPI_InitTypeDef::FifoThreshold***
- ***uint32_t QSPI_InitTypeDef::SampleShifting***
- ***uint32_t QSPI_InitTypeDef::FlashSize***
- ***uint32_t QSPI_InitTypeDef::ChipSelectHighTime***
- ***uint32_t QSPI_InitTypeDef::ClockMode***
- ***uint32_t QSPI_InitTypeDef::FlashID***
- ***uint32_t QSPI_InitTypeDef::DualFlash***

56.1.2 QSPI_HandleTypeDef

QSPI_HandleTypeDef is defined in the stm32l4xx_hal_qspi.h

Data Fields

- ***QUADSPI_TypeDef * Instance***
- ***QSPI_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***__IO uint32_t TxXferSize***
- ***__IO uint32_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***__IO uint32_t RxXferSize***
- ***__IO uint32_t RxXferCount***
- ***DMA_HandleTypeDef * hdma***
- ***__IO HAL_LockTypeDef Lock***
- ***__IO HAL_QSPI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***uint32_t Timeout***

Field Documentation

- ***QUADSPI_TypeDef* QSPI_HandleTypeDef::Instance***
- ***QSPI_InitTypeDef QSPI_HandleTypeDef::Init***
- ***uint8_t* QSPI_HandleTypeDef::pTxBuffPtr***

- *__IO uint32_t QSPI_HandleTypeDef::TxXferSize*
- *__IO uint32_t QSPI_HandleTypeDef::TxXferCount*
- *uint8_t* QSPI_HandleTypeDef::pRxBuffPtr*
- *__IO uint32_t QSPI_HandleTypeDef::RxXferSize*
- *__IO uint32_t QSPI_HandleTypeDef::RxXferCount*
- *DMA_HandleTypeDef* QSPI_HandleTypeDef::hdma*
- *__IO HAL_LockTypeDef QSPI_HandleTypeDef::Lock*
- *__IO HAL_QSPI_StateTypeDef QSPI_HandleTypeDef::State*
- *__IO uint32_t QSPI_HandleTypeDef::ErrorCode*
- *uint32_t QSPI_HandleTypeDef::Timeout*

56.1.3 QSPI_CommandTypeDef

QSPI_CommandTypeDef is defined in the stm32l4xx_hal_qspi.h

Data Fields

- *uint32_t Instruction*
- *uint32_t Address*
- *uint32_t AlternateBytes*
- *uint32_t AddressSize*
- *uint32_t AlternateBytesSize*
- *uint32_t DummyCycles*
- *uint32_t InstructionMode*
- *uint32_t AddressMode*
- *uint32_t AlternateByteMode*
- *uint32_t DataMode*
- *uint32_t NbData*
- *uint32_t DdrMode*
- *uint32_t DdrHoldHalfCycle*
- *uint32_t SIOOMode*

Field Documentation

- *uint32_t QSPI_CommandTypeDef::Instruction*
- *uint32_t QSPI_CommandTypeDef::Address*
- *uint32_t QSPI_CommandTypeDef::AlternateBytes*
- *uint32_t QSPI_CommandTypeDef::AddressSize*
- *uint32_t QSPI_CommandTypeDef::AlternateBytesSize*
- *uint32_t QSPI_CommandTypeDef::DummyCycles*
- *uint32_t QSPI_CommandTypeDef::InstructionMode*
- *uint32_t QSPI_CommandTypeDef::AddressMode*
- *uint32_t QSPI_CommandTypeDef::AlternateByteMode*
- *uint32_t QSPI_CommandTypeDef::DataMode*
- *uint32_t QSPI_CommandTypeDef::NbData*
- *uint32_t QSPI_CommandTypeDef::DdrMode*
- *uint32_t QSPI_CommandTypeDef::DdrHoldHalfCycle*
- *uint32_t QSPI_CommandTypeDef::SIOOMode*

56.1.4 QSPI_AutoPollingTypeDef

QSPI_AutoPollingTypeDef is defined in the stm32l4xx_hal_qspi.h

Data Fields

- ***uint32_t Match***
- ***uint32_t Mask***
- ***uint32_t Interval***
- ***uint32_t StatusBytesSize***
- ***uint32_t MatchMode***
- ***uint32_t AutomaticStop***

Field Documentation

- ***uint32_t QSPI_AutoPollingTypeDef::Match***
- ***uint32_t QSPI_AutoPollingTypeDef::Mask***
- ***uint32_t QSPI_AutoPollingTypeDef::Interval***
- ***uint32_t QSPI_AutoPollingTypeDef::StatusBytesSize***
- ***uint32_t QSPI_AutoPollingTypeDef::MatchMode***
- ***uint32_t QSPI_AutoPollingTypeDef::AutomaticStop***

56.1.5 QSPI_MemoryMappedTypeDef

QSPI_MemoryMappedTypeDef is defined in the stm32l4xx_hal_qspi.h

Data Fields

- ***uint32_t TimeOutPeriod***
- ***uint32_t TimeOutActivation***

Field Documentation

- ***uint32_t QSPI_MemoryMappedTypeDef::TimeOutPeriod***
- ***uint32_t QSPI_MemoryMappedTypeDef::TimeOutActivation***

56.2 QSPI Firmware driver API description

The following section lists the various functions of the QSPI library.

56.2.1 How to use this driver

Initialization

1. As prerequisite, fill in the HAL_QSPI_MspInit() :
   - Enable QuadSPI clock interface with __HAL_RCC_QSPI_CLK_ENABLE().
   - Reset QuadSPI IP with __HAL_RCC_QSPI_FORCE_RESET() and __HAL_RCC_QSPI_RELEASE_RESET().
   - Enable the clocks for the QuadSPI GPIOS with __HAL_RCC_GPIOx_CLK_ENABLE().
   - Configure these QuadSPI pins in alternate mode using HAL_GPIO_Init().
   - If interrupt mode is used, enable and configure QuadSPI global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
   - If DMA mode is used, enable the clocks for the QuadSPI DMA channel with __HAL_RCC_DMAx_CLK_ENABLE(), configure DMA with HAL_DMA_Init(), link it with QuadSPI handle using __HAL_LINKDMA(), enable and configure DMA channel global interrupt with HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ().
2. Configure the flash size, the clock prescaler, the fifo threshold, the clock mode, the sample shifting and the CS high time using the HAL_QSPI_Init() function.

Indirect functional mode

1. Configure the command sequence using the HAL_QSPI_Command() or HAL_QSPI_Command_IT() functions :
   - Instruction phase : the mode used and if present the instruction opcode.
   - Address phase : the mode used and if present the size and the address value.
   - Alternate-bytes phase : the mode used and if present the size and the alternate bytes values.
   - Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
   - Data phase : the mode used and if present the number of bytes.
   - Double Data Rate (DDR) mode : the activation (or not) of this mode and the delay if activated.
   - Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
2. If no data is required for the command, it is sent directly to the memory :
   - In polling mode, the output of the function is done when the transfer is complete.
   - In interrupt mode, HAL_QSPI_CmdCpltCallback() will be called when the transfer is complete.
3. For the indirect write mode, use HAL_QSPI_Transmit(), HAL_QSPI_Transmit_DMA() or HAL_QSPI_Transmit_IT() after the command configuration :
   - In polling mode, the output of the function is done when the transfer is complete.
   - In interrupt mode, HAL_QSPI_FifoThresholdCallback() will be called when the fifo threshold is reached and HAL_QSPI_TxCpltCallback() will be called when the transfer is complete.
   - In DMA mode, HAL_QSPI_TxHalfCpltCallback() will be called at the half transfer and HAL_QSPI_TxCpltCallback() will be called when the transfer is complete.
4. For the indirect read mode, use HAL_QSPI_Receive(), HAL_QSPI_Receive_DMA() or HAL_QSPI_Receive_IT() after the command configuration :
   - In polling mode, the output of the function is done when the transfer is complete.
   - In interrupt mode, HAL_QSPI_FifoThresholdCallback() will be called when the fifo threshold is reached and HAL_QSPI_RxCpltCallback() will be called when the transfer is complete.
   - In DMA mode, HAL_QSPI_RxHalfCpltCallback() will be called at the half transfer and HAL_QSPI_RxCpltCallback() will be called when the transfer is complete.

Auto-polling functional mode

1. Configure the command sequence and the auto-polling functional mode using the HAL_QSPI_AutoPolling() or HAL_QSPI_AutoPolling_IT() functions :
   - Instruction phase : the mode used and if present the instruction opcode.
   - Address phase : the mode used and if present the size and the address value.
   - Alternate-bytes phase : the mode used and if present the size and the alternate bytes values.
   - Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
   - Data phase : the mode used.
   - Double Data Rate (DDR) mode : the activation (or not) of this mode and the delay if activated.
   - Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
   - The size of the status bytes, the match value, the mask used, the match mode (OR/AND), the polling interval and the automatic stop activation.
2. After the configuration :
   - In polling mode, the output of the function is done when the status match is reached. The automatic stop is activated to avoid an infinite loop.
   - In interrupt mode, HAL_QSPI_StatusMatchCallback() will be called each time the status match is reached.

Memory-mapped functional mode

1. Configure the command sequence and the memory-mapped functional mode using the HAL_QSPI_MemoryMapped() functions :
   – Instruction phase : the mode used and if present the instruction opcode.
   – Address phase : the mode used and the size.
   – Alternate-bytes phase : the mode used and if present the size and the alternate bytes values.
   – Dummy-cycles phase : the number of dummy cycles (mode used is same as data phase).
   – Data phase : the mode used.
   – Double Data Rate (DDR) mode : the activation (or not) of this mode and the delay if activated.
   – Sending Instruction Only Once (SIOO) mode : the activation (or not) of this mode.
   – The timeout activation and the timeout period.
2. After the configuration, the QuadSPI will be used as soon as an access on the AHB is done on the address range. HAL_QSPI_TimeOutCallback() will be called when the timeout expires.

Errors management and abort functionality

1. HAL_QSPI_GetError() function gives the error raised during the last operation.
2. HAL_QSPI_Abort() and HAL_QSPI_AbortIT() functions aborts any on-going operation and flushes the fifo :
   – In polling mode, the output of the function is done when the transfer complete bit is set and the busy bit cleared.
   – In interrupt mode, HAL_QSPI_AbortCpltCallback() will be called when the transfer complete bi is set.

Control functions

1. HAL_QSPI_GetState() function gives the current state of the HAL QuadSPI driver.
2. HAL_QSPI_SetTimeout() function configures the timeout value used in the driver.
3. HAL_QSPI_SetFifoThreshold() function configures the threshold on the Fifo of the QSPI IP.
4. HAL_QSPI_GetFifoThreshold() function gives the current of the Fifo's threshold

Workarounds linked to Silicon Limitation

1. Workarounds Implemented inside HAL Driver
   – Extra data written in the FIFO at the end of a read transfer

56.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to :

- Initialize the QuadSPI.
- De-initialize the QuadSPI.

This section contains the following APIs:

- ***HAL_QSPI_Init***
- ***HAL_QSPI_DeInit***
- ***HAL_QSPI_MspInit***
- ***HAL_QSPI_MspDeInit***

56.2.3 IO operation functions

This subsection provides a set of functions allowing to :

- Handle the interrupts.
- Handle the command sequence.
- Transmit data in blocking, interrupt or DMA mode.
- Receive data in blocking, interrupt or DMA mode.
- Manage the auto-polling functional mode.
- Manage the memory-mapped functional mode.

This section contains the following APIs:

- *HAL_QSPI_IRQHandler*
- *HAL_QSPI_Command*
- *HAL_QSPI_Command_IT*
- *HAL_QSPI_Transmit*
- *HAL_QSPI_Receive*
- *HAL_QSPI_Transmit_IT*
- *HAL_QSPI_Receive_IT*
- *HAL_QSPI_Transmit_DMA*
- *HAL_QSPI_Receive_DMA*
- *HAL_QSPI_AutoPolling*
- *HAL_QSPI_AutoPolling_IT*
- *HAL_QSPI_MemoryMapped*
- *HAL_QSPI_ErrorCallback*
- *HAL_QSPI_AbortCpltCallback*
- *HAL_QSPI_CmdCpltCallback*
- *HAL_QSPI_RxCpltCallback*
- *HAL_QSPI_TxCpltCallback*
- *HAL_QSPI_RxHalfCpltCallback*
- *HAL_QSPI_TxHalfCpltCallback*
- *HAL_QSPI_FifoThresholdCallback*
- *HAL_QSPI_StatusMatchCallback*
- *HAL_QSPI_TimeOutCallback*

56.2.4 Peripheral Control and State functions

This subsection provides a set of functions allowing to :

- Check in run-time the state of the driver.
- Check the error code set during last operation.
- Abort any operation.

This section contains the following APIs:

- *HAL_QSPI_GetState*
- *HAL_QSPI_GetError*
- *HAL_QSPI_Abort*
- *HAL_QSPI_Abort_IT*
- *HAL_QSPI_SetTimeout*
- *HAL_QSPI_SetFifoThreshold*
- *HAL_QSPI_GetFifoThreshold*

56.2.5 Detailed description of functions

`HAL_QSPI_Init`

Function name **HAL_StatusTypeDef HAL_QSPI_Init (QSPI_HandleTypeDef * hqspi)**

Function description Initialize the QSPI mode according to the specified parameters in the QSPI_InitTypeDef and initialize the associated handle.

Parameters

- **hqspi:** QSPI handle

Return values
- **HAL:** status

`HAL_QSPI_DeInit`

Function name **HAL_StatusTypeDef HAL_QSPI_DeInit (QSPI_HandleTypeDef * hqspi)**

Function description De-Initialize the QSPI peripheral.

Parameters
- **hqspi:** QSPI handle

Return values
- **HAL:** status

`HAL_QSPI_MspInit`

Function name **void HAL_QSPI_MspInit (QSPI_HandleTypeDef * hqspi)**

Function description Initialize the QSPI MSP.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_MspDeInit`

Function name **void HAL_QSPI_MspDeInit (QSPI_HandleTypeDef * hqspi)**

Function description DeInitialize the QSPI MSP.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_IRQHandler`

Function name **void HAL_QSPI_IRQHandler (QSPI_HandleTypeDef * hqspi)**

Function description Handle QSPI interrupt request.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_Command`

Function name **HAL_StatusTypeDef HAL_QSPI_Command (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, uint32_t Timeout)**

Function description Set the command configuration.

Parameters
- **hqspi:** QSPI handle
- **cmd:** : structure that contains the command configuration information
- **Timeout:** : Timeout duration

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Read or Write Modes

`HAL_QSPI_Transmit`

Function name **HAL_StatusTypeDef HAL_QSPI_Transmit (QSPI_HandleTypeDef * hqspi, uint8_t * pData, uint32_t Timeout)**

Function description Transmit an amount of data in blocking mode.

Parameters
- **hqspi:** QSPI handle
- **pData:** pointer to data buffer
- **Timeout:** : Timeout duration

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Write Mode

`HAL_QSPI_Receive`

Function name **HAL_StatusTypeDef HAL_QSPI_Receive (QSPI_HandleTypeDef * hqspi, uint8_t * pData, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

Parameters
- **hqspi:** QSPI handle
- **pData:** pointer to data buffer
- **Timeout:** : Timeout duration

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Read Mode

`HAL_QSPI_Command_IT`

Function name **HAL_StatusTypeDef HAL_QSPI_Command_IT (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd)**

Function description Set the command configuration in interrupt mode.

Parameters
- **hqspi:** QSPI handle
- **cmd:** : structure that contains the command configuration information

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Read or Write Modes

`HAL_QSPI_Transmit_IT`

Function name **HAL_StatusTypeDef HAL_QSPI_Transmit_IT (QSPI_HandleTypeDef * hqspi, uint8_t * pData)**

Function description Send an amount of data in non-blocking mode with interrupt.

Parameters
- **hqspi:** QSPI handle
- **pData:** pointer to data buffer

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Write Mode

`HAL_QSPI_Receive_IT`

Function name **HAL_StatusTypeDef HAL_QSPI_Receive_IT (QSPI_HandleTypeDef * hqspi, uint8_t * pData)**

Function description Receive an amount of data in non-blocking mode with interrupt.

Parameters
- **hqspi:** QSPI handle
- **pData:** pointer to data buffer

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Read Mode

`HAL_QSPI_Transmit_DMA`

Function name **HAL_StatusTypeDef HAL_QSPI_Transmit_DMA (QSPI_HandleTypeDef * hqspi, uint8_t * pData)**

Function description Send an amount of data in non-blocking mode with DMA.

Parameters
- **hqspi:** QSPI handle
- **pData:** pointer to data buffer

Return values
- **HAL:** status

Notes
- This function is used only in Indirect Write Mode
- If DMA peripheral access is configured as halfword, the number of data and the fifo threshold should be aligned on halfword
- If DMA peripheral access is configured as word, the number of data and the fifo threshold should be aligned on word

`HAL_QSPI_Receive_DMA`

Function name **HAL_StatusTypeDef HAL_QSPI_Receive_DMA (QSPI_HandleTypeDef * hqspi, uint8_t * pData)**

Function description Receive an amount of data in non-blocking mode with DMA.

Parameters
- **hqspi:** QSPI handle
- **pData:** pointer to data buffer.

Return values
- **HAL:** status

Notes

- This function is used only in Indirect Read Mode
- If DMA peripheral access is configured as halfword, the number of data and the fifo threshold should be aligned on halfword
- If DMA peripheral access is configured as word, the number of data and the fifo threshold should be aligned on word

`HAL_QSPI_AutoPolling`

Function name **HAL_StatusTypeDef HAL_QSPI_AutoPolling (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, QSPI_AutoPollingTypeDef * cfg, uint32_t Timeout)**

Function description Configure the QSPI Automatic Polling Mode in blocking mode.

Parameters

- **hqspi:** QSPI handle
- **cmd:** structure that contains the command configuration information.
- **cfg:** structure that contains the polling configuration information.
- **Timeout:** : Timeout duration

Return values

- **HAL:** status

Notes

- This function is used only in Automatic Polling Mode

`HAL_QSPI_AutoPolling_IT`

Function name **HAL_StatusTypeDef HAL_QSPI_AutoPolling_IT (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, QSPI_AutoPollingTypeDef * cfg)**

Function description Configure the QSPI Automatic Polling Mode in non-blocking mode.

Parameters

- **hqspi:** QSPI handle
- **cmd:** structure that contains the command configuration information.
- **cfg:** structure that contains the polling configuration information.

Return values

- **HAL:** status

Notes

- This function is used only in Automatic Polling Mode

`HAL_QSPI_MemoryMapped`

Function name **HAL_StatusTypeDef HAL_QSPI_MemoryMapped (QSPI_HandleTypeDef * hqspi, QSPI_CommandTypeDef * cmd, QSPI_MemoryMappedTypeDef * cfg)**

Function description Configure the Memory Mapped mode.

Parameters

- **hqspi:** QSPI handle
- **cmd:** structure that contains the command configuration information.
- **cfg:** structure that contains the memory mapped configuration information.

Return values

- **HAL:** status

Notes

- This function is used only in Memory mapped Mode

`HAL_QSPI_ErrorCallback`

Function name **void HAL_QSPI_ErrorCallback (QSPI_HandleTypeDef * hqspi)**

Function description Transfer Error callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_AbortCpltCallback`

Function name **void HAL_QSPI_AbortCpltCallback (QSPI_HandleTypeDef * hqspi)**

Function description Abort completed callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_FifoThresholdCallback`

Function name **void HAL_QSPI_FifoThresholdCallback (QSPI_HandleTypeDef * hqspi)**

Function description FIFO Threshold callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_CmdCpltCallback`

Function name **void HAL_QSPI_CmdCpltCallback (QSPI_HandleTypeDef * hqspi)**

Function description Command completed callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_RxCpltCallback`

Function name **void HAL_QSPI_RxCpltCallback (QSPI_HandleTypeDef * hqspi)**

Function description Rx Transfer completed callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_TxCpltCallback`

Function name **void HAL_QSPI_TxCpltCallback (QSPI_HandleTypeDef * hqspi)**

Function description Tx Transfer completed callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_RxHalfCpltCallback`

Function name **void HAL_QSPI_RxHalfCpltCallback (QSPI_HandleTypeDef * hqspi)**

Function description Rx Half Transfer completed callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_TxHalfCpltCallback`

Function name **void HAL_QSPI_TxHalfCpltCallback (QSPI_HandleTypeDef * hqspi)**

Function description Tx Half Transfer completed callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_StatusMatchCallback`

Function name **void HAL_QSPI_StatusMatchCallback (QSPI_HandleTypeDef * hqspi)**

Function description Status Match callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

`HAL_QSPI_TimeOutCallback`

Function name **void HAL_QSPI_TimeOutCallback (QSPI_HandleTypeDef * hqspi)**

Function description Timeout callback.

Parameters
- **hqspi:** QSPI handle

Return values
- **None:**

HAL_QSPI_GetState

Function name **HAL_QSPI_StateTypeDef HAL_QSPI_GetState (QSPI_HandleTypeDef * hqspi)**

Function description Return the QSPI handle state.

Parameters
- **hqspi:** QSPI handle

Return values
- **HAL:** state

HAL_QSPI_GetError

Function name **uint32_t HAL_QSPI_GetError (QSPI_HandleTypeDef * hqspi)**

Function description Return the QSPI error code.

Parameters
- **hqspi:** QSPI handle

Return values
- **QSPI:** Error Code

HAL_QSPI_Abort

Function name **HAL_StatusTypeDef HAL_QSPI_Abort (QSPI_HandleTypeDef * hqspi)**

Function description Abort the current transmission.

Parameters
- **hqspi:** QSPI handle

Return values
- **HAL:** status

HAL_QSPI_Abort_IT

Function name **HAL_StatusTypeDef HAL_QSPI_Abort_IT (QSPI_HandleTypeDef * hqspi)**

Function description Abort the current transmission (non-blocking function)

Parameters
- **hqspi:** QSPI handle

Return values
- **HAL:** status

HAL_QSPI_SetTimeout

Function name **void HAL_QSPI_SetTimeout (QSPI_HandleTypeDef * hqspi, uint32_t Timeout)**

Function description Set QSPI timeout.

Parameters
- **hqspi:** QSPI handle.
- **Timeout:** Timeout for the QSPI memory access.

Return values
- **None:**

`HAL_QSPI_SetFifoThreshold`

Function name **HAL_StatusTypeDef HAL_QSPI_SetFifoThreshold (QSPI_HandleTypeDef * hqspi, uint32_t Threshold)**

Function description Set QSPI Fifo threshold.

Parameters
- **hqspi:** QSPI handle.
- **Threshold:** Threshold of the Fifo (value between 1 and 16).

Return values
- **HAL:** status

`HAL_QSPI_GetFifoThreshold`

Function name **uint32_t HAL_QSPI_GetFifoThreshold (QSPI_HandleTypeDef * hqspi)**

Function description Get QSPI Fifo threshold.

Parameters
- **hqspi:** QSPI handle.

Return values
- **Fifo:** threshold (value between 1 and 16)

56.3 QSPI Firmware driver defines

The following section lists the various define and macros of the module.

56.3.1 QSPI

QSPI

QSPI Address Mode

QSPI_ADDRESS_NONE No address

QSPI_ADDRESS_1_LINE Address on a single line

QSPI_ADDRESS_2_LINES Address on two lines

QSPI_ADDRESS_4_LINES Address on four lines

QSPI Address Size

QSPI_ADDRESS_8_BITS 8-bit address

QSPI_ADDRESS_16_BITS 16-bit address

QSPI_ADDRESS_24_BITS 24-bit address

QSPI_ADDRESS_32_BITS 32-bit address

QSPI Alternate Bytes Mode

QSPI_ALTERNATE_BYTES_NONE No alternate bytes

QSPI_ALTERNATE_BYTES_1_LINE Alternate bytes on a single line

QSPI_ALTERNATE_BYTES_2_LINES Alternate bytes on two lines

QSPI_ALTERNATE_BYTES_4_LINES Alternate bytes on four lines

QSPI Alternate Bytes Size

QSPI_ALTERNATE_BYTES_8_BITS 8-bit alternate bytes

QSPI_ALTERNATE_BYTES_16_BITS 16-bit alternate bytes

QSPI_ALTERNATE_BYTES_24_BITS 24-bit alternate bytes

QSPI_ALTERNATE_BYTES_32_BITS 32-bit alternate bytes

QSPI Automatic Stop

QSPI_AUTOMATIC_STOP_DISABLE AutoPolling stops only with abort or QSPI disabling

QSPI_AUTOMATIC_STOP_ENABLE AutoPolling stops as soon as there is a match

QSPI ChipSelect High Time

QSPI_CS_HIGH_TIME_1_CYCLE nCS stay high for at least 1 clock cycle between commands

QSPI_CS_HIGH_TIME_2_CYCLE nCS stay high for at least 2 clock cycles between commands

QSPI_CS_HIGH_TIME_3_CYCLE nCS stay high for at least 3 clock cycles between commands

QSPI_CS_HIGH_TIME_4_CYCLE nCS stay high for at least 4 clock cycles between commands

QSPI_CS_HIGH_TIME_5_CYCLE nCS stay high for at least 5 clock cycles between commands

QSPI_CS_HIGH_TIME_6_CYCLE nCS stay high for at least 6 clock cycles between commands

QSPI_CS_HIGH_TIME_7_CYCLE nCS stay high for at least 7 clock cycles between commands

QSPI_CS_HIGH_TIME_8_CYCLE	nCS stay high for at least 8 clock cycles between commands

QSPI Clock Mode

QSPI_CLOCK_MODE_0	Clk stays low while nCS is released
QSPI_CLOCK_MODE_3	Clk goes high while nCS is released

QSPI Data Mode

QSPI_DATA_NONE	No data
QSPI_DATA_1_LINE	Data on a single line
QSPI_DATA_2_LINES	Data on two lines
QSPI_DATA_4_LINES	Data on four lines

QSPI DDR Data Output Delay

QSPI_DDR_HHC_ANALOG_DELAY	Delay the data output using analog delay in DDR mode
QSPI_DDR_HHC_HALF_CLK_DELAY	Delay the data output by 1/2 clock cycle in DDR mode

QSPI DDR Mode

QSPI_DDR_MODE_DISABLE	Double data rate mode disabled
QSPI_DDR_MODE_ENABLE	Double data rate mode enabled

QSPI Dual Flash Mode

QSPI_DUALFLASH_ENABLE	Dual-flash mode enabled
QSPI_DUALFLASH_DISABLE	Dual-flash mode disabled

QSPI Error Code

HAL_QSPI_ERROR_NONE	No error
HAL_QSPI_ERROR_TIMEOUT	Timeout error
HAL_QSPI_ERROR_TRANSFER	Transfer error
HAL_QSPI_ERROR_DMA	DMA transfer error

HAL_QSPI_ERROR_INVALID_PARAM Invalid parameters error

QSPI Exported Macros

__HAL_QSPI_RESET_HANDLE_STATE

Description:
- Reset QSPI handle state.

Parameters:
- __HANDLE__: QSPI handle.

Return value:
- None

__HAL_QSPI_ENABLE

Description:
- Enable the QSPI peripheral.

Parameters:
- __HANDLE__: specifies the QSPI Handle.

Return value:
- None

__HAL_QSPI_DISABLE

Description:
- Disable the QSPI peripheral.

Parameters:
- __HANDLE__: specifies the QSPI Handle.

Return value:
- None

__HAL_QSPI_ENABLE_IT

Description:
- Enable the specified QSPI interrupt.

Parameters:
- __HANDLE__: specifies the QSPI Handle.
- __INTERRUPT__: specifies the QSPI interrupt source to enable. This parameter can be one of the following values:
  - QSPI_IT_TO: QSPI Timeout interrupt
  - QSPI_IT_SM: QSPI Status match interrupt
  - QSPI_IT_FT: QSPI FIFO threshold interrupt
  - QSPI_IT_TC: QSPI Transfer complete interrupt
  - QSPI_IT_TE: QSPI Transfer error interrupt

Return value:
- None

__HAL_QSPI_DISABLE_IT

Description:

- Disable the specified QSPI interrupt.

Parameters:

- __HANDLE__: specifies the QSPI Handle.
- __INTERRUPT__: specifies the QSPI interrupt source to disable. This parameter can be one of the following values:
  - QSPI_IT_TO: QSPI Timeout interrupt
  - QSPI_IT_SM: QSPI Status match interrupt
  - QSPI_IT_FT: QSPI FIFO threshold interrupt
  - QSPI_IT_TC: QSPI Transfer complete interrupt
  - QSPI_IT_TE: QSPI Transfer error interrupt

Return value:

- None

__HAL_QSPI_GET_IT_SOURCE

Description:

- Check whether the specified QSPI interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the QSPI Handle.
- __INTERRUPT__: specifies the QSPI interrupt source to check. This parameter can be one of the following values:
  - QSPI_IT_TO: QSPI Timeout interrupt
  - QSPI_IT_SM: QSPI Status match interrupt
  - QSPI_IT_FT: QSPI FIFO threshold interrupt
  - QSPI_IT_TC: QSPI Transfer complete interrupt
  - QSPI_IT_TE: QSPI Transfer error interrupt

Return value:

- The: new state of __INTERRUPT__ (TRUE or FALSE).

__HAL_QSPI_GET_FLAG

Description:

- Check whether the selected QSPI flag is set or not.

Parameters:

- __HANDLE__: specifies the QSPI Handle.
- __FLAG__: specifies the QSPI flag to check. This parameter can be one of the following values:
  - QSPI_FLAG_BUSY: QSPI Busy flag
  - QSPI_FLAG_TO: QSPI Timeout flag
  - QSPI_FLAG_SM: QSPI Status match flag
  - QSPI_FLAG_FT: QSPI FIFO threshold flag
  - QSPI_FLAG_TC: QSPI Transfer complete flag
  - QSPI_FLAG_TE: QSPI Transfer error flag

Return value:

- None

__HAL_QSPI_CLEAR_FLAG

Description:

- Clears the specified QSPI's flag status.

Parameters:

- __HANDLE__: specifies the QSPI Handle.
- __FLAG__: specifies the QSPI clear register flag that needs to be set This parameter can be one of the following values:
  - QSPI_FLAG_TO: QSPI Timeout flag
  - QSPI_FLAG_SM: QSPI Status match flag
  - QSPI_FLAG_TC: QSPI Transfer complete flag
  - QSPI_FLAG_TE: QSPI Transfer error flag

Return value:

- None

QSPI Flags

QSPI_FLAG_BUSY	Busy flag: operation is ongoing
QSPI_FLAG_TO	Timeout flag: timeout occurs in memory-mapped mode
QSPI_FLAG_SM	Status match flag: received data matches in autopolling mode
QSPI_FLAG_FT	Fifo threshold flag: Fifo threshold reached or data left after read from memory is complete
QSPI_FLAG_TC	Transfer complete flag: programmed number of data have been transferred or the transfer has been aborted
QSPI_FLAG_TE	Transfer error flag: invalid address is being accessed

QSPI Flash Select

QSPI_FLASH_ID_1	FLASH 1 selected
QSPI_FLASH_ID_2	FLASH 2 selected

QSPI Instruction Mode

QSPI_INSTRUCTION_NONE	No instruction
QSPI_INSTRUCTION_1_LINE	Instruction on a single line
QSPI_INSTRUCTION_2_LINES	Instruction on two lines
QSPI_INSTRUCTION_4_LINES	Instruction on four lines

QSPI Interrupts

QSPI_IT_TO	Interrupt on the timeout flag

QSPI_IT_SM	Interrupt on the status match flag
QSPI_IT_FT	Interrupt on the fifo threshold flag
QSPI_IT_TC	Interrupt on the transfer complete flag
QSPI_IT_TE	Interrupt on the transfer error flag

QSPI Match Mode

QSPI_MATCH_MODE_AND	AND match mode between unmasked bits
QSPI_MATCH_MODE_OR	OR match mode between unmasked bits

QSPI Sample Shifting

QSPI_SAMPLE_SHIFTING_NONE	No clock cycle shift to sample data
QSPI_SAMPLE_SHIFTING_HALFCYCLE	1/2 clock cycle shift to sample data

QSPI Send Instruction Mode

QSPI_SIOO_INST_EVERY_CMD	Send instruction on every transaction
QSPI_SIOO_INST_ONLY_FIRST_CMD	Send instruction only for the first command

QSPI Timeout Activation

QSPI_TIMEOUT_COUNTER_DISABLE	Timeout counter disabled, nCS remains active
QSPI_TIMEOUT_COUNTER_ENABLE	Timeout counter enabled, nCS released when timeout expires

QSPI Timeout definition

HAL_QPSI_TIMEOUT_DEFAULT_VALUE

57 HAL RCC Generic Driver

57.1 RCC Firmware driver registers structures

57.1.1 RCC_PLLInitTypeDef

RCC_PLLInitTypeDef is defined in the stm32l4xx_hal_rcc.h

Data Fields

- ***uint32_t PLLState***
- ***uint32_t PLLSource***
- ***uint32_t PLLM***
- ***uint32_t PLLN***
- ***uint32_t PLLP***
- ***uint32_t PLLQ***
- ***uint32_t PLLR***

Field Documentation

- ***uint32_t RCC_PLLInitTypeDef::PLLState***

  The new state of the PLL. This parameter can be a value of *RCC_PLL_Config*
- ***uint32_t RCC_PLLInitTypeDef::PLLSource***

  RCC_PLLSource: PLL entry clock source. This parameter must be a value of *RCC_PLL_Clock_Source*
- ***uint32_t RCC_PLLInitTypeDef::PLLM***

  PLLM: Division factor for PLL VCO input clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16 on STM32L4Rx/STM32L4Sx devices. This parameter must be a number between Min_Data = 1 and Max_Data = 8 on the other devices
- ***uint32_t RCC_PLLInitTypeDef::PLLN***

  PLLN: Multiplication factor for PLL VCO output clock. This parameter must be a number between Min_Data = 8 and Max_Data = 86
- ***uint32_t RCC_PLLInitTypeDef::PLLP***

  PLLP: Division factor for SAI clock. This parameter must be a value of *RCC_PLLP_Clock_Divider*
- ***uint32_t RCC_PLLInitTypeDef::PLLQ***

  PLLQ: Division factor for SDMMC1, RNG and USB clocks. This parameter must be a value of *RCC_PLLQ_Clock_Divider*
- ***uint32_t RCC_PLLInitTypeDef::PLLR***

  PLLR: Division for the main system clock. User have to set the PLLR parameter correctly to not exceed max frequency 120MHZ on STM32L4Rx/STM32L4Sx devices else 80MHz on the other devices. This parameter must be a value of *RCC_PLLR_Clock_Divider*

57.1.2 RCC_OscInitTypeDef

RCC_OscInitTypeDef is defined in the stm32l4xx_hal_rcc.h

Data Fields

- ***uint32_t OscillatorType***
- ***uint32_t HSEState***
- ***uint32_t LSEState***
- ***uint32_t HSIState***
- ***uint32_t HSICalibrationValue***
- ***uint32_t LSIState***
- ***uint32_t MSIState***
- ***uint32_t MSICalibrationValue***
- ***uint32_t MSIClockRange***

- ***uint32_t HSI48State***
- ***RCC_PLLInitTypeDef PLL***

Field Documentation

- ***uint32_t RCC_OscInitTypeDef::OscillatorType***
  The oscillators to be configured. This parameter can be a value of *RCC_Oscillator_Type*
- ***uint32_t RCC_OscInitTypeDef::HSEState***
  The new state of the HSE. This parameter can be a value of *RCC_HSE_Config*
- ***uint32_t RCC_OscInitTypeDef::LSEState***
  The new state of the LSE. This parameter can be a value of *RCC_LSE_Config*
- ***uint32_t RCC_OscInitTypeDef::HSIState***
  The new state of the HSI. This parameter can be a value of *RCC_HSI_Config*
- ***uint32_t RCC_OscInitTypeDef::HSICalibrationValue***
  The calibration trimming value (default is RCC_HSICALIBRATION_DEFAULT). This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F on STM32L43x/STM32L44x/STM32L47x/ STM32L48x devices. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7F on the other devices
- ***uint32_t RCC_OscInitTypeDef::LSIState***
  The new state of the LSI. This parameter can be a value of *RCC_LSI_Config*
- ***uint32_t RCC_OscInitTypeDef::MSIState***
  The new state of the MSI. This parameter can be a value of *RCC_MSI_Config*
- ***uint32_t RCC_OscInitTypeDef::MSICalibrationValue***
  The calibration trimming value (default is RCC_MSICALIBRATION_DEFAULT). This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF
- ***uint32_t RCC_OscInitTypeDef::MSIClockRange***
  The MSI frequency range. This parameter can be a value of *RCC_MSI_Clock_Range*
- ***uint32_t RCC_OscInitTypeDef::HSI48State***
  The new state of the HSI48 (only applicable to STM32L43x/STM32L44x/STM32L49x/STM32L4Ax devices). This parameter can be a value of *RCC_HSI48_Config*
- ***RCC_PLLInitTypeDef RCC_OscInitTypeDef::PLL***
  Main PLL structure parameters

57.1.3 RCC_ClkInitTypeDef

RCC_ClkInitTypeDef is defined in the stm32l4xx_hal_rcc.h

Data Fields

- ***uint32_t ClockType***
- ***uint32_t SYSCLKSource***
- ***uint32_t AHBCLKDivider***
- ***uint32_t APB1CLKDivider***
- ***uint32_t APB2CLKDivider***

Field Documentation

- ***uint32_t RCC_ClkInitTypeDef::ClockType***
  The clock to be configured. This parameter can be a value of *RCC_System_Clock_Type*
- ***uint32_t RCC_ClkInitTypeDef::SYSCLKSource***
  The clock source used as system clock (SYSCLK). This parameter can be a value of *RCC_System_Clock_Source*
- ***uint32_t RCC_ClkInitTypeDef::AHBCLKDivider***
  The AHB clock (HCLK) divider. This clock is derived from the system clock (SYSCLK). This parameter can be a value of *RCC_AHB_Clock_Source*
- ***uint32_t RCC_ClkInitTypeDef::APB1CLKDivider***
  The APB1 clock (PCLK1) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of *RCC_APB1_APB2_Clock_Source*

- ***uint32_t RCC_ClkInitTypeDef::APB2CLKDivider***

  The APB2 clock (PCLK2) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of ***RCC_APB1_APB2_Clock_Source***

57.2 RCC Firmware driver API description

The following section lists the various functions of the RCC library.

57.2.1 RCC specific features

After reset the device is running from Multiple Speed Internal oscillator (4 MHz) with Flash 0 wait state. Flash prefetch buffer, D-Cache and I-Cache are disabled, and all peripherals are off except internal SRAM, Flash and JTAG.

- There is no prescaler on High speed (AHBs) and Low speed (APBs) busses: all peripherals mapped on these busses are running at MSI speed.
- The clock for all peripherals is switched off, except the SRAM and FLASH.
- All GPIOs are in analog mode, except the JTAG pins which are assigned to be used for debug purpose.

Once the device started from reset, the user application has to:

- Configure the clock source to be used to drive the System clock (if the application needs higher frequency/ performance)
- Configure the System clock frequency and Flash settings
- Configure the AHB and APB busses prescalers
- Enable the clock for the peripheral(s) to be used
- Configure the clock source(s) for peripherals which clocks are not derived from the System clock (SAIx, RTC, ADC, USB OTG FS/SDMMC1/RNG)

57.2.2 Initialization and de-initialization functions

This section provides functions allowing to configure the internal and external oscillators (HSE, HSI, LSE, MSI, LSI, PLL, CSS and MCO) and the System busses clocks (SYSCLK, AHB, APB1 and APB2).

Internal/external clock and PLL configuration

- HSI (high-speed internal): 16 MHz factory-trimmed RC used directly or through the PLL as System clock source.
- MSI (Mutiple Speed Internal): Its frequency is software trimmable from 100KHZ to 48MHZ. It can be used to generate the clock for the USB OTG FS (48 MHz). The number of flash wait states is automatically adjusted when MSI range is updated with HAL_RCC_OscConfig() and the MSI is used as System clock source.
- LSI (low-speed internal): 32 KHz low consumption RC used as IWDG and/or RTC clock source.
- HSE (high-speed external): 4 to 48 MHz crystal oscillator used directly or through the PLL as System clock source. Can be used also optionally as RTC clock source.
- LSE (low-speed external): 32.768 KHz oscillator used optionally as RTC clock source.
- PLL (clocked by HSI, HSE or MSI) providing up to three independent output clocks:
  - The first output is used to generate the high speed system clock (up to 80MHz).
  - The second output is used to generate the clock for the USB OTG FS (48 MHz), the random analog generator (<=48 MHz) and the SDMMC1 (<= 48 MHz).
  - The third output is used to generate an accurate clock to achieve high-quality audio performance on SAI interface.
- PLLSAI1 (clocked by HSI, HSE or MSI) providing up to three independent output clocks:
  - The first output is used to generate SAR ADC1 clock.
  - The second output is used to generate the clock for the USB OTG FS (48 MHz), the random analog generator (<=48 MHz) and the SDMMC1 (<= 48 MHz).
  - The Third output is used to generate an accurate clock to achieve high-quality audio performance on SAI interface.

- PLLSAI2 (clocked by HSI, HSE or MSI) providing up to two independent output clocks:
  - The first output is used to generate SAR ADC2 clock.
  - The second output is used to generate an accurate clock to achieve high-quality audio performance on SAI interface.
- CSS (Clock security system): once enabled, if a HSE clock failure occurs (HSE used directly or through PLL as System clock source), the System clock is automatically switched to HSI and an interrupt is generated if enabled. The interrupt is linked to the Cortex-M4 NMI (Non-Maskable Interrupt) exception vector.
- MCO (microcontroller clock output): used to output MSI, LSI, HSI, LSE, HSE or main PLL clock (through a configurable prescaler) on PA8 pin.

System, AHB and APB busses clocks configuration

- Several clock sources can be used to drive the System clock (SYSCLK): MSI, HSI, HSE and main PLL. The AHB clock (HCLK) is derived from System clock through configurable prescaler and used to clock the CPU, memory and peripherals mapped on AHB bus (DMA, GPIO...). APB1 (PCLK1) and APB2 (PCLK2) clocks are derived from AHB clock through configurable prescalers and used to clock the peripherals mapped on these busses. You can use "HAL_RCC_GetSysClockFreq()" function to retrieve the frequencies of these clocks.

Note: All the peripheral clocks are derived from the System clock (SYSCLK) except:

- *SAI: the SAI clock can be derived either from a specific PLL (PLLSAI1) or (PLLSAI2) or from an external clock mapped on the SAI_CKIN pin. You have to use HAL_RCCEx_PeriphCLKConfig() function to configure this clock.*
- *RTC: the RTC clock can be derived either from the LSI, LSE or HSE clock divided by 2 to 31. You have to use __HAL_RCC_RTC_ENABLE() and HAL_RCCEx_PeriphCLKConfig() function to configure this clock.*
- *USB OTG FS, SDMMC1 and RNG: USB OTG FS requires a frequency equal to 48 MHz to work correctly, while the SDMMC1 and RNG peripherals require a frequency equal or lower than to 48 MHz. This clock is derived of the main PLL or PLLSAI1 through PLLQ divider. You have to enable the peripheral clock and use HAL_RCCEx_PeriphCLKConfig() function to configure this clock.*
- *IWDG clock which is always the LSI clock.*

- The maximum frequency of the SYSCLK, HCLK, PCLK1 and PCLK2 is 80 MHz. The clock source frequency should be adapted depending on the device voltage range as listed in the Reference Manual "Clock source frequency versus voltage scaling" chapter.

This section contains the following APIs:

- ***HAL_RCC_DeInit***
- ***HAL_RCC_OscConfig***
- ***HAL_RCC_ClockConfig***

57.2.3 Peripheral Control functions

This subsection provides a set of functions allowing to:

- Ouput clock to MCO pin.
- Retrieve current clock frequencies.
- Enable the Clock Security System.

This section contains the following APIs:

- ***HAL_RCC_MCOConfig***
- ***HAL_RCC_GetSysClockFreq***
- ***HAL_RCC_GetHCLKFreq***
- ***HAL_RCC_GetPCLK1Freq***
- ***HAL_RCC_GetPCLK2Freq***
- ***HAL_RCC_GetOscConfig***
- ***HAL_RCC_GetClockConfig***
- ***HAL_RCC_EnableCSS***
- ***HAL_RCC_NMI_IRQHandler***
- ***HAL_RCC_CSSCallback***

57.2.4 Detailed description of functions

`HAL_RCC_DeInit`

Function name

HAL_StatusTypeDef HAL_RCC_DeInit (void)

Function description

Reset the RCC clock configuration to the default reset state.

Return values

- **HAL:** status

Notes

- The default reset state of the clock configuration is given below: MSI ON and used as system clock sourceHSE, HSI, PLL, PLLSAI1 and PLLSAI2 OFFAHB, APB1 and APB2 prescalers set to 1.CSS, MCO1 OFFAll interrupts disabledAll interrupt and reset flags cleared
- This function does not modify the configuration of the Peripheral clock sourcesLSI, LSE and RTC clocks (Backup domain)

`HAL_RCC_OscConfig`

Function name

HAL_StatusTypeDef HAL_RCC_OscConfig (RCC_OscInitTypeDef * RCC_OscInitStruct)

Function description

Initialize the RCC Oscillators according to the specified parameters in the RCC_OscInitTypeDef.

Parameters

- **RCC_OscInitStruct:** pointer to an RCC_OscInitTypeDef structure that contains the configuration information for the RCC Oscillators.

Return values

- **HAL:** status

Notes

- The PLL is not disabled when used as system clock.
- Transitions LSE Bypass to LSE On and LSE On to LSE Bypass are not supported by this macro. User should request a transition to LSE Off first and then LSE On or LSE Bypass.
- Transition HSE Bypass to HSE On and HSE On to HSE Bypass are not supported by this macro. User should request a transition to HSE Off first and then HSE On or HSE Bypass.

`HAL_RCC_ClockConfig`

Function name

HAL_StatusTypeDef HAL_RCC_ClockConfig (RCC_ClkInitTypeDef * RCC_ClkInitStruct, uint32_t FLatency)

Function description

Initialize the CPU, AHB and APB busses clocks according to the specified parameters in the RCC_ClkInitStruct.

Parameters

- **RCC_ClkInitStruct:** pointer to an RCC_OscInitTypeDef structure that contains the configuration information for the RCC peripheral.
- **FLatency:** FLASH Latency This parameter can be one of the following values:
  - FLASH_LATENCY_0 FLASH 0 Latency cycle
  - FLASH_LATENCY_1 FLASH 1 Latency cycle
  - FLASH_LATENCY_2 FLASH 2 Latency cycles
  - FLASH_LATENCY_3 FLASH 3 Latency cycles
  - FLASH_LATENCY_4 FLASH 4 Latency cycles
  - FLASH_LATENCY_5 FLASH 5 Latency cycles
  - FLASH_LATENCY_6 FLASH 6 Latency cycles
  - FLASH_LATENCY_7 FLASH 7 Latency cycles
  - FLASH_LATENCY_8 FLASH 8 Latency cycles
  - FLASH_LATENCY_9 FLASH 9 Latency cycles
  - FLASH_LATENCY_10 FLASH 10 Latency cycles
  - FLASH_LATENCY_11 FLASH 11 Latency cycles
  - FLASH_LATENCY_12 FLASH 12 Latency cycles
  - FLASH_LATENCY_13 FLASH 13 Latency cycles
  - FLASH_LATENCY_14 FLASH 14 Latency cycles
  - FLASH_LATENCY_15 FLASH 15 Latency cycles

Return values

- **None:**

Notes

- The SystemCoreClock CMSIS variable is used to store System Clock Frequency and updated by HAL_RCC_GetHCLKFreq() function called within this function
- The MSI is used by default as system clock source after startup from Reset, wake-up from STANDBY mode. After restart from Reset, the MSI frequency is set to its default value 4 MHz.
- The HSI can be selected as system clock source after from STOP modes or in case of failure of the HSE used directly or indirectly as system clock (if the Clock Security System CSS is enabled).
- A switch from one clock source to another occurs only if the target clock source is ready (clock stable after startup delay or PLL locked). If a clock source which is not yet ready is selected, the switch will occur when the clock source is ready.
- You can use HAL_RCC_GetClockConfig() function to know which clock is currently used as system clock source.
- Depending on the device voltage range, the software has to set correctly HPRE[3:0] bits to ensure that HCLK not exceed the maximum allowed frequency (for more details refer to section above "Initialization/de-initialization functions")

HAL_RCC_MCOConfig

Function name

void HAL_RCC_MCOConfig (uint32_t RCC_MCOx, uint32_t RCC_MCOSource, uint32_t RCC_MCODiv)

Function description

Select the clock source to output on MCO pin(PA8).

Parameters

- **RCC_MCOx:** specifies the output direction for the clock source. For STM32L4xx family this parameter can have only one value:
  - RCC_MCO1 Clock source to output on MCO1 pin(PA8).
- **RCC_MCOSource:** specifies the clock source to output. This parameter can be one of the following values:
  - RCC_MCO1SOURCE_NOCLOCK MCO output disabled, no clock on MCO
  - RCC_MCO1SOURCE_SYSCLK system clock selected as MCO source
  - RCC_MCO1SOURCE_MSI MSI clock selected as MCO source
  - RCC_MCO1SOURCE_HSI HSI clock selected as MCO source
  - RCC_MCO1SOURCE_HSE HSE clock selected as MCO sourcee
  - RCC_MCO1SOURCE_PLLCLK main PLL clock selected as MCO source
  - RCC_MCO1SOURCE_LSI LSI clock selected as MCO source
  - RCC_MCO1SOURCE_LSE LSE clock selected as MCO source
- **RCC_MCODiv:** specifies the MCO prescaler. This parameter can be one of the following values:
  - RCC_MCODIV_1 no division applied to MCO clock
  - RCC_MCODIV_2 division by 2 applied to MCO clock
  - RCC_MCODIV_4 division by 4 applied to MCO clock
  - RCC_MCODIV_8 division by 8 applied to MCO clock
  - RCC_MCODIV_16 division by 16 applied to MCO clock

Return values

- **None:**

Notes

- PA8 should be configured in alternate function mode.

`HAL_RCC_EnableCSS`

Function name

void HAL_RCC_EnableCSS (void)

Function description

Enable the Clock Security System.

Return values

- **None:**

Notes

- If a failure is detected on the HSE oscillator clock, this oscillator is automatically disabled and an interrupt is generated to inform the software about the failure (Clock Security System Interrupt, CSSI), allowing the MCU to perform rescue operations. The CSSI is linked to the Cortex-M4 NMI (Non-Maskable Interrupt) exception vector.
- The Clock Security System can only be cleared by reset.

`HAL_RCC_GetSysClockFreq`

Function name

uint32_t HAL_RCC_GetSysClockFreq (void)

Function description

Return the SYSCLK frequency.

Return values

- **SYSCLK:** frequency

Notes

- The system frequency computed by this function is not the real frequency in the chip. It is calculated based on the predefined constant and the selected clock source:
- If SYSCLK source is MSI, function returns values based on MSI Value as defined by the MSI range.
- If SYSCLK source is HSI, function returns values based on HSI_VALUE(*)
- If SYSCLK source is HSE, function returns values based on HSE_VALUE(**)
- If SYSCLK source is PLL, function returns values based on HSE_VALUE(**), HSI_VALUE(*) or MSI Value multiplied/divided by the PLL factors.
- (*) HSI_VALUE is a constant defined in stm32l4xx_hal_conf.h file (default value 16 MHz) but the real value may vary depending on the variations in voltage and temperature.
- (**) HSE_VALUE is a constant defined in stm32l4xx_hal_conf.h file (default value 8 MHz), user has to ensure that HSE_VALUE is same as the real frequency of the crystal used. Otherwise, this function may have wrong result.
- The result of this function could be not correct when using fractional value for HSE crystal.
- This function can be used by the user application to compute the baudrate for the communication peripherals or configure other parameters.
- Each time SYSCLK changes, this function must be called to update the right SYSCLK value. Otherwise, any configuration based on this function will be incorrect.

`HAL_RCC_GetHCLKFreq`

Function name

uint32_t HAL_RCC_GetHCLKFreq (void)

Function description

Return the HCLK frequency.

Return values

- **HCLK:** frequency in Hz

Notes

- Each time HCLK changes, this function must be called to update the right HCLK value. Otherwise, any configuration based on this function will be incorrect.
- The SystemCoreClock CMSIS variable is used to store System Clock Frequency.

`HAL_RCC_GetPCLK1Freq`

Function name

uint32_t HAL_RCC_GetPCLK1Freq (void)

Function description

Return the PCLK1 frequency.

Return values

- **PCLK1:** frequency in Hz

Notes

- Each time PCLK1 changes, this function must be called to update the right PCLK1 value. Otherwise, any configuration based on this function will be incorrect.

HAL_RCC_GetPCLK2Freq

Function name

uint32_t HAL_RCC_GetPCLK2Freq (void)

Function description

Return the PCLK2 frequency.

Return values

- **PCLK2:** frequency in Hz

Notes

- Each time PCLK2 changes, this function must be called to update the right PCLK2 value. Otherwise, any configuration based on this function will be incorrect.

HAL_RCC_GetOscConfig

Function name

void HAL_RCC_GetOscConfig (RCC_OscInitTypeDef * RCC_OscInitStruct)

Function description

Configure the RCC_OscInitStruct according to the internal RCC configuration registers.

Parameters

- **RCC_OscInitStruct:** pointer to an RCC_OscInitTypeDef structure that will be configured.

Return values

- **None:**

HAL_RCC_GetClockConfig

Function name

void HAL_RCC_GetClockConfig (RCC_ClkInitTypeDef * RCC_ClkInitStruct, uint32_t * pFLatency)

Function description

Configure the RCC_ClkInitStruct according to the internal RCC configuration registers.

Parameters

- **RCC_ClkInitStruct:** pointer to an RCC_ClkInitTypeDef structure that will be configured.
- **pFLatency:** Pointer on the Flash Latency.

Return values

- **None:**

HAL_RCC_NMI_IRQHandler

Function name

void HAL_RCC_NMI_IRQHandler (void)

Function description

Handle the RCC Clock Security System interrupt request.

Return values

- **None:**

Notes

- This API should be called under the NMI_Handler().

`HAL_RCC_CSSCallback`

Function name

void HAL_RCC_CSSCallback (void)

Function description

RCC Clock Security System interrupt callback.

Return values

- **none:**

57.3 RCC Firmware driver defines

The following section lists the various define and macros of the module.

57.3.1 RCC

RCC

AHB1 Peripheral Clock Sleep Enable Disable

__HAL_RCC_DMA1_CLK_SLEEP_ENABLE

__HAL_RCC_DMA2_CLK_SLEEP_ENABLE

__HAL_RCC_DMAMUX1_CLK_SLEEP_ENABLE

__HAL_RCC_FLASH_CLK_SLEEP_ENABLE

__HAL_RCC_SRAM1_CLK_SLEEP_ENABLE

__HAL_RCC_CRC_CLK_SLEEP_ENABLE

__HAL_RCC_TSC_CLK_SLEEP_ENABLE

__HAL_RCC_DMA2D_CLK_SLEEP_ENABLE

__HAL_RCC_GFXMMU_CLK_SLEEP_ENABLE

__HAL_RCC_DMA1_CLK_SLEEP_DISABLE

__HAL_RCC_DMA2_CLK_SLEEP_DISABLE

__HAL_RCC_DMAMUX1_CLK_SLEEP_DISABLE

__HAL_RCC_FLASH_CLK_SLEEP_DISABLE

__HAL_RCC_SRAM1_CLK_SLEEP_DISABLE

__HAL_RCC_CRC_CLK_SLEEP_DISABLE

__HAL_RCC_TSC_CLK_SLEEP_DISABLE

__HAL_RCC_DMA2D_CLK_SLEEP_DISABLE

__HAL_RCC_GFXMMU_CLK_SLEEP_DISABLE

AHB1 Peripheral Clock Sleep Enabled or Disabled Status

__HAL_RCC_DMA1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMA2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMAMUX1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_FLASH_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SRAM1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_CRC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TSC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMA2D_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GFXMMU_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMA1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMA2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMAMUX1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_FLASH_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SRAM1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_CRC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TSC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMA2D_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GFXMMU_IS_CLK_SLEEP_DISABLED

AHB1 Peripheral Force Release Reset

__HAL_RCC_AHB1_FORCE_RESET

__HAL_RCC_DMA1_FORCE_RESET

__HAL_RCC_DMA2_FORCE_RESET

__HAL_RCC_DMAMUX1_FORCE_RESET

__HAL_RCC_FLASH_FORCE_RESET

__HAL_RCC_CRC_FORCE_RESET

__HAL_RCC_TSC_FORCE_RESET

__HAL_RCC_DMA2D_FORCE_RESET

__HAL_RCC_GFXMMU_FORCE_RESET

__HAL_RCC_AHB1_RELEASE_RESET

__HAL_RCC_DMA1_RELEASE_RESET

__HAL_RCC_DMA2_RELEASE_RESET

__HAL_RCC_DMAMUX1_RELEASE_RESET

__HAL_RCC_FLASH_RELEASE_RESET

__HAL_RCC_CRC_RELEASE_RESET

__HAL_RCC_TSC_RELEASE_RESET

__HAL_RCC_DMA2D_RELEASE_RESET

__HAL_RCC_GFXMMU_RELEASE_RESET

AHB1 Peripheral Clock Enable Disable

__HAL_RCC_DMA1_CLK_ENABLE

__HAL_RCC_DMA2_CLK_ENABLE

__HAL_RCC_DMAMUX1_CLK_ENABLE

__HAL_RCC_FLASH_CLK_ENABLE

__HAL_RCC_CRC_CLK_ENABLE

__HAL_RCC_TSC_CLK_ENABLE

__HAL_RCC_DMA2D_CLK_ENABLE

__HAL_RCC_GFXMMU_CLK_ENABLE

__HAL_RCC_DMA1_CLK_DISABLE

__HAL_RCC_DMA2_CLK_DISABLE

__HAL_RCC_DMAMUX1_CLK_DISABLE

__HAL_RCC_FLASH_CLK_DISABLE

__HAL_RCC_CRC_CLK_DISABLE

__HAL_RCC_TSC_CLK_DISABLE

__HAL_RCC_DMA2D_CLK_DISABLE

__HAL_RCC_GFXMMU_CLK_DISABLE

AHB1 Peripheral Clock Enabled or Disabled Status

__HAL_RCC_DMA1_IS_CLK_ENABLED

__HAL_RCC_DMA2_IS_CLK_ENABLED

__HAL_RCC_DMAMUX1_IS_CLK_ENABLED

__HAL_RCC_FLASH_IS_CLK_ENABLED

__HAL_RCC_CRC_IS_CLK_ENABLED

__HAL_RCC_TSC_IS_CLK_ENABLED

__HAL_RCC_DMA2D_IS_CLK_ENABLED

__HAL_RCC_GFXMMU_IS_CLK_ENABLED

__HAL_RCC_DMA1_IS_CLK_DISABLED

__HAL_RCC_DMA2_IS_CLK_DISABLED

__HAL_RCC_DMAMUX1_IS_CLK_DISABLED

__HAL_RCC_FLASH_IS_CLK_DISABLED

__HAL_RCC_CRC_IS_CLK_DISABLED

__HAL_RCC_TSC_IS_CLK_DISABLED

__HAL_RCC_DMA2D_IS_CLK_DISABLED

__HAL_RCC_GFXMMU_IS_CLK_DISABLED

AHB2 Peripheral Clock Enabled or Disabled Status

__HAL_RCC_GPIOA_IS_CLK_ENABLED

__HAL_RCC_GPIOB_IS_CLK_ENABLED

__HAL_RCC_GPIOC_IS_CLK_ENABLED

__HAL_RCC_GPIOD_IS_CLK_ENABLED

__HAL_RCC_GPIOE_IS_CLK_ENABLED

__HAL_RCC_GPIOF_IS_CLK_ENABLED

__HAL_RCC_GPIOG_IS_CLK_ENABLED

__HAL_RCC_GPIOH_IS_CLK_ENABLED

__HAL_RCC_GPIOI_IS_CLK_ENABLED

__HAL_RCC_USB_OTG_FS_IS_CLK_ENABLED

__HAL_RCC_ADC_IS_CLK_ENABLED

__HAL_RCC_DCMI_IS_CLK_ENABLED

__HAL_RCC_AES_IS_CLK_ENABLED

__HAL_RCC_HASH_IS_CLK_ENABLED

__HAL_RCC_RNG_IS_CLK_ENABLED

__HAL_RCC_OSPIM_IS_CLK_ENABLED

__HAL_RCC_SDMMC1_IS_CLK_ENABLED

__HAL_RCC_GPIOA_IS_CLK_DISABLED

__HAL_RCC_GPIOB_IS_CLK_DISABLED

__HAL_RCC_GPIOC_IS_CLK_DISABLED

__HAL_RCC_GPIOD_IS_CLK_DISABLED

__HAL_RCC_GPIOE_IS_CLK_DISABLED

__HAL_RCC_GPIOF_IS_CLK_DISABLED

__HAL_RCC_GPIOG_IS_CLK_DISABLED

__HAL_RCC_GPIOH_IS_CLK_DISABLED

__HAL_RCC_GPIOI_IS_CLK_DISABLED

__HAL_RCC_USB_OTG_FS_IS_CLK_DISABLED

__HAL_RCC_ADC_IS_CLK_DISABLED

__HAL_RCC_DCMI_IS_CLK_DISABLED

__HAL_RCC_AES_IS_CLK_DISABLED

__HAL_RCC_HASH_IS_CLK_DISABLED

__HAL_RCC_RNG_IS_CLK_DISABLED

__HAL_RCC_OSPIM_IS_CLK_DISABLED

__HAL_RCC_SDMMC1_IS_CLK_DISABLED

AHB2 Peripheral Clock Sleep Enable Disable

__HAL_RCC_GPIOA_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOB_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOC_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOD_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOE_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOF_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOG_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOH_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOI_CLK_SLEEP_ENABLE

__HAL_RCC_SRAM2_CLK_SLEEP_ENABLE

__HAL_RCC_USB_OTG_FS_CLK_SLEEP_ENABLE

__HAL_RCC_ADC_CLK_SLEEP_ENABLE

__HAL_RCC_DCMI_CLK_SLEEP_ENABLE

__HAL_RCC_AES_CLK_SLEEP_ENABLE

__HAL_RCC_HASH_CLK_SLEEP_ENABLE

__HAL_RCC_RNG_CLK_SLEEP_ENABLE

__HAL_RCC_OSPIM_CLK_SLEEP_ENABLE

__HAL_RCC_SDMMC1_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOA_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOB_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOC_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOD_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOE_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOF_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOG_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOH_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOI_CLK_SLEEP_DISABLE

__HAL_RCC_SRAM2_CLK_SLEEP_DISABLE

__HAL_RCC_USB_OTG_FS_CLK_SLEEP_DISABLE

__HAL_RCC_ADC_CLK_SLEEP_DISABLE

__HAL_RCC_DCMI_CLK_SLEEP_DISABLE

__HAL_RCC_AES_CLK_SLEEP_DISABLE

__HAL_RCC_HASH_CLK_SLEEP_DISABLE

__HAL_RCC_RNG_CLK_SLEEP_DISABLE

__HAL_RCC_OSPIM_CLK_SLEEP_DISABLE

__HAL_RCC_SDMMC1_CLK_SLEEP_DISABLE

AHB2 Peripheral Clock Sleep Enabled or Disabled Status

__HAL_RCC_GPIOA_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOB_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOD_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOE_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOF_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOH_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOI_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SRAM2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_USB_OTG_FS_IS_CLK_SLEEP_ENABLED

__HAL_RCC_ADC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DCMI_IS_CLK_SLEEP_ENABLED

__HAL_RCC_AES_IS_CLK_SLEEP_ENABLED

__HAL_RCC_HASH_IS_CLK_SLEEP_ENABLED

__HAL_RCC_RNG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_OSPIM_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SDMMC1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOA_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOB_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOD_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOE_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOF_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOH_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOI_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SRAM2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_USB_OTG_FS_IS_CLK_SLEEP_DISABLED

__HAL_RCC_ADC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DCMI_IS_CLK_SLEEP_DISABLED

__HAL_RCC_AES_IS_CLK_SLEEP_DISABLED

__HAL_RCC_HASH_IS_CLK_SLEEP_DISABLED

__HAL_RCC_RNG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_OSPIM_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SDMMC1_IS_CLK_SLEEP_DISABLED

AHB2 Peripheral Force Release Reset

__HAL_RCC_AHB2_FORCE_RESET

__HAL_RCC_GPIOA_FORCE_RESET

__HAL_RCC_GPIOB_FORCE_RESET

__HAL_RCC_GPIOC_FORCE_RESET

__HAL_RCC_GPIOD_FORCE_RESET

__HAL_RCC_GPIOE_FORCE_RESET

__HAL_RCC_GPIOF_FORCE_RESET

__HAL_RCC_GPIOG_FORCE_RESET

__HAL_RCC_GPIOH_FORCE_RESET

__HAL_RCC_GPIOI_FORCE_RESET

__HAL_RCC_USB_OTG_FS_FORCE_RESET

__HAL_RCC_ADC_FORCE_RESET

__HAL_RCC_DCMI_FORCE_RESET

__HAL_RCC_AES_FORCE_RESET

__HAL_RCC_HASH_FORCE_RESET

__HAL_RCC_RNG_FORCE_RESET

__HAL_RCC_OSPIM_FORCE_RESET

__HAL_RCC_SDMMC1_FORCE_RESET

__HAL_RCC_AHB2_RELEASE_RESET

__HAL_RCC_GPIOA_RELEASE_RESET

__HAL_RCC_GPIOB_RELEASE_RESET

__HAL_RCC_GPIOC_RELEASE_RESET

__HAL_RCC_GPIOD_RELEASE_RESET

__HAL_RCC_GPIOE_RELEASE_RESET

__HAL_RCC_GPIOF_RELEASE_RESET

__HAL_RCC_GPIOG_RELEASE_RESET

__HAL_RCC_GPIOH_RELEASE_RESET

__HAL_RCC_GPIOI_RELEASE_RESET

__HAL_RCC_USB_OTG_FS_RELEASE_RESET

__HAL_RCC_ADC_RELEASE_RESET

__HAL_RCC_DCMI_RELEASE_RESET

__HAL_RCC_AES_RELEASE_RESET

__HAL_RCC_HASH_RELEASE_RESET

__HAL_RCC_RNG_RELEASE_RESET

__HAL_RCC_OSPIM_RELEASE_RESET

__HAL_RCC_SDMMC1_RELEASE_RESET

AHB2 Peripheral Clock Enable Disable

__HAL_RCC_GPIOA_CLK_ENABLE

__HAL_RCC_GPIOB_CLK_ENABLE

__HAL_RCC_GPIOC_CLK_ENABLE

__HAL_RCC_GPIOD_CLK_ENABLE

__HAL_RCC_GPIOE_CLK_ENABLE

__HAL_RCC_GPIOF_CLK_ENABLE

__HAL_RCC_GPIOG_CLK_ENABLE

__HAL_RCC_GPIOH_CLK_ENABLE

__HAL_RCC_GPIOI_CLK_ENABLE

__HAL_RCC_USB_OTG_FS_CLK_ENABLE

__HAL_RCC_ADC_CLK_ENABLE

__HAL_RCC_DCMI_CLK_ENABLE

__HAL_RCC_AES_CLK_ENABLE

__HAL_RCC_HASH_CLK_ENABLE

__HAL_RCC_RNG_CLK_ENABLE

__HAL_RCC_OSPIM_CLK_ENABLE

__HAL_RCC_SDMMC1_CLK_ENABLE

__HAL_RCC_GPIOA_CLK_DISABLE

__HAL_RCC_GPIOB_CLK_DISABLE

__HAL_RCC_GPIOC_CLK_DISABLE

__HAL_RCC_GPIOD_CLK_DISABLE

__HAL_RCC_GPIOE_CLK_DISABLE

__HAL_RCC_GPIOF_CLK_DISABLE

__HAL_RCC_GPIOG_CLK_DISABLE

__HAL_RCC_GPIOH_CLK_DISABLE

__HAL_RCC_GPIOI_CLK_DISABLE

__HAL_RCC_USB_OTG_FS_CLK_DISABLE

__HAL_RCC_ADC_CLK_DISABLE

__HAL_RCC_DCMI_CLK_DISABLE

__HAL_RCC_AES_CLK_DISABLE

__HAL_RCC_HASH_CLK_DISABLE

__HAL_RCC_RNG_CLK_DISABLE

__HAL_RCC_OSPIM_CLK_DISABLE

__HAL_RCC_SDMMC1_CLK_DISABLE

AHB3 Peripheral Clock Enable Disable

__HAL_RCC_FMC_CLK_ENABLE

__HAL_RCC_OSPI1_CLK_ENABLE

__HAL_RCC_OSPI2_CLK_ENABLE

__HAL_RCC_FMC_CLK_DISABLE

__HAL_RCC_OSPI1_CLK_DISABLE

__HAL_RCC_OSPI2_CLK_DISABLE

AHB3 Peripheral Clock Enabled or Disabled Status

__HAL_RCC_FMC_IS_CLK_ENABLED

__HAL_RCC_OSPI1_IS_CLK_ENABLED

__HAL_RCC_OSPI2_IS_CLK_ENABLED

__HAL_RCC_FMC_IS_CLK_DISABLED

__HAL_RCC_OSPI1_IS_CLK_DISABLED

__HAL_RCC_OSPI2_IS_CLK_DISABLED

AHB3 Peripheral Clock Sleep Enable Disable

__HAL_RCC_OSPI1_CLK_SLEEP_ENABLE

__HAL_RCC_OSPI2_CLK_SLEEP_ENABLE

__HAL_RCC_FMC_CLK_SLEEP_ENABLE

__HAL_RCC_OSPI1_CLK_SLEEP_DISABLE

__HAL_RCC_OSPI2_CLK_SLEEP_DISABLE

__HAL_RCC_FMC_CLK_SLEEP_DISABLE

AHB3 Peripheral Clock Sleep Enabled or Disabled Status

__HAL_RCC_OSPI1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_OSPI2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_FMC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_OSPI1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_OSPI2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_FMC_IS_CLK_SLEEP_DISABLED

AHB3 Peripheral Force Release Reset

__HAL_RCC_AHB3_FORCE_RESET

__HAL_RCC_FMC_FORCE_RESET

__HAL_RCC_OSPI1_FORCE_RESET

__HAL_RCC_OSPI2_FORCE_RESET

__HAL_RCC_AHB3_RELEASE_RESET

__HAL_RCC_FMC_RELEASE_RESET

__HAL_RCC_OSPI1_RELEASE_RESET

__HAL_RCC_OSPI2_RELEASE_RESET

AHB Clock Source

RCC_SYSCLK_DIV1

SYSCLK not divided

RCC_SYSCLK_DIV2

SYSCLK divided by 2

RCC_SYSCLK_DIV4

SYSCLK divided by 4

RCC_SYSCLK_DIV8

SYSCLK divided by 8

RCC_SYSCLK_DIV16

SYSCLK divided by 16

RCC_SYSCLK_DIV64

SYSCLK divided by 64

RCC_SYSCLK_DIV128

SYSCLK divided by 128

RCC_SYSCLK_DIV256

SYSCLK divided by 256

RCC_SYSCLK_DIV512

SYSCLK divided by 512

APB1 APB2 Clock Source

RCC_HCLK_DIV1

HCLK not divided

RCC_HCLK_DIV2

HCLK divided by 2

RCC_HCLK_DIV4

HCLK divided by 4

RCC_HCLK_DIV8

HCLK divided by 8

RCC_HCLK_DIV16

HCLK divided by 16

APB1 Peripheral Clock Enable Disable

__HAL_RCC_TIM2_CLK_ENABLE

__HAL_RCC_TIM3_CLK_ENABLE

__HAL_RCC_TIM4_CLK_ENABLE

__HAL_RCC_TIM5_CLK_ENABLE

__HAL_RCC_TIM6_CLK_ENABLE

__HAL_RCC_TIM7_CLK_ENABLE

__HAL_RCC_RTCAPB_CLK_ENABLE

__HAL_RCC_WWDG_CLK_ENABLE

__HAL_RCC_SPI2_CLK_ENABLE

__HAL_RCC_SPI3_CLK_ENABLE

__HAL_RCC_USART2_CLK_ENABLE

__HAL_RCC_USART3_CLK_ENABLE

__HAL_RCC_UART4_CLK_ENABLE

__HAL_RCC_UART5_CLK_ENABLE

__HAL_RCC_I2C1_CLK_ENABLE

__HAL_RCC_I2C2_CLK_ENABLE

__HAL_RCC_I2C3_CLK_ENABLE

__HAL_RCC_I2C4_CLK_ENABLE

__HAL_RCC_CRS_CLK_ENABLE

__HAL_RCC_CAN1_CLK_ENABLE

__HAL_RCC_PWR_CLK_ENABLE

__HAL_RCC_DAC1_CLK_ENABLE

__HAL_RCC_OPAMP_CLK_ENABLE

__HAL_RCC_LPTIM1_CLK_ENABLE

__HAL_RCC_LPUART1_CLK_ENABLE

__HAL_RCC_LPTIM2_CLK_ENABLE

__HAL_RCC_TIM2_CLK_DISABLE

__HAL_RCC_TIM3_CLK_DISABLE

__HAL_RCC_TIM4_CLK_DISABLE

__HAL_RCC_TIM5_CLK_DISABLE

__HAL_RCC_TIM6_CLK_DISABLE

__HAL_RCC_TIM7_CLK_DISABLE

__HAL_RCC_RTCAPB_CLK_DISABLE

__HAL_RCC_SPI2_CLK_DISABLE

__HAL_RCC_SPI3_CLK_DISABLE

__HAL_RCC_USART2_CLK_DISABLE

__HAL_RCC_USART3_CLK_DISABLE

__HAL_RCC_UART4_CLK_DISABLE

__HAL_RCC_UART5_CLK_DISABLE

__HAL_RCC_I2C1_CLK_DISABLE

__HAL_RCC_I2C2_CLK_DISABLE

__HAL_RCC_I2C3_CLK_DISABLE

__HAL_RCC_I2C4_CLK_DISABLE

__HAL_RCC_CRS_CLK_DISABLE

__HAL_RCC_CAN1_CLK_DISABLE

__HAL_RCC_PWR_CLK_DISABLE

__HAL_RCC_DAC1_CLK_DISABLE

__HAL_RCC_OPAMP_CLK_DISABLE

__HAL_RCC_LPTIM1_CLK_DISABLE

__HAL_RCC_LPUART1_CLK_DISABLE

__HAL_RCC_LPTIM2_CLK_DISABLE

APB1 Peripheral Clock Enabled or Disabled Status

__HAL_RCC_TIM2_IS_CLK_ENABLED

__HAL_RCC_TIM3_IS_CLK_ENABLED

__HAL_RCC_TIM4_IS_CLK_ENABLED

__HAL_RCC_TIM5_IS_CLK_ENABLED

__HAL_RCC_TIM6_IS_CLK_ENABLED

__HAL_RCC_TIM7_IS_CLK_ENABLED

__HAL_RCC_RTCAPB_IS_CLK_ENABLED

__HAL_RCC_WWDG_IS_CLK_ENABLED

__HAL_RCC_SPI2_IS_CLK_ENABLED

__HAL_RCC_SPI3_IS_CLK_ENABLED

__HAL_RCC_USART2_IS_CLK_ENABLED

__HAL_RCC_USART3_IS_CLK_ENABLED

__HAL_RCC_UART4_IS_CLK_ENABLED

__HAL_RCC_UART5_IS_CLK_ENABLED

__HAL_RCC_I2C1_IS_CLK_ENABLED

__HAL_RCC_I2C2_IS_CLK_ENABLED

__HAL_RCC_I2C3_IS_CLK_ENABLED

__HAL_RCC_I2C4_IS_CLK_ENABLED

__HAL_RCC_CRS_IS_CLK_ENABLED

__HAL_RCC_CAN1_IS_CLK_ENABLED

__HAL_RCC_PWR_IS_CLK_ENABLED

__HAL_RCC_DAC1_IS_CLK_ENABLED

__HAL_RCC_OPAMP_IS_CLK_ENABLED

__HAL_RCC_LPTIM1_IS_CLK_ENABLED

__HAL_RCC_LPUART1_IS_CLK_ENABLED

__HAL_RCC_LPTIM2_IS_CLK_ENABLED

__HAL_RCC_TIM2_IS_CLK_DISABLED

__HAL_RCC_TIM3_IS_CLK_DISABLED

__HAL_RCC_TIM4_IS_CLK_DISABLED

__HAL_RCC_TIM5_IS_CLK_DISABLED

__HAL_RCC_TIM6_IS_CLK_DISABLED

__HAL_RCC_TIM7_IS_CLK_DISABLED

__HAL_RCC_RTCAPB_IS_CLK_DISABLED

__HAL_RCC_WWDG_IS_CLK_DISABLED

__HAL_RCC_SPI2_IS_CLK_DISABLED

__HAL_RCC_SPI3_IS_CLK_DISABLED

__HAL_RCC_USART2_IS_CLK_DISABLED

__HAL_RCC_USART3_IS_CLK_DISABLED

__HAL_RCC_UART4_IS_CLK_DISABLED

__HAL_RCC_UART5_IS_CLK_DISABLED

__HAL_RCC_I2C1_IS_CLK_DISABLED

__HAL_RCC_I2C2_IS_CLK_DISABLED

__HAL_RCC_I2C3_IS_CLK_DISABLED

__HAL_RCC_I2C4_IS_CLK_DISABLED

__HAL_RCC_CRS_IS_CLK_DISABLED

__HAL_RCC_CAN1_IS_CLK_DISABLED

__HAL_RCC_PWR_IS_CLK_DISABLED

__HAL_RCC_DAC1_IS_CLK_DISABLED

__HAL_RCC_OPAMP_IS_CLK_DISABLED

__HAL_RCC_LPTIM1_IS_CLK_DISABLED

__HAL_RCC_LPUART1_IS_CLK_DISABLED

__HAL_RCC_LPTIM2_IS_CLK_DISABLED

APB1 Peripheral Clock Sleep Enable Disable

__HAL_RCC_TIM2_CLK_SLEEP_ENABLE

__HAL_RCC_TIM3_CLK_SLEEP_ENABLE

__HAL_RCC_TIM4_CLK_SLEEP_ENABLE

__HAL_RCC_TIM5_CLK_SLEEP_ENABLE

__HAL_RCC_TIM6_CLK_SLEEP_ENABLE

__HAL_RCC_TIM7_CLK_SLEEP_ENABLE

__HAL_RCC_RTCAPB_CLK_SLEEP_ENABLE

__HAL_RCC_WWDG_CLK_SLEEP_ENABLE

__HAL_RCC_SPI2_CLK_SLEEP_ENABLE

__HAL_RCC_SPI3_CLK_SLEEP_ENABLE

__HAL_RCC_USART2_CLK_SLEEP_ENABLE

__HAL_RCC_USART3_CLK_SLEEP_ENABLE

__HAL_RCC_UART4_CLK_SLEEP_ENABLE

__HAL_RCC_UART5_CLK_SLEEP_ENABLE

__HAL_RCC_I2C1_CLK_SLEEP_ENABLE

__HAL_RCC_I2C2_CLK_SLEEP_ENABLE

__HAL_RCC_I2C3_CLK_SLEEP_ENABLE

__HAL_RCC_I2C4_CLK_SLEEP_ENABLE

__HAL_RCC_CRS_CLK_SLEEP_ENABLE

__HAL_RCC_CAN1_CLK_SLEEP_ENABLE

__HAL_RCC_PWR_CLK_SLEEP_ENABLE

__HAL_RCC_DAC1_CLK_SLEEP_ENABLE

__HAL_RCC_OPAMP_CLK_SLEEP_ENABLE

__HAL_RCC_LPTIM1_CLK_SLEEP_ENABLE

__HAL_RCC_LPUART1_CLK_SLEEP_ENABLE

__HAL_RCC_LPTIM2_CLK_SLEEP_ENABLE

__HAL_RCC_TIM2_CLK_SLEEP_DISABLE

__HAL_RCC_TIM3_CLK_SLEEP_DISABLE

__HAL_RCC_TIM4_CLK_SLEEP_DISABLE

__HAL_RCC_TIM5_CLK_SLEEP_DISABLE

__HAL_RCC_TIM6_CLK_SLEEP_DISABLE

__HAL_RCC_TIM7_CLK_SLEEP_DISABLE

__HAL_RCC_RTCAPB_CLK_SLEEP_DISABLE

__HAL_RCC_WWDG_CLK_SLEEP_DISABLE

__HAL_RCC_SPI2_CLK_SLEEP_DISABLE

__HAL_RCC_SPI3_CLK_SLEEP_DISABLE

__HAL_RCC_USART2_CLK_SLEEP_DISABLE

__HAL_RCC_USART3_CLK_SLEEP_DISABLE

__HAL_RCC_UART4_CLK_SLEEP_DISABLE

__HAL_RCC_UART5_CLK_SLEEP_DISABLE

__HAL_RCC_I2C1_CLK_SLEEP_DISABLE

__HAL_RCC_I2C2_CLK_SLEEP_DISABLE

__HAL_RCC_I2C3_CLK_SLEEP_DISABLE

__HAL_RCC_I2C4_CLK_SLEEP_DISABLE

__HAL_RCC_CRS_CLK_SLEEP_DISABLE

__HAL_RCC_CAN1_CLK_SLEEP_DISABLE

__HAL_RCC_PWR_CLK_SLEEP_DISABLE

__HAL_RCC_DAC1_CLK_SLEEP_DISABLE

__HAL_RCC_OPAMP_CLK_SLEEP_DISABLE

__HAL_RCC_LPTIM1_CLK_SLEEP_DISABLE

__HAL_RCC_LPUART1_CLK_SLEEP_DISABLE

__HAL_RCC_LPTIM2_CLK_SLEEP_DISABLE

APB1 Peripheral Clock Sleep Enabled or Disabled Status

__HAL_RCC_TIM2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM3_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM4_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM5_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM6_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM7_IS_CLK_SLEEP_ENABLED

__HAL_RCC_RTCAPB_IS_CLK_SLEEP_ENABLED

__HAL_RCC_WWDG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SPI2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SPI3_IS_CLK_SLEEP_ENABLED

__HAL_RCC_USART2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_USART3_IS_CLK_SLEEP_ENABLED

__HAL_RCC_UART4_IS_CLK_SLEEP_ENABLED

__HAL_RCC_UART5_IS_CLK_SLEEP_ENABLED

__HAL_RCC_I2C1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_I2C2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_I2C3_IS_CLK_SLEEP_ENABLED

__HAL_RCC_I2C4_IS_CLK_SLEEP_ENABLED

__HAL_RCC_CRS_IS_CLK_SLEEP_ENABLED

__HAL_RCC_CAN1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_PWR_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DAC1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_OPAMP_IS_CLK_SLEEP_ENABLED

__HAL_RCC_LPTIM1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_LPUART1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_LPTIM2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM3_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM4_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM5_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM6_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM7_IS_CLK_SLEEP_DISABLED

__HAL_RCC_RTCAPB_IS_CLK_SLEEP_DISABLED

__HAL_RCC_WWDG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SPI2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SPI3_IS_CLK_SLEEP_DISABLED

__HAL_RCC_USART2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_USART3_IS_CLK_SLEEP_DISABLED

__HAL_RCC_UART4_IS_CLK_SLEEP_DISABLED

__HAL_RCC_UART5_IS_CLK_SLEEP_DISABLED

__HAL_RCC_I2C1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_I2C2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_I2C3_IS_CLK_SLEEP_DISABLED

__HAL_RCC_I2C4_IS_CLK_SLEEP_DISABLED

__HAL_RCC_CRS_IS_CLK_SLEEP_DISABLED

__HAL_RCC_CAN1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_PWR_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DAC1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_OPAMP_IS_CLK_SLEEP_DISABLED

__HAL_RCC_LPTIM1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_LPUART1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_LPTIM2_IS_CLK_SLEEP_DISABLED

APB1 Peripheral Force Release Reset

__HAL_RCC_APB1_FORCE_RESET

__HAL_RCC_TIM2_FORCE_RESET

__HAL_RCC_TIM3_FORCE_RESET

__HAL_RCC_TIM4_FORCE_RESET

__HAL_RCC_TIM5_FORCE_RESET

__HAL_RCC_TIM6_FORCE_RESET

__HAL_RCC_TIM7_FORCE_RESET

__HAL_RCC_SPI2_FORCE_RESET

__HAL_RCC_SPI3_FORCE_RESET

__HAL_RCC_USART2_FORCE_RESET

__HAL_RCC_USART3_FORCE_RESET

__HAL_RCC_UART4_FORCE_RESET

__HAL_RCC_UART5_FORCE_RESET

__HAL_RCC_I2C1_FORCE_RESET

__HAL_RCC_I2C2_FORCE_RESET

__HAL_RCC_I2C3_FORCE_RESET

__HAL_RCC_I2C4_FORCE_RESET

__HAL_RCC_CRS_FORCE_RESET

__HAL_RCC_CAN1_FORCE_RESET

__HAL_RCC_PWR_FORCE_RESET

__HAL_RCC_DAC1_FORCE_RESET

__HAL_RCC_OPAMP_FORCE_RESET

__HAL_RCC_LPTIM1_FORCE_RESET

__HAL_RCC_LPUART1_FORCE_RESET

__HAL_RCC_LPTIM2_FORCE_RESET

__HAL_RCC_APB1_RELEASE_RESET

__HAL_RCC_TIM2_RELEASE_RESET

__HAL_RCC_TIM3_RELEASE_RESET

__HAL_RCC_TIM4_RELEASE_RESET

__HAL_RCC_TIM5_RELEASE_RESET

__HAL_RCC_TIM6_RELEASE_RESET

__HAL_RCC_TIM7_RELEASE_RESET

__HAL_RCC_SPI2_RELEASE_RESET

__HAL_RCC_SPI3_RELEASE_RESET

__HAL_RCC_USART2_RELEASE_RESET

__HAL_RCC_USART3_RELEASE_RESET

__HAL_RCC_UART4_RELEASE_RESET

__HAL_RCC_UART5_RELEASE_RESET

__HAL_RCC_I2C1_RELEASE_RESET

__HAL_RCC_I2C2_RELEASE_RESET

__HAL_RCC_I2C3_RELEASE_RESET

__HAL_RCC_I2C4_RELEASE_RESET

__HAL_RCC_CRS_RELEASE_RESET

__HAL_RCC_CAN1_RELEASE_RESET

__HAL_RCC_PWR_RELEASE_RESET

__HAL_RCC_DAC1_RELEASE_RESET

__HAL_RCC_OPAMP_RELEASE_RESET

__HAL_RCC_LPTIM1_RELEASE_RESET

__HAL_RCC_LPUART1_RELEASE_RESET

__HAL_RCC_LPTIM2_RELEASE_RESET

APB2 Peripheral Clock Enable Disable

__HAL_RCC_SYSCFG_CLK_ENABLE

__HAL_RCC_FIREWALL_CLK_ENABLE

__HAL_RCC_TIM1_CLK_ENABLE

__HAL_RCC_SPI1_CLK_ENABLE

__HAL_RCC_TIM8_CLK_ENABLE

__HAL_RCC_USART1_CLK_ENABLE

__HAL_RCC_TIM15_CLK_ENABLE

__HAL_RCC_TIM16_CLK_ENABLE

__HAL_RCC_TIM17_CLK_ENABLE

__HAL_RCC_SAI1_CLK_ENABLE

__HAL_RCC_SAI2_CLK_ENABLE

__HAL_RCC_DFSDM1_CLK_ENABLE

__HAL_RCC_LTDC_CLK_ENABLE

__HAL_RCC_DSI_CLK_ENABLE

__HAL_RCC_SYSCFG_CLK_DISABLE

__HAL_RCC_TIM1_CLK_DISABLE

__HAL_RCC_SPI1_CLK_DISABLE

__HAL_RCC_TIM8_CLK_DISABLE

__HAL_RCC_USART1_CLK_DISABLE

__HAL_RCC_TIM15_CLK_DISABLE

__HAL_RCC_TIM16_CLK_DISABLE

__HAL_RCC_TIM17_CLK_DISABLE

__HAL_RCC_SAI1_CLK_DISABLE

__HAL_RCC_SAI2_CLK_DISABLE

__HAL_RCC_DFSDM1_CLK_DISABLE

__HAL_RCC_LTDC_CLK_DISABLE

__HAL_RCC_DSI_CLK_DISABLE

APB2 Peripheral Clock Enabled or Disabled Status

__HAL_RCC_SYSCFG_IS_CLK_ENABLED

__HAL_RCC_FIREWALL_IS_CLK_ENABLED

__HAL_RCC_TIM1_IS_CLK_ENABLED

__HAL_RCC_SPI1_IS_CLK_ENABLED

__HAL_RCC_TIM8_IS_CLK_ENABLED

__HAL_RCC_USART1_IS_CLK_ENABLED

__HAL_RCC_TIM15_IS_CLK_ENABLED

__HAL_RCC_TIM16_IS_CLK_ENABLED

__HAL_RCC_TIM17_IS_CLK_ENABLED

__HAL_RCC_SAI1_IS_CLK_ENABLED

__HAL_RCC_SAI2_IS_CLK_ENABLED

__HAL_RCC_DFSDM1_IS_CLK_ENABLED

__HAL_RCC_LTDC_IS_CLK_ENABLED

__HAL_RCC_DSI_IS_CLK_ENABLED

__HAL_RCC_SYSCFG_IS_CLK_DISABLED

__HAL_RCC_TIM1_IS_CLK_DISABLED

__HAL_RCC_SPI1_IS_CLK_DISABLED

__HAL_RCC_TIM8_IS_CLK_DISABLED

__HAL_RCC_USART1_IS_CLK_DISABLED

__HAL_RCC_TIM15_IS_CLK_DISABLED

__HAL_RCC_TIM16_IS_CLK_DISABLED

__HAL_RCC_TIM17_IS_CLK_DISABLED

__HAL_RCC_SAI1_IS_CLK_DISABLED

__HAL_RCC_SAI2_IS_CLK_DISABLED

__HAL_RCC_DFSDM1_IS_CLK_DISABLED

__HAL_RCC_LTDC_IS_CLK_DISABLED

__HAL_RCC_DSI_IS_CLK_DISABLED

APB2 Peripheral Clock Sleep Enable Disable

__HAL_RCC_SYSCFG_CLK_SLEEP_ENABLE

__HAL_RCC_TIM1_CLK_SLEEP_ENABLE

__HAL_RCC_SPI1_CLK_SLEEP_ENABLE

__HAL_RCC_TIM8_CLK_SLEEP_ENABLE

__HAL_RCC_USART1_CLK_SLEEP_ENABLE

__HAL_RCC_TIM15_CLK_SLEEP_ENABLE

__HAL_RCC_TIM16_CLK_SLEEP_ENABLE

__HAL_RCC_TIM17_CLK_SLEEP_ENABLE

__HAL_RCC_SAI1_CLK_SLEEP_ENABLE

__HAL_RCC_SAI2_CLK_SLEEP_ENABLE

__HAL_RCC_DFSDM1_CLK_SLEEP_ENABLE

__HAL_RCC_LTDC_CLK_SLEEP_ENABLE

__HAL_RCC_DSI_CLK_SLEEP_ENABLE

__HAL_RCC_SYSCFG_CLK_SLEEP_DISABLE

__HAL_RCC_TIM1_CLK_SLEEP_DISABLE

__HAL_RCC_SPI1_CLK_SLEEP_DISABLE

__HAL_RCC_TIM8_CLK_SLEEP_DISABLE

__HAL_RCC_USART1_CLK_SLEEP_DISABLE

__HAL_RCC_TIM15_CLK_SLEEP_DISABLE

__HAL_RCC_TIM16_CLK_SLEEP_DISABLE

__HAL_RCC_TIM17_CLK_SLEEP_DISABLE

__HAL_RCC_SAI1_CLK_SLEEP_DISABLE

__HAL_RCC_SAI2_CLK_SLEEP_DISABLE

__HAL_RCC_DFSDM1_CLK_SLEEP_DISABLE

__HAL_RCC_LTDC_CLK_SLEEP_DISABLE

__HAL_RCC_DSI_CLK_SLEEP_DISABLE

APB2 Peripheral Clock Sleep Enabled or Disabled Status

__HAL_RCC_SYSCFG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SPI1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM8_IS_CLK_SLEEP_ENABLED

__HAL_RCC_USART1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM15_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM16_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM17_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SAI1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SAI2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DFSDM1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_LTDC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DSI_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SYSCFG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SPI1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM8_IS_CLK_SLEEP_DISABLED

__HAL_RCC_USART1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM15_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM16_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM17_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SAI1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SAI2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DFSDM1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_LTDC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DSI_IS_CLK_SLEEP_DISABLED

APB2 Peripheral Force Release Reset

__HAL_RCC_APB2_FORCE_RESET

__HAL_RCC_SYSCFG_FORCE_RESET

__HAL_RCC_TIM1_FORCE_RESET

__HAL_RCC_SPI1_FORCE_RESET

__HAL_RCC_TIM8_FORCE_RESET

__HAL_RCC_USART1_FORCE_RESET

__HAL_RCC_TIM15_FORCE_RESET

__HAL_RCC_TIM16_FORCE_RESET

__HAL_RCC_TIM17_FORCE_RESET

__HAL_RCC_SAI1_FORCE_RESET

__HAL_RCC_SAI2_FORCE_RESET

__HAL_RCC_DFSDM1_FORCE_RESET

__HAL_RCC_LTDC_FORCE_RESET

__HAL_RCC_DSI_FORCE_RESET

__HAL_RCC_APB2_RELEASE_RESET

__HAL_RCC_SYSCFG_RELEASE_RESET

__HAL_RCC_TIM1_RELEASE_RESET

__HAL_RCC_SPI1_RELEASE_RESET

__HAL_RCC_TIM8_RELEASE_RESET

__HAL_RCC_USART1_RELEASE_RESET

__HAL_RCC_TIM15_RELEASE_RESET

__HAL_RCC_TIM16_RELEASE_RESET

__HAL_RCC_TIM17_RELEASE_RESET

__HAL_RCC_SAI1_RELEASE_RESET

__HAL_RCC_SAI2_RELEASE_RESET

__HAL_RCC_DFSDM1_RELEASE_RESET

__HAL_RCC_LTDC_RELEASE_RESET

__HAL_RCC_DSI_RELEASE_RESET

RCC Backup Domain Reset

__HAL_RCC_BACKUPRESET_FORCE

Description:

- Macros to force or release the Backup domain reset.

Return value:

- None

Notes:

- This function resets the RTC peripheral (including the backup registers) and the RTC clock source selection in RCC_CSR register. The BKPSRAM is not affected by this reset.

__HAL_RCC_BACKUPRESET_RELEASE

RCC Exported Macros

__HAL_RCC_HSI_ENABLE

Description:

- Macros to enable or disable the Internal High Speed 16MHz oscillator (HSI).

Return value:

- None

Notes:

- The HSI is stopped by hardware when entering STOP and STANDBY modes. It is used (enabled by hardware) as system clock source after startup from Reset, wakeup from STOP and STANDBY mode, or in case of failure of the HSE used directly or indirectly as system clock (if the Clock Security System CSS is enabled). HSI can not be stopped if it is used as system clock source. In this case, you have to select another source of the system clock then stop the HSI. After enabling the HSI, the application software should wait on HSIRDY flag to be set indicating that HSI clock is stable and can be used as system clock source. This parameter can be: ENABLE or DISABLE. When the HSI is stopped, HSIRDY flag goes low after 6 HSI oscillator clock cycles.

__HAL_RCC_HSI_DISABLE

__HAL_RCC_HSI_CALIBRATIONVALUE_ADJUST

Description:

- Macro to adjust the Internal High Speed 16MHz oscillator (HSI) calibration value.

Parameters:

- __HSICALIBRATIONVALUE__: specifies the calibration trimming value (default is RCC_HSICALIBRATION_DEFAULT). This parameter must be a number between 0 and 0x1F (STM32L43x/STM32L44x/STM32L47x/STM32L48x) or 0x7F (for other devices).

Return value:

- None

Notes:

- The calibration is used to compensate for the variations in voltage and temperature that influence the frequency of the internal HSI RC.

__HAL_RCC_HSIAUTOMATIC_START_ENABLE

Description:

- Macros to enable or disable the wakeup the Internal High Speed oscillator (HSI) in parallel to the Internal Multi Speed oscillator (MSI) used at system wakeup.

Return value:

- None

Notes:

- The enable of this function has not effect on the HSION bit. This parameter can be: ENABLE or DISABLE.

__HAL_RCC_HSIAUTOMATIC_START_DISABLE

__HAL_RCC_HSISTOP_ENABLE

Description:

- Macros to enable or disable the force of the Internal High Speed oscillator (HSI) in STOP mode to be quickly available as kernel clock for USARTs and I2Cs.

Return value:

- None

Notes:

- Keeping the HSI ON in STOP mode allows to avoid slowing down the communication speed because of the HSI startup time. The enable of this function has not effect on the HSION bit. This parameter can be: ENABLE or DISABLE.

__HAL_RCC_HSISTOP_DISABLE

__HAL_RCC_MSI_ENABLE

Description:

- Macros to enable or disable the Internal Multi Speed oscillator (MSI).

Return value:

- None

Notes:

- The MSI is stopped by hardware when entering STOP and STANDBY modes. It is used (enabled by hardware) as system clock source after startup from Reset, wakeup from STOP and STANDBY mode, or in case of failure of the HSE used directly or indirectly as system clock (if the Clock Security System CSS is enabled). MSI can not be stopped if it is used as system clock source. In this case, you have to select another source of the system clock then stop the MSI. After enabling the MSI, the application software should wait on MSIRDY flag to be set indicating that MSI clock is stable and can be used as system clock source. When the MSI is stopped, MSIRDY flag goes low after 6 MSI oscillator clock cycles.

__HAL_RCC_MSI_DISABLE

__HAL_RCC_MSI_CALIBRATIONVALUE_ADJUST

Description:

- Macro Adjusts the Internal Multi Speed oscillator (MSI) calibration value.

Parameters:

- __MSICALIBRATIONVALUE__: specifies the calibration trimming value (default is RCC_MSICALIBRATION_DEFAULT). This parameter must be a number between 0 and 255.

Return value:

- None

Notes:

- The calibration is used to compensate for the variations in voltage and temperature that influence the frequency of the internal MSI RC. Refer to the Application Note AN3300 for more details on how to calibrate the MSI.

__HAL_RCC_MSI_RANGE_CONFIG

Description:

- Macro configures the Internal Multi Speed oscillator (MSI) clock range in run mode.

Parameters:

- __MSIRANGEVALUE__: specifies the MSI clock range. This parameter must be one of the following values:
  - RCC_MSIRANGE_0 MSI clock is around 100 KHz
  - RCC_MSIRANGE_1 MSI clock is around 200 KHz
  - RCC_MSIRANGE_2 MSI clock is around 400 KHz
  - RCC_MSIRANGE_3 MSI clock is around 800 KHz
  - RCC_MSIRANGE_4 MSI clock is around 1 MHz
  - RCC_MSIRANGE_5 MSI clock is around 2 MHz
  - RCC_MSIRANGE_6 MSI clock is around 4 MHz (default after Reset)
  - RCC_MSIRANGE_7 MSI clock is around 8 MHz
  - RCC_MSIRANGE_8 MSI clock is around 16 MHz
  - RCC_MSIRANGE_9 MSI clock is around 24 MHz
  - RCC_MSIRANGE_10 MSI clock is around 32 MHz
  - RCC_MSIRANGE_11 MSI clock is around 48 MHz

Return value:

- None

Notes:

- After restart from Reset , the MSI clock is around 4 MHz. After stop the startup clock can be MSI (at any of its possible frequencies, the one that was used before entering stop mode) or HSI. After Standby its frequency can be selected between 4 possible values (1, 2, 4 or 8 MHz). MSIRANGE can be modified when MSI is OFF (MSION=0) or when MSI is ready (MSIRDY=1). The MSI clock range after reset can be modified on the fly.

__HAL_RCC_MSI_STANDBY_RANGE_CONFIG

Description:

- Macro configures the Internal Multi Speed oscillator (MSI) clock range after Standby mode After Standby its frequency can be selected between 4 possible values (1, 2, 4 or 8 MHz).

Parameters:

- __MSIRANGEVALUE__: specifies the MSI clock range. This parameter must be one of the following values:
  - RCC_MSIRANGE_4 MSI clock is around 1 MHz
  - RCC_MSIRANGE_5 MSI clock is around 2 MHz
  - RCC_MSIRANGE_6 MSI clock is around 4 MHz (default after Reset)
  - RCC_MSIRANGE_7 MSI clock is around 8 MHz

Return value:

- None

__HAL_RCC_GET_MSI_RANGE

Description:

- Macro to get the Internal Multi Speed oscillator (MSI) clock range in run mode.

Return value:

- MSI: clock range. This parameter must be one of the following values:
  - RCC_MSIRANGE_0 MSI clock is around 100 KHz
  - RCC_MSIRANGE_1 MSI clock is around 200 KHz
  - RCC_MSIRANGE_2 MSI clock is around 400 KHz
  - RCC_MSIRANGE_3 MSI clock is around 800 KHz
  - RCC_MSIRANGE_4 MSI clock is around 1 MHz
  - RCC_MSIRANGE_5 MSI clock is around 2 MHz
  - RCC_MSIRANGE_6 MSI clock is around 4 MHz (default after Reset)
  - RCC_MSIRANGE_7 MSI clock is around 8 MHz
  - RCC_MSIRANGE_8 MSI clock is around 16 MHz
  - RCC_MSIRANGE_9 MSI clock is around 24 MHz
  - RCC_MSIRANGE_10 MSI clock is around 32 MHz
  - RCC_MSIRANGE_11 MSI clock is around 48 MHz

__HAL_RCC_LSI_ENABLE

Description:

- Macros to enable or disable the Internal Low Speed oscillator (LSI).

Return value:

- None

Notes:

- After enabling the LSI, the application software should wait on LSIRDY flag to be set indicating that LSI clock is stable and can be used to clock the IWDG and/or the RTC. LSI can not be disabled if the IWDG is running. When the LSI is stopped, LSIRDY flag goes low after 6 LSI oscillator clock cycles.

__HAL_RCC_LSI_DISABLE

__HAL_RCC_HSE_CONFIG

Description:

- Macro to configure the External High Speed oscillator (HSE).

Parameters:

- __STATE__: specifies the new state of the HSE. This parameter can be one of the following values:
  - RCC_HSE_OFF Turn OFF the HSE oscillator, HSERDY flag goes low after 6 HSE oscillator clock cycles.
  - RCC_HSE_ON Turn ON the HSE oscillator.
  - RCC_HSE_BYPASS HSE oscillator bypassed with external clock.

Return value:

- None

Notes:

- Transition HSE Bypass to HSE On and HSE On to HSE Bypass are not supported by this macro. User should request a transition to HSE Off first and then HSE On or HSE Bypass. After enabling the HSE (RCC_HSE_ON or RCC_HSE_Bypass), the application software should wait on HSERDY flag to be set indicating that HSE clock is stable and can be used to clock the PLL and/or system clock. HSE state can not be changed if it is used directly or through the PLL as system clock. In this case, you have to select another source of the system clock then change the HSE state (ex. disable it). The HSE is stopped by hardware when entering STOP and STANDBY modes. This function reset the CSSON bit, so if the clock security system(CSS) was previously enabled you have to enable it again after calling this function.

__HAL_RCC_LSE_CONFIG

Description:

- Macro to configure the External Low Speed oscillator (LSE).

Parameters:

- __STATE__: specifies the new state of the LSE. This parameter can be one of the following values:
  - RCC_LSE_OFF Turn OFF the LSE oscillator, LSERDY flag goes low after 6 LSE oscillator clock cycles.
  - RCC_LSE_ON Turn ON the LSE oscillator.
  - RCC_LSE_BYPASS LSE oscillator bypassed with external clock.

Return value:

- None

Notes:

- Transitions LSE Bypass to LSE On and LSE On to LSE Bypass are not supported by this macro. User should request a transition to LSE Off first and then LSE On or LSE Bypass. As the LSE is in the Backup domain and write access is denied to this domain after reset, you have to enable write access using HAL_PWR_EnableBkUpAccess() function before to configure the LSE (to be done once after reset). After enabling the LSE (RCC_LSE_ON or RCC_LSE_BYPASS), the application software should wait on LSERDY flag to be set indicating that LSE clock is stable and can be used to clock the RTC.

__HAL_RCC_HSI48_ENABLE

Description:

- Macros to enable or disable the Internal High Speed 48MHz oscillator (HSI48).

Return value:

- None

Notes:

- The HSI48 is stopped by hardware when entering STOP and STANDBY modes. After enabling the HSI48, the application software should wait on HSI48RDY flag to be set indicating that HSI48 clock is stable. This parameter can be: ENABLE or DISABLE.

__HAL_RCC_HSI48_DISABLE

__HAL_RCC_RTC_CONFIG

Description:

- Macros to configure the RTC clock (RTCCLK).

Parameters:

- __RTC_CLKSOURCE__: specifies the RTC clock source. This parameter can be one of the following values:
  - RCC_RTCCLKSOURCE_NONE No clock selected as RTC clock.
  - RCC_RTCCLKSOURCE_LSE LSE selected as RTC clock.
  - RCC_RTCCLKSOURCE_LSI LSI selected as RTC clock.
  - RCC_RTCCLKSOURCE_HSE_DIV32 HSE clock divided by 32 selected

Return value:

- None

Notes:

- As the RTC clock configuration bits are in the Backup domain and write access is denied to this domain after reset, you have to enable write access using the Power Backup Access macro before to configure the RTC clock source (to be done once after reset). Once the RTC clock is configured it cannot be changed unless the Backup domain is reset using __HAL_RCC_BACKUPRESET_FORCE() macro, or by a Power On Reset (POR).
- If the LSE or LSI is used as RTC clock source, the RTC continues to work in STOP and STANDBY modes, and can be used as wakeup source. However, when the HSE clock is used as RTC clock source, the RTC cannot be used in STOP and STANDBY modes. The maximum input clock frequency for RTC is 1MHz (when using HSE as RTC clock source).

__HAL_RCC_GET_RTC_SOURCE

Description:

- Macro to get the RTC clock source.

Return value:

- The: returned value can be one of the following:
  - RCC_RTCCLKSOURCE_NONE No clock selected as RTC clock.
  - RCC_RTCCLKSOURCE_LSE LSE selected as RTC clock.
  - RCC_RTCCLKSOURCE_LSI LSI selected as RTC clock.
  - RCC_RTCCLKSOURCE_HSE_DIV32 HSE clock divided by 32 selected

__HAL_RCC_PLL_ENABLE

Description:

- Macros to enable or disable the main PLL.

Return value:

- None

Notes:

- After enabling the main PLL, the application software should wait on PLLRDY flag to be set indicating that PLL clock is stable and can be used as system clock source. The main PLL can not be disabled if it is used as system clock source The main PLL is disabled by hardware when entering STOP and STANDBY modes.

__HAL_RCC_PLL_DISABLE

__HAL_RCC_PLL_PLLSOURCE_CONFIG

Description:

- Macro to configure the PLL clock source.

Parameters:

- __PLLSOURCE__: specifies the PLL entry clock source. This parameter can be one of the following values:
  - RCC_PLLSOURCE_NONE No clock selected as PLL clock entry
  - RCC_PLLSOURCE_MSI MSI oscillator clock selected as PLL clock entry
  - RCC_PLLSOURCE_HSI HSI oscillator clock selected as PLL clock entry
  - RCC_PLLSOURCE_HSE HSE oscillator clock selected as PLL clock entry

Return value:

- None

Notes:

- This function must be used only when the main PLL is disabled.
- This clock source is common for the main PLL and audio PLL (PLLSAI1 and PLLSAI2).

__HAL_RCC_PLL_PLLM_CONFIG

Description:

- Macro to configure the PLL source division factor M.

Parameters:

- __PLLM__: specifies the division factor for PLL VCO input clock This parameter must be a number between Min_Data = 1 and Max_Data = 16 on STM32L4Rx/STM32L4Sx devices. This parameter must be a number between Min_Data = 1 and Max_Data = 8 on other devices.

Return value:

- None

Notes:

- This function must be used only when the main PLL is disabled.
- You have to set the PLLM parameter correctly to ensure that the VCO input frequency ranges from 4 to 16 MHz. It is recommended to select a frequency of 16 MHz to limit PLL jitter.

__HAL_RCC_PLL_CONFIG

Description:

- Macro to configure the main PLL clock source, multiplication and division factors.

Parameters:

- __PLLSOURCE__: specifies the PLL entry clock source. This parameter can be one of the following values:
  - RCC_PLLSOURCE_NONE No clock selected as PLL clock entry
  - RCC_PLLSOURCE_MSI MSI oscillator clock selected as PLL clock entry
  - RCC_PLLSOURCE_HSI HSI oscillator clock selected as PLL clock entry
  - RCC_PLLSOURCE_HSE HSE oscillator clock selected as PLL clock entry
- __PLLM__: specifies the division factor for PLL VCO input clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16 on STM32L4Rx/STM32L4Sx devices. This parameter must be a number between Min_Data = 1 and Max_Data = 8 on other devices.
- __PLLN__: specifies the multiplication factor for PLL VCO output clock. This parameter must be a number between 8 and 86.
- __PLLP__: specifies the division factor for SAI clock when SAI available on device. This parameter must be a number in the range (7 or 17) for STM32L47x/STM32L48x else (2 to 31).
- __PLLQ__: specifies the division factor for OTG FS, SDMMC1 and RNG clocks. This parameter must be in the range (2, 4, 6 or 8).
- __PLLR__: specifies the division factor for the main system clock.

Return value:

- None

Notes:

- This function must be used only when the main PLL is disabled.
- This clock source is common for the main PLL and audio PLL (PLLSAI1 and PLLSAI2).
- You have to set the PLLM parameter correctly to ensure that the VCO input frequency ranges from 4 to 16 MHz. It is recommended to select a frequency of 16 MHz to limit PLL jitter.
- You have to set the PLLN parameter correctly to ensure that the VCO output frequency is between 64 and 344 MHz.
- If the USB OTG FS is used in your application, you have to set the PLLQ parameter correctly to have 48 MHz clock for the USB. However, the SDMMC1 and RNG need a frequency lower than or equal to 48 MHz to work correctly.
- You have to set the PLLR parameter correctly to not exceed 80MHZ. This parameter must be in the range (2, 4, 6 or 8).

__HAL_RCC_GET_PLL_OSCSOURCE

Description:

- Macro to get the oscillator used as PLL clock source.

Return value:

- The: oscillator used as PLL clock source. The returned value can be one of the following:
  - RCC_PLLSOURCE_NONE: No oscillator is used as PLL clock source.
  - RCC_PLLSOURCE_MSI: MSI oscillator is used as PLL clock source.
  - RCC_PLLSOURCE_HSI: HSI oscillator is used as PLL clock source.
  - RCC_PLLSOURCE_HSE: HSE oscillator is used as PLL clock source.

__HAL_RCC_PLLCLKOUT_ENABLE

Description:

- Enable or disable each clock output (RCC_PLL_SYSCLK, RCC_PLL_48M1CLK, RCC_PLL_SAI3CLK)

Parameters:

- __PLLCLOCKOUT__: specifies the PLL clock to be output. This parameter can be one or a combination of the following values:
  - RCC_PLL_SAI3CLK This clock is used to generate an accurate clock to achieve high-quality audio performance on SAI interface in case.
  - RCC_PLL_48M1CLK This Clock is used to generate the clock for the USB OTG FS (48 MHz), the random analog generator (<=48 MHz) and the SDMMC1 (<= 48 MHz).
  - RCC_PLL_SYSCLK This Clock is used to generate the high speed system clock (up to 80MHz)

Return value:

- None

Notes:

- Enabling/disabling clock outputs RCC_PLL_SAI3CLK and RCC_PLL_48M1CLK can be done at anytime without the need to stop the PLL in order to save power. But RCC_PLL_SYSCLK cannot be stopped if used as System Clock.

__HAL_RCC_PLLCLKOUT_DISABLE

__HAL_RCC_GET_PLLCLKOUT_CONFIG

Description:

- Get clock output enable status (RCC_PLL_SYSCLK, RCC_PLL_48M1CLK, RCC_PLL_SAI3CLK)

Parameters:

- __PLLCLOCKOUT__: specifies the output PLL clock to be checked. This parameter can be one of the following values:
  - RCC_PLL_SAI3CLK This clock is used to generate an accurate clock to achieve high-quality audio performance on SAI interface in case.
  - RCC_PLL_48M1CLK This Clock is used to generate the clock for the USB OTG FS (48 MHz), the random analog generator (<=48 MHz) and the SDMMC1 (<= 48 MHz).
  - RCC_PLL_SYSCLK This Clock is used to generate the high speed system clock (up to 80MHz)

Return value:

- SET: / RESET

__HAL_RCC_SYSCLK_CONFIG

Description:

- Macro to configure the system clock source.

Parameters:

- __SYSCLKSOURCE__: specifies the system clock source. This parameter can be one of the following values:
  - RCC_SYSCLKSOURCE_MSI: MSI oscillator is used as system clock source.
  - RCC_SYSCLKSOURCE_HSI: HSI oscillator is used as system clock source.
  - RCC_SYSCLKSOURCE_HSE: HSE oscillator is used as system clock source.
  - RCC_SYSCLKSOURCE_PLLCLK: PLL output is used as system clock source.

Return value:

- None

__HAL_RCC_GET_SYSCLK_SOURCE

Description:

- Macro to get the clock source used as system clock.

Return value:

- The: clock source used as system clock. The returned value can be one of the following:
  - RCC_SYSCLKSOURCE_STATUS_MSI: MSI used as system clock.
  - RCC_SYSCLKSOURCE_STATUS_HSI: HSI used as system clock.
  - RCC_SYSCLKSOURCE_STATUS_HSE: HSE used as system clock.
  - RCC_SYSCLKSOURCE_STATUS_PLLCLK: PLL used as system clock.

__HAL_RCC_LSEDRIVE_CONFIG

Description:

- Macro to configure the External Low Speed oscillator (LSE) drive capability.

Parameters:

- __LSEDRIVE__: specifies the new state of the LSE drive capability. This parameter can be one of the following values:
  - RCC_LSEDRIVE_LOW LSE oscillator low drive capability.
  - RCC_LSEDRIVE_MEDIUMLOW LSE oscillator medium low drive capability.
  - RCC_LSEDRIVE_MEDIUMHIGH LSE oscillator medium high drive capability.
  - RCC_LSEDRIVE_HIGH LSE oscillator high drive capability.

Return value:

- None

Notes:

- As the LSE is in the Backup domain and write access is denied to this domain after reset, you have to enable write access using HAL_PWR_EnableBkUpAccess() function before to configure the LSE (to be done once after reset).

__HAL_RCC_WAKEUPSTOP_CLK_CONFIG

Description:

- Macro to configure the wake up from stop clock.

Parameters:

- __STOPWUCLK__: specifies the clock source used after wake up from stop. This parameter can be one of the following values:
  - RCC_STOP_WAKEUPCLOCK_MSI MSI selected as system clock source
  - RCC_STOP_WAKEUPCLOCK_HSI HSI selected as system clock source

Return value:

- None

__HAL_RCC_MCO1_CONFIG

Description:

- Macro to configure the MCO clock.

Parameters:

- __MCOCLKSOURCE__: specifies the MCO clock source. This parameter can be one of the following values:
  - RCC_MCO1SOURCE_NOCLOCK MCO output disabled
  - RCC_MCO1SOURCE_SYSCLK System clock selected as MCO source
  - RCC_MCO1SOURCE_MSI MSI clock selected as MCO source
  - RCC_MCO1SOURCE_HSI HSI clock selected as MCO source
  - RCC_MCO1SOURCE_HSE HSE clock selected as MCO sourcee
  - RCC_MCO1SOURCE_PLLCLK Main PLL clock selected as MCO source
  - RCC_MCO1SOURCE_LSI LSI clock selected as MCO source
  - RCC_MCO1SOURCE_LSE LSE clock selected as MCO source
- __MCODIV__: specifies the MCO clock prescaler. This parameter can be one of the following values:
  - RCC_MCODIV_1 MCO clock source is divided by 1
  - RCC_MCODIV_2 MCO clock source is divided by 2
  - RCC_MCODIV_4 MCO clock source is divided by 4
  - RCC_MCODIV_8 MCO clock source is divided by 8
  - RCC_MCODIV_16 MCO clock source is divided by 16

Flags

RCC_FLAG_MSIRDY

MSI Ready flag

RCC_FLAG_HSIRDY

HSI Ready flag

RCC_FLAG_HSERDY

HSE Ready flag

RCC_FLAG_PLLRDY

PLL Ready flag

RCC_FLAG_PLLSAI1RDY

PLLSAI1 Ready flag

RCC_FLAG_PLLSAI2RDY

PLLSAI2 Ready flag

RCC_FLAG_LSERDY

LSE Ready flag

RCC_FLAG_LSECSSD

LSE Clock Security System Interrupt flag

RCC_FLAG_LSIRDY

LSI Ready flag

RCC_FLAG_FWRST

Firewall reset flag

RCC_FLAG_OBLRST

Option Byte Loader reset flag

RCC_FLAG_PINRST

PIN reset flag

RCC_FLAG_BORRST

BOR reset flag

RCC_FLAG_SFTRST

Software Reset flag

RCC_FLAG_IWDGRST

Independent Watchdog reset flag

RCC_FLAG_WWDGRST

Window watchdog reset flag

RCC_FLAG_LPWRRST

Low-Power reset flag

RCC_FLAG_HSI48RDY

HSI48 Ready flag

Flags Interrupts Management

__HAL_RCC_ENABLE_IT

Description:

- Enable RCC interrupt(s).

Parameters:

- __INTERRUPT__: specifies the RCC interrupt source(s) to be enabled. This parameter can be any combination of the following values:
  - RCC_IT_LSIRDY LSI ready interrupt
  - RCC_IT_LSERDY LSE ready interrupt
  - RCC_IT_MSIRDY HSI ready interrupt
  - RCC_IT_HSIRDY HSI ready interrupt
  - RCC_IT_HSERDY HSE ready interrupt
  - RCC_IT_PLLRDY Main PLL ready interrupt
  - RCC_IT_PLLSAI1RDY PLLSAI1 ready interrupt for devices with PLLSAI1
  - RCC_IT_PLLSAI2RDY PLLSAI2 ready interrupt for devices with PLLSAI2
  - RCC_IT_LSECSS LSE Clock security system interrupt

Return value:

- None

__HAL_RCC_DISABLE_IT

Description:

- Disable RCC interrupt(s).

Parameters:

- __INTERRUPT__: specifies the RCC interrupt source(s) to be disabled. This parameter can be any combination of the following values:
  - RCC_IT_LSIRDY LSI ready interrupt
  - RCC_IT_LSERDY LSE ready interrupt
  - RCC_IT_MSIRDY HSI ready interrupt
  - RCC_IT_HSIRDY HSI ready interrupt
  - RCC_IT_HSERDY HSE ready interrupt
  - RCC_IT_PLLRDY Main PLL ready interrupt
  - RCC_IT_PLLSAI1RDY PLLSAI1 ready interrupt for devices with PLLSAI1
  - RCC_IT_PLLSAI2RDY PLLSAI2 ready interrupt for devices with PLLSAI2
  - RCC_IT_LSECSS LSE Clock security system interrupt

Return value:

- None

__HAL_RCC_CLEAR_IT

Description:

- Clear the RCC's interrupt pending bits.

Parameters:

- __INTERRUPT__: specifies the interrupt pending bit to clear. This parameter can be any combination of the following values:
  - RCC_IT_LSIRDY LSI ready interrupt
  - RCC_IT_LSERDY LSE ready interrupt
  - RCC_IT_MSIRDY MSI ready interrupt
  - RCC_IT_HSIRDY HSI ready interrupt
  - RCC_IT_HSERDY HSE ready interrupt
  - RCC_IT_PLLRDY Main PLL ready interrupt
  - RCC_IT_PLLSAI1RDY PLLSAI1 ready interrupt for devices with PLLSAI1
  - RCC_IT_PLLSAI2RDY PLLSAI2 ready interrupt for devices with PLLSAI2
  - RCC_IT_CSS HSE Clock security system interrupt
  - RCC_IT_LSECSS LSE Clock security system interrupt

Return value:

- None

__HAL_RCC_GET_IT

Description:

- Check whether the RCC interrupt has occurred or not.

Parameters:

- __INTERRUPT__: specifies the RCC interrupt source to check. This parameter can be one of the following values:
  - RCC_IT_LSIRDY LSI ready interrupt
  - RCC_IT_LSERDY LSE ready interrupt
  - RCC_IT_MSIRDY MSI ready interrupt
  - RCC_IT_HSIRDY HSI ready interrupt
  - RCC_IT_HSERDY HSE ready interrupt
  - RCC_IT_PLLRDY Main PLL ready interrupt
  - RCC_IT_PLLSAI1RDY PLLSAI1 ready interrupt for devices with PLLSAI1
  - RCC_IT_PLLSAI2RDY PLLSAI2 ready interrupt for devices with PLLSAI2
  - RCC_IT_CSS HSE Clock security system interrupt
  - RCC_IT_LSECSS LSE Clock security system interrupt

Return value:

- The: new state of __INTERRUPT__ (TRUE or FALSE).

__HAL_RCC_CLEAR_RESET_FLAGS

Description:

- Set RMVF bit to clear the reset flags.

Return value:

- None

__HAL_RCC_GET_FLAG

Description:

- Check whether the selected RCC flag is set or not.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - RCC_FLAG_MSIRDY MSI oscillator clock ready
  - RCC_FLAG_HSIRDY HSI oscillator clock ready
  - RCC_FLAG_HSERDY HSE oscillator clock ready
  - RCC_FLAG_PLLRDY Main PLL clock ready
  - RCC_FLAG_PLLSAI1RDY PLLSAI1 clock ready for devices with PLLSAI1
  - RCC_FLAG_PLLSAI2RDY PLLSAI2 clock ready for devices with PLLSAI2
  - RCC_FLAG_LSERDY LSE oscillator clock ready
  - RCC_FLAG_LSECSSD Clock security system failure on LSE oscillator detection
  - RCC_FLAG_LSIRDY LSI oscillator clock ready
  - RCC_FLAG_BORRST BOR reset
  - RCC_FLAG_OBLRST OBLRST reset
  - RCC_FLAG_PINRST Pin reset
  - RCC_FLAG_FWRST FIREWALL reset
  - RCC_FLAG_SFTRST Software reset
  - RCC_FLAG_IWDGRST Independent Watchdog reset
  - RCC_FLAG_WWDGRST Window Watchdog reset
  - RCC_FLAG_LPWRRST Low Power reset

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

HSE Config

RCC_HSE_OFF

HSE clock deactivation

RCC_HSE_ON

HSE clock activation

RCC_HSE_BYPASS

External clock source for HSE clock

HSI48 Config

RCC_HSI48_OFF

HSI48 clock deactivation

RCC_HSI48_ON

HSI48 clock activation

HSI Config

RCC_HSI_OFF

HSI clock deactivation

RCC_HSI_ON

HSI clock activation

RCC_HSICALIBRATION_DEFAULT

Interrupts

RCC_IT_LSIRDY

LSI Ready Interrupt flag

RCC_IT_LSERDY

LSE Ready Interrupt flag

RCC_IT_MSIRDY

MSI Ready Interrupt flag

RCC_IT_HSIRDY

HSI16 Ready Interrupt flag

RCC_IT_HSERDY

HSE Ready Interrupt flag

RCC_IT_PLLRDY

PLL Ready Interrupt flag

RCC_IT_PLLSAI1RDY

PLLSAI1 Ready Interrupt flag

RCC_IT_PLLSAI2RDY

PLLSAI2 Ready Interrupt flag

RCC_IT_CSS

Clock Security System Interrupt flag

RCC_IT_LSECSS

LSE Clock Security System Interrupt flag

RCC_IT_HSI48RDY

HSI48 Ready Interrupt flag

LSE Drive Config

RCC_LSEDRIVE_LOW

LSE low drive capability

RCC_LSEDRIVE_MEDIUMLOW

LSE medium low drive capability

RCC_LSEDRIVE_MEDIUMHIGH

LSE medium high drive capability

RCC_LSEDRIVE_HIGH

LSE high drive capability

LSE Config

RCC_LSE_OFF

LSE clock deactivation

RCC_LSE_ON

LSE clock activation

RCC_LSE_BYPASS

External clock source for LSE clock

LSI Config

RCC_LSI_OFF

LSI clock deactivation

RCC_LSI_ON

LSI clock activation

MCO1 Clock Source

RCC_MCO1SOURCE_NOCLOCK

MCO1 output disabled, no clock on MCO1

RCC_MCO1SOURCE_SYSCLK

SYSCLK selection as MCO1 source

RCC_MCO1SOURCE_MSI

MSI selection as MCO1 source

RCC_MCO1SOURCE_HSI

HSI selection as MCO1 source

RCC_MCO1SOURCE_HSE

HSE selection as MCO1 source

RCC_MCO1SOURCE_PLLCLK

PLLCLK selection as MCO1 source

RCC_MCO1SOURCE_LSI

LSI selection as MCO1 source

RCC_MCO1SOURCE_LSE

LSE selection as MCO1 source

RCC_MCO1SOURCE_HSI48

HSI48 selection as MCO1 source (STM32L43x/STM32L44x devices)

MCO1 Clock Prescaler

RCC_MCODIV_1

MCO not divided

RCC_MCODIV_2

MCO divided by 2

RCC_MCODIV_4

MCO divided by 4

RCC_MCODIV_8

MCO divided by 8

RCC_MCODIV_16

MCO divided by 16

MCO Index

RCC_MCO1

RCC_MCO

MCO1 to be compliant with other families with 2 MCOs

MSI Clock Range

RCC_MSIRANGE_0

MSI = 100 KHz

RCC_MSIRANGE_1

MSI = 200 KHz

RCC_MSIRANGE_2

MSI = 400 KHz

RCC_MSIRANGE_3

MSI = 800 KHz

RCC_MSIRANGE_4

MSI = 1 MHz

RCC_MSIRANGE_5

MSI = 2 MHz

RCC_MSIRANGE_6

MSI = 4 MHz

RCC_MSIRANGE_7

MSI = 8 MHz

RCC_MSIRANGE_8

MSI = 16 MHz

RCC_MSIRANGE_9

MSI = 24 MHz

RCC_MSIRANGE_10

MSI = 32 MHz

RCC_MSIRANGE_11

MSI = 48 MHz

MSI Config

RCC_MSI_OFF

MSI clock deactivation

RCC_MSI_ON

MSI clock activation

RCC_MSICALIBRATION_DEFAULT

Default MSI calibration trimming value

Oscillator Type

RCC_OSCILLATORTYPE_NONE

Oscillator configuration unchanged

RCC_OSCILLATORTYPE_HSE

HSE to configure

RCC_OSCILLATORTYPE_HSI

HSI to configure

RCC_OSCILLATORTYPE_LSE

LSE to configure

RCC_OSCILLATORTYPE_LSI

LSI to configure

RCC_OSCILLATORTYPE_MSI

MSI to configure

RCC_OSCILLATORTYPE_HSI48

HSI48 to configure

PLLP Clock Divider

RCC_PLLP_DIV2

PLLP division factor = 2

RCC_PLLP_DIV3

PLLP division factor = 3

RCC_PLLP_DIV4

PLLP division factor = 4

RCC_PLLP_DIV5

PLLP division factor = 5

RCC_PLLP_DIV6

PLLP division factor = 6

RCC_PLLP_DIV7

PLLP division factor = 7

RCC_PLLP_DIV8

PLLP division factor = 8

RCC_PLLP_DIV9

PLLP division factor = 9

RCC_PLLP_DIV10

PLLP division factor = 10

RCC_PLLP_DIV11

PLLP division factor = 11

RCC_PLLP_DIV12

PLLP division factor = 12

RCC_PLLP_DIV13

PLLP division factor = 13

RCC_PLLP_DIV14

PLLP division factor = 14

RCC_PLLP_DIV15

PLLP division factor = 15

RCC_PLLP_DIV16

PLLP division factor = 16

RCC_PLLP_DIV17

PLLP division factor = 17

RCC_PLLP_DIV18

PLLP division factor = 18

RCC_PLLP_DIV19

PLLP division factor = 19

RCC_PLLP_DIV20

PLLP division factor = 20

RCC_PLLP_DIV21

PLLP division factor = 21

RCC_PLLP_DIV22

PLLP division factor = 22

RCC_PLLP_DIV23

PLLP division factor = 23

RCC_PLLP_DIV24

PLLP division factor = 24

RCC_PLLP_DIV25

PLLP division factor = 25

RCC_PLLP_DIV26

PLLP division factor = 26

RCC_PLLP_DIV27

PLLP division factor = 27

RCC_PLLP_DIV28

PLLP division factor = 28

RCC_PLLP_DIV29

PLLP division factor = 29

RCC_PLLP_DIV30

PLLP division factor = 30

RCC_PLLP_DIV31

PLLP division factor = 31

PLLQ Clock Divider

RCC_PLLQ_DIV2

PLLQ division factor = 2

RCC_PLLQ_DIV4

PLLQ division factor = 4

RCC_PLLQ_DIV6

PLLQ division factor = 6

RCC_PLLQ_DIV8

PLLQ division factor = 8

PLLR Clock Divider

RCC_PLLR_DIV2

PLLR division factor = 2

RCC_PLLR_DIV4

PLLR division factor = 4

RCC_PLLR_DIV6

PLLR division factor = 6

RCC_PLLR_DIV8

PLLR division factor = 8

PLLSAI1 Clock Output

RCC_PLLSAI1_SAI1CLK

PLLSAI1CLK selection from PLLSAI1

RCC_PLLSAI1_48M2CLK

PLL48M2CLK selection from PLLSAI1

RCC_PLLSAI1_ADC1CLK

PLLADC1CLK selection from PLLSAI1

PLLSAI2 Clock Output

RCC_PLLSAI2_SAI2CLK

PLLSAI2CLK selection from PLLSAI2

RCC_PLLSAI2_DSICLK

PLLDSICLK selection from PLLSAI2

RCC_PLLSAI2_LTDCCLK

PLLLTDCCLK selection from PLLSAI2

PLL Clock Output

RCC_PLL_SAI3CLK

PLLSAI3CLK selection from main PLL (for devices with PLLSAI2)

RCC_PLL_48M1CLK

PLL48M1CLK selection from main PLL

RCC_PLL_SYSCLK

PLLCLK selection from main PLL

PLL Clock Source

RCC_PLLSOURCE_NONE

No clock selected as PLL entry clock source

RCC_PLLSOURCE_MSI

MSI clock selected as PLL entry clock source

RCC_PLLSOURCE_HSI

HSI clock selected as PLL entry clock source

RCC_PLLSOURCE_HSE

HSE clock selected as PLL entry clock source

PLL Config

RCC_PLL_NONE

PLL configuration unchanged

RCC_PLL_OFF

PLL deactivation

RCC_PLL_ON

PLL activation

RCC RTC Clock Configuration

__HAL_RCC_RTC_ENABLE

Description:

- Macros to enable or disable the RTC clock.

Return value:

- None

Notes:

- As the RTC is in the Backup domain and write access is denied to this domain after reset, you have to enable write access using HAL_PWR_EnableBkUpAccess() function before to configure the RTC (to be done once after reset). These macros must be used after the RTC clock source was selected.

__HAL_RCC_RTC_DISABLE

RTC Clock Source

RCC_RTCCLKSOURCE_NONE

No clock used as RTC clock

RCC_RTCCLKSOURCE_LSE

LSE oscillator clock used as RTC clock

RCC_RTCCLKSOURCE_LSI

LSI oscillator clock used as RTC clock

RCC_RTCCLKSOURCE_HSE_DIV32

HSE oscillator clock divided by 32 used as RTC clock

Wake-Up from STOP Clock

RCC_STOP_WAKEUPCLOCK_MSI

MSI selection after wake-up from STOP

RCC_STOP_WAKEUPCLOCK_HSI

HSI selection after wake-up from STOP

System Clock Source

RCC_SYSCLKSOURCE_MSI

MSI selection as system clock

RCC_SYSCLKSOURCE_HSI

HSI selection as system clock

RCC_SYSCLKSOURCE_HSE

HSE selection as system clock

RCC_SYSCLKSOURCE_PLLCLK

PLL selection as system clock

System Clock Source Status

RCC_SYSCLKSOURCE_STATUS_MSI

MSI used as system clock

RCC_SYSCLKSOURCE_STATUS_HSI

HSI used as system clock

RCC_SYSCLKSOURCE_STATUS_HSE

HSE used as system clock

RCC_SYSCLKSOURCE_STATUS_PLLCLK

PLL used as system clock

System Clock Type

RCC_CLOCKTYPE_SYSCLK

SYSCLK to configure

RCC_CLOCKTYPE_HCLK

HCLK to configure

RCC_CLOCKTYPE_PCLK1

PCLK1 to configure

RCC_CLOCKTYPE_PCLK2

PCLK2 to configure

Timeout Values

RCC_DBP_TIMEOUT_VALUE

RCC_LSE_TIMEOUT_VALUE

58 HAL RCC Extension Driver

58.1 RCCEx Firmware driver registers structures

58.1.1 RCC_PLLSAI1InitTypeDef

RCC_PLLSAI1InitTypeDef is defined in the stm32l4xx_hal_rcc_ex.h

Data Fields

- ***uint32_t PLLSAI1Source***
- ***uint32_t PLLSAI1M***
- ***uint32_t PLLSAI1N***
- ***uint32_t PLLSAI1P***
- ***uint32_t PLLSAI1Q***
- ***uint32_t PLLSAI1R***
- ***uint32_t PLLSAI1ClockOut***

Field Documentation

- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1Source***

  PLLSAI1Source: PLLSAI1 entry clock source. This parameter must be a value of ***RCC_PLL_Clock_Source***
- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1M***

  PLLSAI1M: specifies the division factor for PLLSAI1 input clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16
- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1N***

  PLLSAI1N: specifies the multiplication factor for PLLSAI1 VCO output clock. This parameter must be a number between 8 and 86 or 127 depending on devices.
- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1P***

  PLLSAI1P: specifies the division factor for SAI clock. This parameter must be a value of ***RCC_PLLP_Clock_Divider***
- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1Q***

  PLLSAI1Q: specifies the division factor for USB/RNG/SDMMC1 clock. This parameter must be a value of ***RCC_PLLQ_Clock_Divider***
- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1R***

  PLLSAI1R: specifies the division factor for ADC clock. This parameter must be a value of ***RCC_PLLR_Clock_Divider***
- ***uint32_t RCC_PLLSAI1InitTypeDef::PLLSAI1ClockOut***

  PLLSAIClockOut: specifies PLLSAI1 output clock to be enabled. This parameter must be a value of ***RCC_PLLSAI1_Clock_Output***

58.1.2 RCC_PLLSAI2InitTypeDef

RCC_PLLSAI2InitTypeDef is defined in the stm32l4xx_hal_rcc_ex.h

Data Fields

- ***uint32_t PLLSAI2Source***
- ***uint32_t PLLSAI2M***
- ***uint32_t PLLSAI2N***
- ***uint32_t PLLSAI2P***
- ***uint32_t PLLSAI2Q***
- ***uint32_t PLLSAI2R***
- ***uint32_t PLLSAI2ClockOut***

Field Documentation

- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2Source***
  PLLSAI2Source: PLLSAI2 entry clock source. This parameter must be a value of *RCC_PLL_Clock_Source*
- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2M***
  PLLSAI2M: specifies the division factor for PLLSAI2 input clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16
- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2N***
  PLLSAI2N: specifies the multiplication factor for PLLSAI2 VCO output clock. This parameter must be a number between 8 and 86 or 127 depending on devices.
- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2P***
  PLLSAI2P: specifies the division factor for SAI clock. This parameter must be a value of *RCC_PLLP_Clock_Divider*
- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2Q***
  PLLSAI2Q: specifies the division factor for DSI clock. This parameter must be a value of *RCC_PLLQ_Clock_Divider*
- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2R***
  PLLSAI2R: specifies the division factor for ADC clock. This parameter must be a value of *RCC_PLLR_Clock_Divider*
- ***uint32_t RCC_PLLSAI2InitTypeDef::PLLSAI2ClockOut***
  PLLSAIClockOut: specifies PLLSAI2 output clock to be enabled. This parameter must be a value of *RCC_PLLSAI2_Clock_Output*

58.1.3 RCC_PeriphCLKInitTypeDef

RCC_PeriphCLKInitTypeDef is defined in the stm32l4xx_hal_rcc_ex.h

Data Fields

- ***uint32_t PeriphClockSelection***
- ***RCC_PLLSAI1InitTypeDef PLLSAI1***
- ***RCC_PLLSAI2InitTypeDef PLLSAI2***
- ***uint32_t Usart1ClockSelection***
- ***uint32_t Usart2ClockSelection***
- ***uint32_t Usart3ClockSelection***
- ***uint32_t Uart4ClockSelection***
- ***uint32_t Uart5ClockSelection***
- ***uint32_t Lpuart1ClockSelection***
- ***uint32_t I2c1ClockSelection***
- ***uint32_t I2c2ClockSelection***
- ***uint32_t I2c3ClockSelection***
- ***uint32_t I2c4ClockSelection***
- ***uint32_t Lptim1ClockSelection***
- ***uint32_t Lptim2ClockSelection***
- ***uint32_t Sai1ClockSelection***
- ***uint32_t Sai2ClockSelection***
- ***uint32_t UsbClockSelection***
- ***uint32_t Sdmmc1ClockSelection***
- ***uint32_t RngClockSelection***
- ***uint32_t AdcClockSelection***
- ***uint32_t Dfsdm1ClockSelection***
- ***uint32_t Dfsdm1AudioClockSelection***
- ***uint32_t LtdcClockSelection***
- ***uint32_t DsiClockSelection***
- ***uint32_t OspiClockSelection***
- ***uint32_t RTCClockSelection***

Field Documentation

- ***uint32_t RCC_PeriphCLKInitTypeDef::PeriphClockSelection***
  The Extended Clock to be configured. This parameter can be a value of *RCCEx_Periph_Clock_Selection*
- ***RCC_PLLSAI1InitTypeDef RCC_PeriphCLKInitTypeDef::PLLSAI1***
  PLLSAI1 structure parameters. This parameter will be used only when PLLSAI1 is selected as Clock Source for SAI1, USB/RNG/SDMMC1 or ADC
- ***RCC_PLLSAI2InitTypeDef RCC_PeriphCLKInitTypeDef::PLLSAI2***
  PLLSAI2 structure parameters. This parameter will be used only when PLLSAI2 is selected as Clock Source for SAI2 or ADC
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart1ClockSelection***
  Specifies USART1 clock source. This parameter can be a value of *RCCEx_USART1_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart2ClockSelection***
  Specifies USART2 clock source. This parameter can be a value of *RCCEx_USART2_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Usart3ClockSelection***
  Specifies USART3 clock source. This parameter can be a value of *RCCEx_USART3_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Uart4ClockSelection***
  Specifies UART4 clock source. This parameter can be a value of *RCCEx_UART4_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Uart5ClockSelection***
  Specifies UART5 clock source. This parameter can be a value of *RCCEx_UART5_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Lpuart1ClockSelection***
  Specifies LPUART1 clock source. This parameter can be a value of *RCCEx_LPUART1_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c1ClockSelection***
  Specifies I2C1 clock source. This parameter can be a value of *RCCEx_I2C1_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c2ClockSelection***
  Specifies I2C2 clock source. This parameter can be a value of *RCCEx_I2C2_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c3ClockSelection***
  Specifies I2C3 clock source. This parameter can be a value of *RCCEx_I2C3_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::I2c4ClockSelection***
  Specifies I2C4 clock source. This parameter can be a value of *RCCEx_I2C4_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Lptim1ClockSelection***
  Specifies LPTIM1 clock source. This parameter can be a value of *RCCEx_LPTIM1_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Lptim2ClockSelection***
  Specifies LPTIM2 clock source. This parameter can be a value of *RCCEx_LPTIM2_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Sai1ClockSelection***
  Specifies SAI1 clock source. This parameter can be a value of *RCCEx_SAI1_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Sai2ClockSelection***
  Specifies SAI2 clock source. This parameter can be a value of *RCCEx_SAI2_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::UsbClockSelection***
  Specifies USB clock source (warning: same source for SDMMC1 and RNG). This parameter can be a value of *RCCEx_USB_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Sdmmc1ClockSelection***
  Specifies SDMMC1 clock source (warning: same source for USB and RNG). This parameter can be a value of *RCCEx_SDMMC1_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::RngClockSelection***
  Specifies RNG clock source (warning: same source for USB and SDMMC1). This parameter can be a value of *RCCEx_RNG_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::AdcClockSelection***
  Specifies ADC interface clock source. This parameter can be a value of *RCCEx_ADC_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::Dfsdm1ClockSelection***
  Specifies DFSDM1 clock source. This parameter can be a value of *RCCEx_DFSDM1_Clock_Source*

- ***uint32_t RCC_PeriphCLKInitTypeDef::Dfsdm1AudioClockSelection***
  Specifies DFSDM1 audio clock source. This parameter can be a value of *RCCEx_DFSDM1_Audio_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::LtdcClockSelection***
  Specifies LTDC clock source. This parameter can be a value of *RCCEx_LTDC_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::DsiClockSelection***
  Specifies DSI clock source. This parameter can be a value of *RCCEx_DSI_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::OspiClockSelection***
  Specifies OctoSPI clock source. This parameter can be a value of *RCCEx_OSPI_Clock_Source*
- ***uint32_t RCC_PeriphCLKInitTypeDef::RTCClockSelection***
  Specifies RTC clock source. This parameter can be a value of *RCC_RTC_Clock_Source*

58.1.4 RCC_CRSInitTypeDef

RCC_CRSInitTypeDef is defined in the stm32l4xx_hal_rcc_ex.h

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t Source***
- ***uint32_t Polarity***
- ***uint32_t ReloadValue***
- ***uint32_t ErrorLimitValue***
- ***uint32_t HSI48CalibrationValue***

Field Documentation

- ***uint32_t RCC_CRSInitTypeDef::Prescaler***
  Specifies the division factor of the SYNC signal. This parameter can be a value of *RCCEx_CRS_SynchroDivider*
- ***uint32_t RCC_CRSInitTypeDef::Source***
  Specifies the SYNC signal source. This parameter can be a value of *RCCEx_CRS_SynchroSource*
- ***uint32_t RCC_CRSInitTypeDef::Polarity***
  Specifies the input polarity for the SYNC signal source. This parameter can be a value of *RCCEx_CRS_SynchroPolarity*
- ***uint32_t RCC_CRSInitTypeDef::ReloadValue***
  Specifies the value to be loaded in the frequency error counter with each SYNC event. It can be calculated in using macro **__HAL_RCC_CRS_RELOADVALUE_CALCULATE(__FTARGET__, __FSYNC__)** This parameter must be a number between 0 and 0xFFFF or a value of *RCCEx_CRS_ReloadValueDefault* .
- ***uint32_t RCC_CRSInitTypeDef::ErrorLimitValue***
  Specifies the value to be used to evaluate the captured frequency error value. This parameter must be a number between 0 and 0xFF or a value of *RCCEx_CRS_ErrorLimitDefault*
- ***uint32_t RCC_CRSInitTypeDef::HSI48CalibrationValue***
  Specifies a user-programmable trimming value to the HSI48 oscillator. This parameter must be a number between 0 and 0x7F for STM32L412xx/L422xx, between 0 and 0x3F otherwise, or a value of *RCCEx_CRS_HSI48CalibrationDefault*

58.1.5 RCC_CRSSynchroInfoTypeDef

RCC_CRSSynchroInfoTypeDef is defined in the stm32l4xx_hal_rcc_ex.h

Data Fields

- ***uint32_t ReloadValue***
- ***uint32_t HSI48CalibrationValue***
- ***uint32_t FreqErrorCapture***
- ***uint32_t FreqErrorDirection***

Field Documentation

- ***uint32_t RCC_CRSSynchroInfoTypeDef::ReloadValue***
  Specifies the value loaded in the Counter reload value. This parameter must be a number between 0 and 0xFFFF
- ***uint32_t RCC_CRSSynchroInfoTypeDef::HSI48CalibrationValue***
  Specifies value loaded in HSI48 oscillator smooth trimming. This parameter must be a number between 0 and 0x7F for STM32L412xx/L422xx, between 0 and 0x3F otherwise
- ***uint32_t RCC_CRSSynchroInfoTypeDef::FreqErrorCapture***
  Specifies the value loaded in the .FECAP, the frequency error counter value latched in the time of the last SYNC event. This parameter must be a number between 0 and 0xFFFF
- ***uint32_t RCC_CRSSynchroInfoTypeDef::FreqErrorDirection***
  Specifies the value loaded in the .FEDIR, the counting direction of the frequency error counter latched in the time of the last SYNC event. It shows whether the actual frequency is below or above the target. This parameter must be a value of ***RCCEx_CRS_FreqErrorDirection***

58.2 RCCEx Firmware driver API description

The following section lists the various functions of the RCCEx library.

58.2.1 Extended Peripheral Control functions

This subsection provides a set of functions allowing to control the RCC Clocks frequencies.

Note: Important note: Care must be taken when HAL_RCCEx_PeriphCLKConfig() is used to select the RTC clock source; in this case the Backup domain will be reset in order to modify the RTC Clock source, as consequence RTC registers (including the backup registers) are set to their reset values.

This section contains the following APIs:

- ***HAL_RCCEx_PeriphCLKConfig***
- ***HAL_RCCEx_GetPeriphCLKConfig***
- ***HAL_RCCEx_GetPeriphCLKFreq***

58.2.2 Extended clock management functions

This subsection provides a set of functions allowing to control the activation or deactivation of MSI PLL-mode, PLLSAI1, PLLSAI2, LSE CSS, Low speed clock output and clock after wake-up from STOP mode.

This section contains the following APIs:

- ***HAL_RCCEx_EnablePLLSAI1***
- ***HAL_RCCEx_DisablePLLSAI1***
- ***HAL_RCCEx_EnablePLLSAI2***
- ***HAL_RCCEx_DisablePLLSAI2***
- ***HAL_RCCEx_WakeUpStopCLKConfig***
- ***HAL_RCCEx_StandbyMSIRangeConfig***
- ***HAL_RCCEx_EnableLSECSS***
- ***HAL_RCCEx_DisableLSECSS***
- ***HAL_RCCEx_EnableLSECSS_IT***
- ***HAL_RCCEx_LSECSS_IRQHandler***
- ***HAL_RCCEx_LSECSS_Callback***
- ***HAL_RCCEx_EnableLSCO***
- ***HAL_RCCEx_DisableLSCO***
- ***HAL_RCCEx_EnableMSIPLLMode***
- ***HAL_RCCEx_DisableMSIPLLMode***
- ***HAL_RCCEx_OCTOSPIDelayConfig***

58.2.3 Extended Clock Recovery System Control functions

For devices with Clock Recovery System feature (CRS), RCC Extention HAL driver can be used as follows:

1. In System clock config, HSI48 needs to be enabled
2. Enable CRS clock in IP MSP init which will use CRS functions
3. Call CRS functions as follows:
   a. Prepare synchronization configuration necessary for HSI48 calibration
      - Default values can be set for frequency Error Measurement (reload and error limit) and also HSI48 oscillator smooth trimming.
      - Macro __HAL_RCC_CRS_RELOADVALUE_CALCULATE can be also used to calculate directly reload value with target and sychronization frequencies values

   b. Call function HAL_RCCEx_CRSConfig which
      - Resets CRS registers to their default values.
      - Configures CRS registers with synchronization configuration
      - Enables automatic calibration and frequency error counter feature Note: When using USB LPM (Link Power Management) and the device is in Sleep mode, the periodic USB SOF will not be generated by the host. No SYNC signal will therefore be provided to the CRS to calibrate the HSI48 on the run. To guarantee the required clock precision after waking up from Sleep mode, the LSE or reference clock on the GPIOs should be used as SYNC signal.

   c. A polling function is provided to wait for complete synchronization
      - Call function HAL_RCCEx_CRSWaitSynchronization()
      - According to CRS status, user can decide to adjust again the calibration or continue application if synchronization is OK
4. User can retrieve information related to synchronization in calling function HAL_RCCEx_CRSGetSynchronizationInfo()
5. Regarding synchronization status and synchronization information, user can try a new calibration in changing synchronization configuration and call again HAL_RCCEx_CRSConfig. Note: When the SYNC event is detected during the downcounting phase (before reaching the zero value), it means that the actual frequency is lower than the target (and so, that the TRIM value should be incremented), while when it is detected during the upcounting phase it means that the actual frequency is higher (and that the TRIM value should be decremented).
6. In interrupt mode, user can resort to the available macros (__HAL_RCC_CRS_XXX_IT). Interrupts will go through CRS Handler (CRS_IRQn/CRS_IRQHandler)
   – Call function HAL_RCCEx_CRSConfig()
   – Enable CRS_IRQn (thanks to NVIC functions)
   – Enable CRS interrupt (__HAL_RCC_CRS_ENABLE_IT)
   – Implement CRS status management in the following user callbacks called from HAL_RCCEx_CRS_IRQHandler():
      - HAL_RCCEx_CRS_SyncOkCallback()
      - HAL_RCCEx_CRS_SyncWarnCallback()
      - HAL_RCCEx_CRS_ExpectedSyncCallback()
      - HAL_RCCEx_CRS_ErrorCallback()
7. To force a SYNC EVENT, user can use the function HAL_RCCEx_CRSSoftwareSynchronizationGenerate(). This function can be called before calling HAL_RCCEx_CRSConfig (for instance in Systick handler)

This section contains the following APIs:

- ***HAL_RCCEx_CRSConfig***
- ***HAL_RCCEx_CRSSoftwareSynchronizationGenerate***
- ***HAL_RCCEx_CRSGetSynchronizationInfo***
- ***HAL_RCCEx_CRSWaitSynchronization***
- ***HAL_RCCEx_CRS_IRQHandler***
- ***HAL_RCCEx_CRS_SyncOkCallback***
- ***HAL_RCCEx_CRS_SyncWarnCallback***
- ***HAL_RCCEx_CRS_ExpectedSyncCallback***
- ***HAL_RCCEx_CRS_ErrorCallback***

58.2.4 Detailed description of functions

`HAL_RCCEx_PeriphCLKConfig`

Function name

HAL_StatusTypeDef HAL_RCCEx_PeriphCLKConfig (RCC_PeriphCLKInitTypeDef * PeriphClkInit)

Function description

Initialize the RCC extended peripherals clocks according to the specified parameters in the RCC_PeriphCLKInitTypeDef.

Parameters

- **PeriphClkInit:** pointer to an RCC_PeriphCLKInitTypeDef structure that contains a field PeriphClockSelection which can be a combination of the following values:
  - RCC_PERIPHCLK_RTC RTC peripheral clock
  - RCC_PERIPHCLK_ADC ADC peripheral clock
  - RCC_PERIPHCLK_I2C1 I2C1 peripheral clock
  - RCC_PERIPHCLK_I2C2 I2C2 peripheral clock
  - RCC_PERIPHCLK_I2C3 I2C3 peripheral clock
  - RCC_PERIPHCLK_I2C4 I2C4 peripheral clock (only for devices with I2C4)
  - RCC_PERIPHCLK_LPTIM1 LPTIM1 peripheral clock
  - RCC_PERIPHCLK_LPTIM2 LPTIM2 peripheral clock
  - RCC_PERIPHCLK_LPUART1 LPUART1 peripheral clock
  - RCC_PERIPHCLK_RNG RNG peripheral clock
  - RCC_PERIPHCLK_SAI1 SAI1 peripheral clock (only for devices with SAI1)
  - RCC_PERIPHCLK_SAI2 SAI2 peripheral clock (only for devices with SAI2)
  - RCC_PERIPHCLK_SDMMC1 SDMMC1 peripheral clock
  - RCC_PERIPHCLK_USART1 USART1 peripheral clock
  - RCC_PERIPHCLK_USART2 USART1 peripheral clock
  - RCC_PERIPHCLK_USART3 USART1 peripheral clock
  - RCC_PERIPHCLK_UART4 USART1 peripheral clock (only for devices with UART4)
  - RCC_PERIPHCLK_UART5 USART1 peripheral clock (only for devices with UART5)
  - RCC_PERIPHCLK_USB USB peripheral clock (only for devices with USB)
  - RCC_PERIPHCLK_DFSDM1 DFSDM1 peripheral kernel clock (only for devices with DFSDM1)
  - RCC_PERIPHCLK_DFSDM1AUDIO DFSDM1 peripheral audio clock (only for devices with DFSDM1)
  - RCC_PERIPHCLK_LTDC LTDC peripheral clock (only for devices with LTDC)
  - RCC_PERIPHCLK_DSI DSI peripheral clock (only for devices with DSI)
  - RCC_PERIPHCLK_OSPI OctoSPI peripheral clock (only for devices with OctoSPI)

Return values

- **HAL:** status

Notes

- Care must be taken when HAL_RCCEx_PeriphCLKConfig() is used to select the RTC clock source: in this case the access to Backup domain is enabled.

`HAL_RCCEx_GetPeriphCLKConfig`

Function name

void HAL_RCCEx_GetPeriphCLKConfig (RCC_PeriphCLKInitTypeDef * PeriphClkInit)

Function description

Get the RCC_ClkInitStruct according to the internal RCC configuration registers.

Parameters

- **PeriphClkInit:** pointer to an RCC_PeriphCLKInitTypeDef structure that returns the configuration information for the Extended Peripherals clocks(SAI1, SAI2, LPTIM1, LPTIM2, I2C1, I2C2, I2C3, I2C4, LPUART1, USART1, USART2, USART3, UART4, UART5, RTC, ADCx, DFSDMx, SWPMI1, USB, SDMMC1 and RNG).

Return values

- **None:**

`HAL_RCCEx_GetPeriphCLKFreq`

Function name

uint32_t HAL_RCCEx_GetPeriphCLKFreq (uint32_t PeriphClk)

Function description

Return the peripheral clock frequency for peripherals with clock source from PLLSAIs.

Parameters

- **PeriphClk:** Peripheral clock identifier This parameter can be one of the following values:
  - RCC_PERIPHCLK_RTC RTC peripheral clock
  - RCC_PERIPHCLK_ADC ADC peripheral clock
  - RCC_PERIPHCLK_I2C1 I2C1 peripheral clock
  - RCC_PERIPHCLK_I2C2 I2C2 peripheral clock
  - RCC_PERIPHCLK_I2C3 I2C3 peripheral clock
  - RCC_PERIPHCLK_I2C4 I2C4 peripheral clock (only for devices with I2C4)
  - RCC_PERIPHCLK_LPTIM1 LPTIM1 peripheral clock
  - RCC_PERIPHCLK_LPTIM2 LPTIM2 peripheral clock
  - RCC_PERIPHCLK_LPUART1 LPUART1 peripheral clock
  - RCC_PERIPHCLK_RNG RNG peripheral clock
  - RCC_PERIPHCLK_SAI1 SAI1 peripheral clock (only for devices with SAI1)
  - RCC_PERIPHCLK_SAI2 SAI2 peripheral clock (only for devices with SAI2)
  - RCC_PERIPHCLK_SDMMC1 SDMMC1 peripheral clock
  - RCC_PERIPHCLK_USART1 USART1 peripheral clock
  - RCC_PERIPHCLK_USART2 USART1 peripheral clock
  - RCC_PERIPHCLK_USART3 USART1 peripheral clock
  - RCC_PERIPHCLK_UART4 USART1 peripheral clock (only for devices with UART4)
  - RCC_PERIPHCLK_UART5 USART1 peripheral clock (only for devices with UART5)
  - RCC_PERIPHCLK_USB USB peripheral clock (only for devices with USB)
  - RCC_PERIPHCLK_DFSDM1 DFSDM1 peripheral kernel clock (only for devices with DFSDM1)
  - RCC_PERIPHCLK_DFSDM1AUDIO DFSDM1 peripheral audio clock (only for devices with DFSDM1)
  - RCC_PERIPHCLK_LTDC LTDC peripheral clock (only for devices with LTDC)
  - RCC_PERIPHCLK_DSI DSI peripheral clock (only for devices with DSI)
  - RCC_PERIPHCLK_OSPI OctoSPI peripheral clock (only for devices with OctoSPI)

Return values

- **Frequency:** in Hz

Notes

- Return 0 if peripheral clock identifier not managed by this API

`HAL_RCCEx_EnablePLLSAI1`

Function name

HAL_StatusTypeDef HAL_RCCEx_EnablePLLSAI1 (RCC_PLLSAI1InitTypeDef * PLLSAI1Init)

Function description

Enable PLLSAI1.

Parameters

- **PLLSAI1Init:** pointer to an RCC_PLLSAI1InitTypeDef structure that contains the configuration information for the PLLSAI1

Return values

- **HAL:** status

`HAL_RCCEx_DisablePLLSAI1`

Function name

HAL_StatusTypeDef HAL_RCCEx_DisablePLLSAI1 (void)

Function description

Disable PLLSAI1.

Return values

- **HAL:** status

`HAL_RCCEx_EnablePLLSAI2`

Function name

HAL_StatusTypeDef HAL_RCCEx_EnablePLLSAI2 (RCC_PLLSAI2InitTypeDef * PLLSAI2Init)

Function description

Enable PLLSAI2.

Parameters

- **PLLSAI2Init:** pointer to an RCC_PLLSAI2InitTypeDef structure that contains the configuration information for the PLLSAI2

Return values

- **HAL:** status

`HAL_RCCEx_DisablePLLSAI2`

Function name

HAL_StatusTypeDef HAL_RCCEx_DisablePLLSAI2 (void)

Function description

Disable PLLISAI2.

Return values

- **HAL:** status

`HAL_RCCEx_WakeUpStopCLKConfig`

Function name

void HAL_RCCEx_WakeUpStopCLKConfig (uint32_t WakeUpClk)

Function description

Configure the oscillator clock source for wakeup from Stop and CSS backup clock.

Parameters

- **WakeUpClk:** Wakeup clock This parameter can be one of the following values:
  - RCC_STOP_WAKEUPCLOCK_MSI MSI oscillator selection
  - RCC_STOP_WAKEUPCLOCK_HSI HSI oscillator selection

Return values

- **None:**

Notes

- This function shall not be called after the Clock Security System on HSE has been enabled.

HAL_RCCEx_StandbyMSIRangeConfig

Function name

void HAL_RCCEx_StandbyMSIRangeConfig (uint32_t MSIRange)

Function description

Configure the MSI range after standby mode.

Parameters

- **MSIRange:** MSI range This parameter can be one of the following values:
  - RCC_MSIRANGE_4 Range 4 around 1 MHz
  - RCC_MSIRANGE_5 Range 5 around 2 MHz
  - RCC_MSIRANGE_6 Range 6 around 4 MHz (reset value)
  - RCC_MSIRANGE_7 Range 7 around 8 MHz

Return values

- **None:**

Notes

- After Standby its frequency can be selected between 4 possible values (1, 2, 4 or 8 MHz).

HAL_RCCEx_EnableLSECSS

Function name

void HAL_RCCEx_EnableLSECSS (void)

Function description

Enable the LSE Clock Security System.

Return values

- **None:**

Notes

- Prior to enable the LSE Clock Security System, LSE oscillator is to be enabled with HAL_RCC_OscConfig() and the LSE oscillator clock is to be selected as RTC clock with HAL_RCCEx_PeriphCLKConfig().

HAL_RCCEx_DisableLSECSS

Function name

void HAL_RCCEx_DisableLSECSS (void)

Function description

Disable the LSE Clock Security System.

Return values

- **None:**

Notes

- LSE Clock Security System can only be disabled after a LSE failure detection.

`HAL_RCCEx_EnableLSECSS_IT`

Function name

void HAL_RCCEx_EnableLSECSS_IT (void)

Function description

Enable the LSE Clock Security System Interrupt & corresponding EXTI line.

Return values

- **None:**

Notes

- LSE Clock Security System Interrupt is mapped on RTC EXTI line 19

`HAL_RCCEx_LSECSS_IRQHandler`

Function name

void HAL_RCCEx_LSECSS_IRQHandler (void)

Function description

Handle the RCC LSE Clock Security System interrupt request.

Return values

- **None:**

`HAL_RCCEx_LSECSS_Callback`

Function name

void HAL_RCCEx_LSECSS_Callback (void)

Function description

RCCEx LSE Clock Security System interrupt callback.

Return values

- **none:**

`HAL_RCCEx_EnableLSCO`

Function name

void HAL_RCCEx_EnableLSCO (uint32_t LSCOSource)

Function description

Select the Low Speed clock source to output on LSCO pin (PA2).

Parameters

- **LSCOSource:** specifies the Low Speed clock source to output. This parameter can be one of the following values:
  - RCC_LSCOSOURCE_LSI LSI clock selected as LSCO source
  - RCC_LSCOSOURCE_LSE LSE clock selected as LSCO source

Return values

- **None:**

HAL_RCCEx_DisableLSCO

Function name

void HAL_RCCEx_DisableLSCO (void)

Function description

Disable the Low Speed clock output.

Return values

- **None:**

HAL_RCCEx_EnableMSIPLLMode

Function name

void HAL_RCCEx_EnableMSIPLLMode (void)

Function description

Enable the PLL-mode of the MSI.

Return values

- **None:**

Notes

- Prior to enable the PLL-mode of the MSI for automatic hardware calibration LSE oscillator is to be enabled with HAL_RCC_OscConfig().

HAL_RCCEx_DisableMSIPLLMode

Function name

void HAL_RCCEx_DisableMSIPLLMode (void)

Function description

Disable the PLL-mode of the MSI.

Return values

- **None:**

Notes

- PLL-mode of the MSI is automatically reset when LSE oscillator is disabled.

HAL_RCCEx_OCTOSPIDelayConfig

Function name

void HAL_RCCEx_OCTOSPIDelayConfig (uint32_t Delay1, uint32_t Delay2)

Function description

Configure OCTOSPI instances DQS delays.

Parameters

- **Delay1:** OCTOSPI1 DQS delay
- **Delay2:** OCTOSPI2 DQS delay

Return values

- **None:**

Notes

- Delay parameters stand for unitary delays from 0 to 15. Actual delay is Delay1 or Delay2 + 1.

`HAL_RCCEx_CRSConfig`

Function name

void HAL_RCCEx_CRSConfig (RCC_CRSInitTypeDef * pInit)

Function description

Start automatic synchronization for polling mode.

Parameters

- **pInit:** Pointer on RCC_CRSInitTypeDef structure

Return values

- **None:**

`HAL_RCCEx_CRSSoftwareSynchronizationGenerate`

Function name

void HAL_RCCEx_CRSSoftwareSynchronizationGenerate (void)

Function description

Generate the software synchronization event.

Return values

- **None:**

`HAL_RCCEx_CRSGetSynchronizationInfo`

Function name

void HAL_RCCEx_CRSGetSynchronizationInfo (RCC_CRSSynchroInfoTypeDef * pSynchroInfo)

Function description

Return synchronization info.

Parameters

- **pSynchroInfo:** Pointer on RCC_CRSSynchroInfoTypeDef structure

Return values

- **None:**

`HAL_RCCEx_CRSWaitSynchronization`

Function name

uint32_t HAL_RCCEx_CRSWaitSynchronization (uint32_t Timeout)

Function description

Wait for CRS Synchronization status.

Parameters

- **Timeout:** Duration of the timeout

Return values

- **Combination:** of Synchronization status This parameter can be a combination of the following values:
  - RCC_CRS_TIMEOUT
  - RCC_CRS_SYNCOK
  - RCC_CRS_SYNCWARN
  - RCC_CRS_SYNCERR
  - RCC_CRS_SYNCMISS
  - RCC_CRS_TRIMOVF

Notes

- Timeout is based on the maximum time to receive a SYNC event based on synchronization frequency.
- If Timeout set to HAL_MAX_DELAY, HAL_TIMEOUT will be never returned.

HAL_RCCEx_CRS_IRQHandler

Function name

void HAL_RCCEx_CRS_IRQHandler (void)

Function description

Handle the Clock Recovery System interrupt request.

Return values

- **None:**

HAL_RCCEx_CRS_SyncOkCallback

Function name

void HAL_RCCEx_CRS_SyncOkCallback (void)

Function description

RCCEx Clock Recovery System SYNCOK interrupt callback.

Return values

- **none:**

HAL_RCCEx_CRS_SyncWarnCallback

Function name

void HAL_RCCEx_CRS_SyncWarnCallback (void)

Function description

RCCEx Clock Recovery System SYNCWARN interrupt callback.

Return values

- **none:**

HAL_RCCEx_CRS_ExpectedSyncCallback

Function name

void HAL_RCCEx_CRS_ExpectedSyncCallback (void)

Function description

RCCEx Clock Recovery System Expected SYNC interrupt callback.

Return values

- **none:**

`HAL_RCCEx_CRS_ErrorCallback`

Function name

void HAL_RCCEx_CRS_ErrorCallback (uint32_t Error)

Function description

RCCEx Clock Recovery System Error interrupt callback.

Parameters

- **Error:** Combination of Error status. This parameter can be a combination of the following values:
  - RCC_CRS_SYNCERR
  - RCC_CRS_SYNCMISS
  - RCC_CRS_TRIMOVF

Return values

- **none:**

58.3 RCCEx Firmware driver defines

The following section lists the various define and macros of the module.

58.3.1 RCCEx

RCCEx

ADC Clock Source

RCC_ADCCLKSOURCE_NONE

RCC_ADCCLKSOURCE_PLLSAI1

RCC_ADCCLKSOURCE_SYSCLK

RCCEx CRS ErrorLimitDefault

RCC_CRS_ERRORLIMIT_DEFAULT

Default Frequency error limit

RCCEx CRS Extended Features

__HAL_RCC_CRS_FREQ_ERROR_COUNTER_ENABLE

Description:

- Enable the oscillator clock for frequency error counter.

Return value:

- None

Notes:

- when the CEN bit is set the CRS_CFGR register becomes write-protected.

__HAL_RCC_CRS_FREQ_ERROR_COUNTER_DISABLE

Description:

- Disable the oscillator clock for frequency error counter.

Return value:

- None

__HAL_RCC_CRS_AUTOMATIC_CALIB_ENABLE

Description:

- Enable the automatic hardware adjustement of TRIM bits.

Return value:

- None

Notes:

- When the AUTOTRIMEN bit is set the CRS_CFGR register becomes write-protected.

__HAL_RCC_CRS_AUTOMATIC_CALIB_DISABLE

Description:

- Enable or disable the automatic hardware adjustement of TRIM bits.

Return value:

- None

__HAL_RCC_CRS_RELOADVALUE_CALCULATE

Description:

- Macro to calculate reload value to be set in CRS register according to target and sync frequencies.

Parameters:

- __FTARGET__: Target frequency (value in Hz)
- __FSYNC__: Synchronization signal frequency (value in Hz)

Return value:

- None

Notes:

- The RELOAD value should be selected according to the ratio between the target frequency and the frequency of the synchronization source after prescaling. It is then decreased by one in order to reach the expected synchronization on the zero value. The formula is the following: RELOAD = (fTARGET / fSYNC) -1

RCCEx CRS Flags

RCC_CRS_FLAG_SYNCOK

SYNC event OK flag

RCC_CRS_FLAG_SYNCWARN

SYNC warning flag

RCC_CRS_FLAG_ERR

Error flag

RCC_CRS_FLAG_ESYNC

Expected SYNC flag

RCC_CRS_FLAG_SYNCERR

SYNC error

RCC_CRS_FLAG_SYNCMISS

SYNC missed

RCC_CRS_FLAG_TRIMOVF

Trimming overflow or underflow

RCCEx CRS FreqErrorDirection

RCC_CRS_FREQERRORDIR_UP

Upcounting direction, the actual frequency is above the target

RCC_CRS_FREQERRORDIR_DOWN

Downcounting direction, the actual frequency is below the target

RCCEx CRS HSI48CalibrationDefault

RCC_CRS_HSI48CALIBRATION_DEFAULT

The default value is 32, which corresponds to the middle of the trimming interval. The trimming step is specified in the product datasheet. A higher TRIM value corresponds to a higher output frequency

RCCEx CRS Interrupt Sources

RCC_CRS_IT_SYNCOK

SYNC event OK

RCC_CRS_IT_SYNCWARN

SYNC warning

RCC_CRS_IT_ERR

Error

RCC_CRS_IT_ESYNC

Expected SYNC

RCC_CRS_IT_SYNCERR

SYNC error

RCC_CRS_IT_SYNCMISS

SYNC missed

RCC_CRS_IT_TRIMOVF

Trimming overflow or underflow

RCCEx CRS ReloadValueDefault

RCC_CRS_RELOADVALUE_DEFAULT

The reset value of the RELOAD field corresponds to a target frequency of 48 MHz and a synchronization signal frequency of 1 kHz (SOF signal from USB).

RCCEx CRS Status

RCC_CRS_NONE

RCC_CRS_TIMEOUT

RCC_CRS_SYNCOK

RCC_CRS_SYNCWARN

RCC_CRS_SYNCERR

RCC_CRS_SYNCMISS

RCC_CRS_TRIMOVF

RCCEx CRS SynchroDivider

RCC_CRS_SYNC_DIV1

Synchro Signal not divided (default)

RCC_CRS_SYNC_DIV2

Synchro Signal divided by 2

RCC_CRS_SYNC_DIV4

Synchro Signal divided by 4

RCC_CRS_SYNC_DIV8

Synchro Signal divided by 8

RCC_CRS_SYNC_DIV16

Synchro Signal divided by 16

RCC_CRS_SYNC_DIV32

Synchro Signal divided by 32

RCC_CRS_SYNC_DIV64

Synchro Signal divided by 64

RCC_CRS_SYNC_DIV128

Synchro Signal divided by 128

RCCEx CRS SynchroPolarity

RCC_CRS_SYNC_POLARITY_RISING

Synchro Active on rising edge (default)

RCC_CRS_SYNC_POLARITY_FALLING

Synchro Active on falling edge

RCCEx CRS SynchroSource

RCC_CRS_SYNC_SOURCE_GPIO

Synchro Signal source GPIO

RCC_CRS_SYNC_SOURCE_LSE

Synchro Signal source LSE

RCC_CRS_SYNC_SOURCE_USB

Synchro Signal source USB SOF (default)

DFSDM1 Audio Clock Source

RCC_DFSDM1AUDIOCLKSOURCE_SAI1

RCC_DFSDM1AUDIOCLKSOURCE_HSI

RCC_DFSDM1AUDIOCLKSOURCE_MSI

DFSDM1 Clock Source

RCC_DFSDM1CLKSOURCE_PCLK2

RCC_DFSDM1CLKSOURCE_SYSCLK

DSI Clock Source

RCC_DSICLKSOURCE_DSIPHY

RCC_DSICLKSOURCE_PLLSAI2

RCCEx Exported Macros

__HAL_RCC_PLLSAI1_CONFIG

Description:

- Macro to configure the PLLSAI1 clock multiplication and division factors.

Parameters:

- __PLLSAI1M__: specifies the division factor of PLLSAI1 input clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16.
- __PLLSAI1N__: specifies the multiplication factor for PLLSAI1 VCO output clock. This parameter must be a number between 8 and 86.
- __PLLSAI1P__: specifies the division factor for SAI clock. This parameter must be a number in the range (7 or 17) for STM32L47xxx/L48xxx else (2 to 31). SAI1 clock frequency = f(PLLSAI1) / PLLSAI1P
- __PLLSAI1Q__: specifies the division factor for USB/RNG/SDMMC1 clock. This parameter must be in the range (2, 4, 6 or 8). USB/RNG/SDMMC1 clock frequency = f(PLLSAI1) / PLLSAI1Q
- __PLLSAI1R__: specifies the division factor for SAR ADC clock. This parameter must be in the range (2, 4, 6 or 8). ADC clock frequency = f(PLLSAI1) / PLLSAI1R

Return value:

- None

Notes:

- This function must be used only when the PLLSAI1 is disabled. PLLSAI1 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)
- You have to set the PLLSAI1N parameter correctly to ensure that the VCO output frequency is between 64 and 344 MHz. PLLSAI1 clock frequency = f(PLLSAI1) multiplied by PLLSAI1N

__HAL_RCC_PLLSAI1_MULN_CONFIG

Description:

- Macro to configure the PLLSAI1 clock multiplication factor N.

Parameters:

- __PLLSAI1N__: specifies the multiplication factor for PLLSAI1 VCO output clock. This parameter must be a number between 8 and 86.

Return value:

- None

Notes:

- This function must be used only when the PLLSAI1 is disabled. PLLSAI1 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)
- You have to set the PLLSAI1N parameter correctly to ensure that the VCO output frequency is between 64 and 344 MHz. Use to set PLLSAI1 clock frequency = f(PLLSAI1) multiplied by PLLSAI1N

__HAL_RCC_PLLSAI1_DIVM_CONFIG

Description:

- Macro to configure the PLLSAI1 input clock division factor M.

Parameters:

- __PLLSAI1M__: specifies the division factor for PLLSAI1 clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16.

Return value:

- None

Notes:

- This function must be used only when the PLLSAI1 is disabled. PLLSAI1 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI1_DIVP_CONFIG

Description:

- Macro to configure the PLLSAI1 clock division factor P.

Parameters:

- __PLLSAI1P__: specifies the division factor for SAI clock. This parameter must be a number in the range (7 or 17) for STM32L47xxx/L48xxx else (2 to 31). Use to set SAI1 clock frequency = f(PLLSAI1) / PLLSAI1P

Return value:

- None

Notes:

- This function must be used only when the PLLSAI1 is disabled. PLLSAI1 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI1_DIVQ_CONFIG

Description:

- Macro to configure the PLLSAI1 clock division factor Q.

Parameters:

- __PLLSAI1Q__: specifies the division factor for USB/RNG/SDMMC1 clock. This parameter must be in the range (2, 4, 6 or 8). Use to set USB/RNG/SDMMC1 clock frequency = f(PLLSAI1) / PLLSAI1Q

Return value:

- None

Notes:

- This function must be used only when the PLLSAI1 is disabled. PLLSAI1 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI1_DIVR_CONFIG

Description:

- Macro to configure the PLLSAI1 clock division factor R.

Parameters:

- __PLLSAI1R__: specifies the division factor for ADC clock. This parameter must be in the range (2, 4, 6 or 8) Use to set ADC clock frequency = f(PLLSAI1) / PLLSAI1R

Return value:

- None

Notes:

- This function must be used only when the PLLSAI1 is disabled. PLLSAI1 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI1_ENABLE

Description:

- Macros to enable or disable the PLLSAI1.

Return value:

- None

Notes:

- The PLLSAI1 is disabled by hardware when entering STOP and STANDBY modes.

__HAL_RCC_PLLSAI1_DISABLE

__HAL_RCC_PLLSAI1CLKOUT_ENABLE

Description:

- Macros to enable or disable each clock output (PLLSAI1_SAI1, PLLSAI1_USB2 and PLLSAI1_ADC1).

Parameters:

- __PLLSAI1_CLOCKOUT__: specifies the PLLSAI1 clock to be output. This parameter can be one or a combination of the following values:
  - RCC_PLLSAI1_SAI1CLK This clock is used to generate an accurate clock to achieve high-quality audio performance on SAI interface in case.
  - RCC_PLLSAI1_48M2CLK This clock is used to generate the clock for the USB OTG FS (48 MHz), the random number generator (<=48 MHz) and the SDIO (<= 48 MHz).
  - RCC_PLLSAI1_ADC1CLK Clock used to clock ADC peripheral.

Return value:

- None

Notes:

- Enabling and disabling those clocks can be done without the need to stop the PLL. This is mainly used to save Power.

__HAL_RCC_PLLSAI1CLKOUT_DISABLE

__HAL_RCC_GET_PLLSAI1CLKOUT_CONFIG

Description:

- Macro to get clock output enable status (PLLSAI1_SAI1, PLLSAI1_USB2 and PLLSAI1_ADC1).

Parameters:

- __PLLSAI1_CLOCKOUT__: specifies the PLLSAI1 clock to be output. This parameter can be one of the following values:
  - RCC_PLLSAI1_SAI1CLK This clock is used to generate an accurate clock to achieve high-quality audio performance on SAI interface in case.
  - RCC_PLLSAI1_48M2CLK This clock is used to generate the clock for the USB OTG FS (48 MHz), the random number generator (<=48 MHz) and the SDIO (<= 48 MHz).
  - RCC_PLLSAI1_ADC1CLK Clock used to clock ADC peripheral.

Return value:

- SET: / RESET

__HAL_RCC_PLLSAI2_CONFIG

Description:

- Macro to configure the PLLSAI2 clock multiplication and division factors.

Parameters:

- __PLLSAI2M__: specifies the division factor of PLLSAI2 input clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16.
- __PLLSAI2N__: specifies the multiplication factor for PLLSAI2 VCO output clock. This parameter must be a number between 8 and 86.
- __PLLSAI2P__: specifies the division factor for SAI clock. This parameter must be a number in the range (7 or 17) for STM32L47xxx/L48xxx else (2 to 31). SAI2 clock frequency = f(PLLSAI2) / PLLSAI2P
- __PLLSAI2Q__: specifies the division factor for DSI clock. This parameter must be in the range (2, 4, 6 or 8). DSI clock frequency = f(PLLSAI2) / PLLSAI2Q
- __PLLSAI2R__: specifies the division factor for SAR ADC clock. This parameter must be in the range (2, 4, 6 or 8).

Return value:

- None

Notes:

- This function must be used only when the PLLSAI2 is disabled. PLLSAI2 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)
- You have to set the PLLSAI2N parameter correctly to ensure that the VCO output frequency is between 64 and 344 MHz.

__HAL_RCC_PLLSAI2_MULN_CONFIG

Description:

- Macro to configure the PLLSAI2 clock multiplication factor N.

Parameters:

- __PLLSAI2N__: specifies the multiplication factor for PLLSAI2 VCO output clock. This parameter must be a number between 8 and 86.

Return value:

- None

Notes:

- This function must be used only when the PLLSAI2 is disabled. PLLSAI2 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)
- You have to set the PLLSAI2N parameter correctly to ensure that the VCO output frequency is between 64 and 344 MHz. PLLSAI1 clock frequency = f(PLLSAI1) multiplied by PLLSAI2N

__HAL_RCC_PLLSAI2_DIVM_CONFIG

Description:

- Macro to configure the PLLSAI2 input clock division factor M.

Parameters:

- __PLLSAI2M__: specifies the division factor for PLLSAI2 clock. This parameter must be a number between Min_Data = 1 and Max_Data = 16.

Return value:

- None

Notes:

- This function must be used only when the PLLSAI2 is disabled. PLLSAI2 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI2_DIVP_CONFIG

Description:

- Macro to configure the PLLSAI2 clock division factor P.

Parameters:

- __PLLSAI2P__: specifies the division factor. This parameter must be a number in the range (7 or 17). Use to set SAI2 clock frequency = f(PLLSAI2) / __PLLSAI2P__

Return value:

- None

Notes:

- This function must be used only when the PLLSAI2 is disabled. PLLSAI2 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI2_DIVQ_CONFIG

Description:

- Macro to configure the PLLSAI2 clock division factor Q.

Parameters:

- __PLLSAI2Q__: specifies the division factor for USB/RNG/SDMMC1 clock. This parameter must be in the range (2, 4, 6 or 8). Use to set USB/RNG/SDMMC1 clock frequency = f(PLLSAI2) / PLLSAI2Q

Return value:

- None

Notes:

- This function must be used only when the PLLSAI2 is disabled. PLLSAI2 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI2_DIVR_CONFIG

Description:

- Macro to configure the PLLSAI2 clock division factor R.

Parameters:

- __PLLSAI2R__: specifies the division factor. This parameter must be in the range (2, 4, 6 or 8). Use to set ADC clock frequency = f(PLLSAI2) / __PLLSAI2R__

Return value:

- None

Notes:

- This function must be used only when the PLLSAI2 is disabled. PLLSAI2 clock source is common with the main PLL (configured through __HAL_RCC_PLL_CONFIG() macro)

__HAL_RCC_PLLSAI2_ENABLE

Description:

- Macros to enable or disable the PLLSAI2.

Return value:

- None

Notes:

- The PLLSAI2 is disabled by hardware when entering STOP and STANDBY modes.

__HAL_RCC_PLLSAI2_DISABLE

__HAL_RCC_PLLSAI2CLKOUT_ENABLE

Description:

- Macros to enable or disable each clock output (PLLSAI2_SAI2, PLLSAI2_ADC2 and RCC_PLLSAI2_DSICLK).

Parameters:

- __PLLSAI2_CLOCKOUT__: specifies the PLLSAI2 clock to be output. This parameter can be one or a combination of the following values:
  - RCC_PLLSAI2_SAI2CLK This clock is used to generate an accurate clock to achieve high-quality audio performance on SAI interface in case.
  - RCC_PLLSAI2_DSICLK Clock used to clock DSI peripheral.

Return value:

- None

Notes:

- Enabling and disabling those clocks can be done without the need to stop the PLL. This is mainly used to save Power.

__HAL_RCC_PLLSAI2CLKOUT_DISABLE

__HAL_RCC_GET_PLLSAI2CLKOUT_CONFIG

Description:

- Macro to get clock output enable status (PLLSAI2_SAI2, PLLSAI2_ADC2 and RCC_PLLSAI2_DSICLK).

Parameters:

- __PLLSAI2_CLOCKOUT__: specifies the PLLSAI2 clock to be output. This parameter can be one of the following values:
  - RCC_PLLSAI2_SAI2CLK This clock is used to generate an accurate clock to achieve high-quality audio performance on SAI interface in case.
  - RCC_PLLSAI2_DSICLK Clock used to clock DSI peripheral.

Return value:

- SET: / RESET

__HAL_RCC_SAI1_CONFIG

Description:

- Macro to configure the SAI1 clock source.

Parameters:

- __SAI1_CLKSOURCE__: defines the SAI1 clock source. This clock is derived from the PLLSAI1, system PLL or external clock (through a dedicated pin). This parameter can be one of the following values:
  - RCC_SAI1CLKSOURCE_PLLSAI1 SAI1 clock = PLLSAI1 "P" clock (PLLSAI1CLK)
  - RCC_SAI1CLKSOURCE_PLL SAI1 clock = PLL "P" clock (PLLSAI3CLK if PLLSAI2 exists, else PLLSAI2CLK)
  - RCC_SAI1CLKSOURCE_PIN SAI1 clock = External Clock (SAI1_EXTCLK)
  - RCC_SAI1CLKSOURCE_HSI SAI1 clock = HSI16

Return value:

- None

__HAL_RCC_GET_SAI1_SOURCE

Description:

- Macro to get the SAI1 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_SAI1CLKSOURCE_PLLSAI1 SAI1 clock = PLLSAI1 "P" clock (PLLSAI1CLK)
  - RCC_SAI1CLKSOURCE_PLL SAI1 clock = PLL "P" clock (PLLSAI3CLK if PLLSAI2 exists, else PLLSAI2CLK)
  - RCC_SAI1CLKSOURCE_PIN SAI1 clock = External Clock (SAI1_EXTCLK)

Notes:

- Despite returned values RCC_SAI1CLKSOURCE_PLLSAI1 or RCC_SAI1CLKSOURCE_PLL, HSI16 is automatically set as SAI1 clock source when PLLs are disabled for devices without PLLSAI2.

__HAL_RCC_SAI2_CONFIG

Description:

- Macro to configure the SAI2 clock source.

Parameters:

- __SAI2_CLKSOURCE__: defines the SAI2 clock source. This clock is derived from the PLLSAI2, system PLL or external clock (through a dedicated pin). This parameter can be one of the following values:
  - RCC_SAI2CLKSOURCE_PLLSAI1 SAI2 clock = PLLSAI1 "P" clock (PLLSAI1CLK)
  - RCC_SAI2CLKSOURCE_PLLSAI2 SAI2 clock = PLLSAI2 "P" clock (PLLSAI2CLK)
  - RCC_SAI2CLKSOURCE_PLL SAI2 clock = PLL "P" clock (PLLSAI3CLK)
  - RCC_SAI2CLKSOURCE_PIN SAI2 clock = External Clock (SAI2_EXTCLK)
  - RCC_SAI2CLKSOURCE_HSI SAI2 clock = HSI16

Return value:

- None

__HAL_RCC_GET_SAI2_SOURCE

Description:

- Macro to get the SAI2 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_SAI2CLKSOURCE_PLLSAI1 SAI2 clock = PLLSAI1 "P" clock (PLLSAI1CLK)
  - RCC_SAI2CLKSOURCE_PLLSAI2 SAI2 clock = PLLSAI2 "P" clock (PLLSAI2CLK)
  - RCC_SAI2CLKSOURCE_PLL SAI2 clock = PLL "P" clock (PLLSAI3CLK)
  - RCC_SAI2CLKSOURCE_PIN SAI2 clock = External Clock (SAI2_EXTCLK)

__HAL_RCC_I2C1_CONFIG

Description:

- Macro to configure the I2C1 clock (I2C1CLK).

Parameters:

- __I2C1_CLKSOURCE__: specifies the I2C1 clock source. This parameter can be one of the following values:
  - RCC_I2C1CLKSOURCE_PCLK1 PCLK1 selected as I2C1 clock
  - RCC_I2C1CLKSOURCE_HSI HSI selected as I2C1 clock
  - RCC_I2C1CLKSOURCE_SYSCLK System Clock selected as I2C1 clock

Return value:

- None

__HAL_RCC_GET_I2C1_SOURCE

Description:

- Macro to get the I2C1 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_I2C1CLKSOURCE_PCLK1 PCLK1 selected as I2C1 clock
  - RCC_I2C1CLKSOURCE_HSI HSI selected as I2C1 clock
  - RCC_I2C1CLKSOURCE_SYSCLK System Clock selected as I2C1 clock

__HAL_RCC_I2C2_CONFIG

Description:

- Macro to configure the I2C2 clock (I2C2CLK).

Parameters:

- __I2C2_CLKSOURCE__: specifies the I2C2 clock source. This parameter can be one of the following values:
  - RCC_I2C2CLKSOURCE_PCLK1 PCLK1 selected as I2C2 clock
  - RCC_I2C2CLKSOURCE_HSI HSI selected as I2C2 clock
  - RCC_I2C2CLKSOURCE_SYSCLK System Clock selected as I2C2 clock

Return value:

- None

__HAL_RCC_GET_I2C2_SOURCE

Description:

- Macro to get the I2C2 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_I2C2CLKSOURCE_PCLK1 PCLK1 selected as I2C2 clock
  - RCC_I2C2CLKSOURCE_HSI HSI selected as I2C2 clock
  - RCC_I2C2CLKSOURCE_SYSCLK System Clock selected as I2C2 clock

__HAL_RCC_I2C3_CONFIG

Description:

- Macro to configure the I2C3 clock (I2C3CLK).

Parameters:

- __I2C3_CLKSOURCE__: specifies the I2C3 clock source. This parameter can be one of the following values:
  - RCC_I2C3CLKSOURCE_PCLK1 PCLK1 selected as I2C3 clock
  - RCC_I2C3CLKSOURCE_HSI HSI selected as I2C3 clock
  - RCC_I2C3CLKSOURCE_SYSCLK System Clock selected as I2C3 clock

Return value:

- None

__HAL_RCC_GET_I2C3_SOURCE

Description:

- Macro to get the I2C3 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_I2C3CLKSOURCE_PCLK1 PCLK1 selected as I2C3 clock
  - RCC_I2C3CLKSOURCE_HSI HSI selected as I2C3 clock
  - RCC_I2C3CLKSOURCE_SYSCLK System Clock selected as I2C3 clock

__HAL_RCC_I2C4_CONFIG

Description:

- Macro to configure the I2C4 clock (I2C4CLK).

Parameters:

- __I2C4_CLKSOURCE__: specifies the I2C4 clock source. This parameter can be one of the following values:
  - RCC_I2C4CLKSOURCE_PCLK1 PCLK1 selected as I2C4 clock
  - RCC_I2C4CLKSOURCE_HSI HSI selected as I2C4 clock
  - RCC_I2C4CLKSOURCE_SYSCLK System Clock selected as I2C4 clock

Return value:

- None

__HAL_RCC_GET_I2C4_SOURCE

Description:

- Macro to get the I2C4 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_I2C4CLKSOURCE_PCLK1 PCLK1 selected as I2C4 clock
  - RCC_I2C4CLKSOURCE_HSI HSI selected as I2C4 clock
  - RCC_I2C4CLKSOURCE_SYSCLK System Clock selected as I2C4 clock

__HAL_RCC_USART1_CONFIG

Description:

- Macro to configure the USART1 clock (USART1CLK).

Parameters:

- __USART1_CLKSOURCE__: specifies the USART1 clock source. This parameter can be one of the following values:
  - RCC_USART1CLKSOURCE_PCLK2 PCLK2 selected as USART1 clock
  - RCC_USART1CLKSOURCE_HSI HSI selected as USART1 clock
  - RCC_USART1CLKSOURCE_SYSCLK System Clock selected as USART1 clock
  - RCC_USART1CLKSOURCE_LSE SE selected as USART1 clock

Return value:

- None

__HAL_RCC_GET_USART1_SOURCE

Description:

- Macro to get the USART1 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_USART1CLKSOURCE_PCLK2 PCLK2 selected as USART1 clock
  - RCC_USART1CLKSOURCE_HSI HSI selected as USART1 clock
  - RCC_USART1CLKSOURCE_SYSCLK System Clock selected as USART1 clock
  - RCC_USART1CLKSOURCE_LSE LSE selected as USART1 clock

__HAL_RCC_USART2_CONFIG

Description:

- Macro to configure the USART2 clock (USART2CLK).

Parameters:

- __USART2_CLKSOURCE__: specifies the USART2 clock source. This parameter can be one of the following values:
  - RCC_USART2CLKSOURCE_PCLK1 PCLK1 selected as USART2 clock
  - RCC_USART2CLKSOURCE_HSI HSI selected as USART2 clock
  - RCC_USART2CLKSOURCE_SYSCLK System Clock selected as USART2 clock
  - RCC_USART2CLKSOURCE_LSE LSE selected as USART2 clock

Return value:

- None

__HAL_RCC_GET_USART2_SOURCE

Description:

- Macro to get the USART2 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_USART2CLKSOURCE_PCLK1 PCLK1 selected as USART2 clock
  - RCC_USART2CLKSOURCE_HSI HSI selected as USART2 clock
  - RCC_USART2CLKSOURCE_SYSCLK System Clock selected as USART2 clock
  - RCC_USART2CLKSOURCE_LSE LSE selected as USART2 clock

__HAL_RCC_USART3_CONFIG

Description:

- Macro to configure the USART3 clock (USART3CLK).

Parameters:

- __USART3_CLKSOURCE__: specifies the USART3 clock source. This parameter can be one of the following values:
  - RCC_USART3CLKSOURCE_PCLK1 PCLK1 selected as USART3 clock
  - RCC_USART3CLKSOURCE_HSI HSI selected as USART3 clock
  - RCC_USART3CLKSOURCE_SYSCLK System Clock selected as USART3 clock
  - RCC_USART3CLKSOURCE_LSE LSE selected as USART3 clock

Return value:

- None

__HAL_RCC_GET_USART3_SOURCE

Description:

- Macro to get the USART3 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_USART3CLKSOURCE_PCLK1 PCLK1 selected as USART3 clock
  - RCC_USART3CLKSOURCE_HSI HSI selected as USART3 clock
  - RCC_USART3CLKSOURCE_SYSCLK System Clock selected as USART3 clock
  - RCC_USART3CLKSOURCE_LSE LSE selected as USART3 clock

__HAL_RCC_UART4_CONFIG

Description:

- Macro to configure the UART4 clock (UART4CLK).

Parameters:

- __UART4_CLKSOURCE__: specifies the UART4 clock source. This parameter can be one of the following values:
  - RCC_UART4CLKSOURCE_PCLK1 PCLK1 selected as UART4 clock
  - RCC_UART4CLKSOURCE_HSI HSI selected as UART4 clock
  - RCC_UART4CLKSOURCE_SYSCLK System Clock selected as UART4 clock
  - RCC_UART4CLKSOURCE_LSE LSE selected as UART4 clock

Return value:

- None

__HAL_RCC_GET_UART4_SOURCE

Description:

- Macro to get the UART4 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_UART4CLKSOURCE_PCLK1 PCLK1 selected as UART4 clock
  - RCC_UART4CLKSOURCE_HSI HSI selected as UART4 clock
  - RCC_UART4CLKSOURCE_SYSCLK System Clock selected as UART4 clock
  - RCC_UART4CLKSOURCE_LSE LSE selected as UART4 clock

__HAL_RCC_UART5_CONFIG

Description:

- Macro to configure the UART5 clock (UART5CLK).

Parameters:

- __UART5_CLKSOURCE__: specifies the UART5 clock source. This parameter can be one of the following values:
  - RCC_UART5CLKSOURCE_PCLK1 PCLK1 selected as UART5 clock
  - RCC_UART5CLKSOURCE_HSI HSI selected as UART5 clock
  - RCC_UART5CLKSOURCE_SYSCLK System Clock selected as UART5 clock
  - RCC_UART5CLKSOURCE_LSE LSE selected as UART5 clock

Return value:

- None

__HAL_RCC_GET_UART5_SOURCE

Description:

- Macro to get the UART5 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_UART5CLKSOURCE_PCLK1 PCLK1 selected as UART5 clock
  - RCC_UART5CLKSOURCE_HSI HSI selected as UART5 clock
  - RCC_UART5CLKSOURCE_SYSCLK System Clock selected as UART5 clock
  - RCC_UART5CLKSOURCE_LSE LSE selected as UART5 clock

__HAL_RCC_LPUART1_CONFIG

Description:

- Macro to configure the LPUART1 clock (LPUART1CLK).

Parameters:

- __LPUART1_CLKSOURCE__: specifies the LPUART1 clock source. This parameter can be one of the following values:
  - RCC_LPUART1CLKSOURCE_PCLK1 PCLK1 selected as LPUART1 clock
  - RCC_LPUART1CLKSOURCE_HSI HSI selected as LPUART1 clock
  - RCC_LPUART1CLKSOURCE_SYSCLK System Clock selected as LPUART1 clock
  - RCC_LPUART1CLKSOURCE_LSE LSE selected as LPUART1 clock

Return value:

- None

__HAL_RCC_GET_LPUART1_SOURCE

Description:

- Macro to get the LPUART1 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_LPUART1CLKSOURCE_PCLK1 PCLK1 selected as LPUART1 clock
  - RCC_LPUART1CLKSOURCE_HSI HSI selected as LPUART1 clock
  - RCC_LPUART1CLKSOURCE_SYSCLK System Clock selected as LPUART1 clock
  - RCC_LPUART1CLKSOURCE_LSE LSE selected as LPUART1 clock

__HAL_RCC_LPTIM1_CONFIG

Description:

- Macro to configure the LPTIM1 clock (LPTIM1CLK).

Parameters:

- __LPTIM1_CLKSOURCE__: specifies the LPTIM1 clock source. This parameter can be one of the following values:
  - RCC_LPTIM1CLKSOURCE_PCLK1 PCLK1 selected as LPTIM1 clock
  - RCC_LPTIM1CLKSOURCE_LSI HSI selected as LPTIM1 clock
  - RCC_LPTIM1CLKSOURCE_HSI LSI selected as LPTIM1 clock
  - RCC_LPTIM1CLKSOURCE_LSE LSE selected as LPTIM1 clock

Return value:

- None

__HAL_RCC_GET_LPTIM1_SOURCE

Description:

- Macro to get the LPTIM1 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_LPTIM1CLKSOURCE_PCLK1 PCLK1 selected as LPUART1 clock
  - RCC_LPTIM1CLKSOURCE_LSI HSI selected as LPUART1 clock
  - RCC_LPTIM1CLKSOURCE_HSI System Clock selected as LPUART1 clock
  - RCC_LPTIM1CLKSOURCE_LSE LSE selected as LPUART1 clock

__HAL_RCC_LPTIM2_CONFIG

Description:

- Macro to configure the LPTIM2 clock (LPTIM2CLK).

Parameters:

- __LPTIM2_CLKSOURCE__: specifies the LPTIM2 clock source. This parameter can be one of the following values:
  - RCC_LPTIM2CLKSOURCE_PCLK1 PCLK1 selected as LPTIM2 clock
  - RCC_LPTIM2CLKSOURCE_LSI HSI selected as LPTIM2 clock
  - RCC_LPTIM2CLKSOURCE_HSI LSI selected as LPTIM2 clock
  - RCC_LPTIM2CLKSOURCE_LSE LSE selected as LPTIM2 clock

Return value:

- None

__HAL_RCC_GET_LPTIM2_SOURCE

Description:

- Macro to get the LPTIM2 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_LPTIM2CLKSOURCE_PCLK1 PCLK1 selected as LPUART1 clock
  - RCC_LPTIM2CLKSOURCE_LSI HSI selected as LPUART1 clock
  - RCC_LPTIM2CLKSOURCE_HSI System Clock selected as LPUART1 clock
  - RCC_LPTIM2CLKSOURCE_LSE LSE selected as LPUART1 clock

__HAL_RCC_SDMMC1_CONFIG

Description:

- Macro to configure the SDMMC1 clock.

Parameters:

- __SDMMC1_CLKSOURCE__: specifies the SDMMC1 clock source. This parameter can be one of the following values:
  - RCC_SDMMC1CLKSOURCE_HSI48 HSI48 selected as SDMMC1 clock for devices with HSI48
  - RCC_SDMMC1CLKSOURCE_MSI MSI selected as SDMMC1 clock
  - RCC_SDMMC1CLKSOURCE_PLLSAI1 PLLSAI1 "Q" Clock selected as SDMMC1 clock
  - RCC_SDMMC1CLKSOURCE_PLLP PLL "P" Clock selected as SDMMC1 clock
  - RCC_SDMMC1CLKSOURCE_PLL PLL "Q" Clock selected as SDMMC1 clock

Return value:

- None

__HAL_RCC_GET_SDMMC1_SOURCE

Description:

- Macro to get the SDMMC1 clock.

Return value:

- The: clock source can be one of the following values:
  - RCC_SDMMC1CLKSOURCE_HSI48 HSI48 selected as SDMMC1 clock for devices with HSI48
  - RCC_SDMMC1CLKSOURCE_MSI MSI selected as SDMMC1 clock
  - RCC_SDMMC1CLKSOURCE_PLLSAI1 PLLSAI1 "Q" clock (PLL48M2CLK) selected as SDMMC1 clock
  - RCC_SDMMC1CLKSOURCE_PLLP PLL "P" clock (PLLSAI3CLK) selected as SDMMC1 kernel clock
  - RCC_SDMMC1CLKSOURCE_PLL PLL "Q" clock (PLL48M1CLK) selected as SDMMC1 clock

__HAL_RCC_RNG_CONFIG

Description:

- Macro to configure the RNG clock.

Parameters:

- __RNG_CLKSOURCE__: specifies the RNG clock source. This parameter can be one of the following values:
  - RCC_RNGCLKSOURCE_MSI MSI selected as RNG clock
  - RCC_RNGCLKSOURCE_PLLSAI1 PLLSAI1 Clock selected as RNG clock
  - RCC_RNGCLKSOURCE_PLL PLL Clock selected as RNG clock

Return value:

- None

Notes:

- USB, RNG and SDMMC1 peripherals share the same 48MHz clock source.

__HAL_RCC_GET_RNG_SOURCE

Description:

- Macro to get the RNG clock.

Return value:

- The: clock source can be one of the following values:
  - RCC_RNGCLKSOURCE_MSI MSI selected as RNG clock
  - RCC_RNGCLKSOURCE_PLLSAI1 PLLSAI1 "Q" clock (PLL48M2CLK) selected as RNG clock
  - RCC_RNGCLKSOURCE_PLL PLL "Q" clock (PLL48M1CLK) selected as RNG clock

__HAL_RCC_USB_CONFIG

Description:

- Macro to configure the USB clock (USBCLK).

Parameters:

- __USB_CLKSOURCE__: specifies the USB clock source. This parameter can be one of the following values:
  - RCC_USBCLKSOURCE_MSI MSI selected as USB clock
  - RCC_USBCLKSOURCE_PLLSAI1 PLLSAI1 "Q" clock (PLL48M2CLK) selected as USB clock
  - RCC_USBCLKSOURCE_PLL PLL "Q" clock (PLL48M1CLK) selected as USB clock

Return value:

- None

Notes:

- USB, RNG and SDMMC1 peripherals share the same 48MHz clock source.

__HAL_RCC_GET_USB_SOURCE

Description:

- Macro to get the USB clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_USBCLKSOURCE_MSI MSI selected as USB clock
  - RCC_USBCLKSOURCE_PLLSAI1 PLLSAI1 "Q" clock (PLL48M2CLK) selected as USB clock
  - RCC_USBCLKSOURCE_PLL PLL "Q" clock (PLL48M1CLK) selected as USB clock

__HAL_RCC_ADC_CONFIG

Description:

- Macro to configure the ADC interface clock.

Parameters:

- __ADC_CLKSOURCE__: specifies the ADC digital interface clock source. This parameter can be one of the following values:
  - RCC_ADCCLKSOURCE_NONE No clock selected as ADC clock
  - RCC_ADCCLKSOURCE_PLLSAI1 PLLSAI1 Clock selected as ADC clock
  - RCC_ADCCLKSOURCE_SYSCLK System Clock selected as ADC clock

Return value:

- None

__HAL_RCC_GET_ADC_SOURCE

Description:

- Macro to get the ADC clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_ADCCLKSOURCE_NONE No clock selected as ADC clock
  - RCC_ADCCLKSOURCE_PLLSAI1 PLLSAI1 Clock selected as ADC clock
  - RCC_ADCCLKSOURCE_SYSCLK System Clock selected as ADC clock

__HAL_RCC_DFSDM1_CONFIG

Description:

- Macro to configure the DFSDM1 clock.

Parameters:

- __DFSDM1_CLKSOURCE__: specifies the DFSDM1 clock source. This parameter can be one of the following values:
  - RCC_DFSDM1CLKSOURCE_PCLK2 PCLK2 Clock selected as DFSDM1 clock
  - RCC_DFSDM1CLKSOURCE_SYSCLK System Clock selected as DFSDM1 clock

Return value:

- None

__HAL_RCC_GET_DFSDM1_SOURCE

Description:

- Macro to get the DFSDM1 clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_DFSDM1CLKSOURCE_PCLK2 PCLK2 Clock selected as DFSDM1 clock
  - RCC_DFSDM1CLKSOURCE_SYSCLK System Clock selected as DFSDM1 clock

__HAL_RCC_DFSDM1AUDIO_CONFIG

Description:

- Macro to configure the DFSDM1 audio clock.

Parameters:

- __DFSDM1AUDIO_CLKSOURCE__: specifies the DFSDM1 audio clock source. This parameter can be one of the following values:
  - RCC_DFSDM1AUDIOCLKSOURCE_SAI1 SAI1 clock selected as DFSDM1 audio clock
  - RCC_DFSDM1AUDIOCLKSOURCE_HSI HSI clock selected as DFSDM1 audio clock
  - RCC_DFSDM1AUDIOCLKSOURCE_MSI MSI clock selected as DFSDM1 audio clock

Return value:

- None

__HAL_RCC_GET_DFSDM1AUDIO_SOURCE

Description:

- Macro to get the DFSDM1 audio clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_DFSDM1AUDIOCLKSOURCE_SAI1 SAI1 clock selected as DFSDM1 audio clock
  - RCC_DFSDM1AUDIOCLKSOURCE_HSI HSI clock selected as DFSDM1 audio clock
  - RCC_DFSDM1AUDIOCLKSOURCE_MSI MSI clock selected as DFSDM1 audio clock

__HAL_RCC_LTDC_CONFIG

Description:

- Macro to configure the LTDC clock.

Parameters:

- __LTDC_CLKSOURCE__: specifies the DSI clock source. This parameter can be one of the following values:
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV2 PLLSAI2 divider R divided by 2 clock selected as LTDC clock
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV4 PLLSAI2 divider R divided by 4 clock selected as LTDC clock
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV8 PLLSAI2 divider R divided by 8 clock selected as LTDC clock
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV16 PLLSAI2 divider R divided by 16 clock selected as LTDC clock

Return value:

- None

__HAL_RCC_GET_LTDC_SOURCE

Description:

- Macro to get the LTDC clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV2 PLLSAI2 divider R divided by 2 clock selected as LTDC clock
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV4 PLLSAI2 divider R divided by 4 clock selected as LTDC clock
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV8 PLLSAI2 divider R divided by 8 clock selected as LTDC clock
  - RCC_LTDCCLKSOURCE_PLLSAI2_DIV16 PLLSAI2 divider R divided by 16 clock selected as LTDC clock

__HAL_RCC_DSI_CONFIG

Description:

- Macro to configure the DSI clock.

Parameters:

- __DSI_CLKSOURCE__: specifies the DSI clock source. This parameter can be one of the following values:
  - RCC_DSICLKSOURCE_DSIPHY DSI-PHY clock selected as DSI clock
  - RCC_DSICLKSOURCE_PLLSAI2 PLLSAI2 R divider clock selected as DSI clock

Return value:

- None

__HAL_RCC_GET_DSI_SOURCE

Description:

- Macro to get the DSI clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_DSICLKSOURCE_DSIPHY DSI-PHY clock selected as DSI clock
  - RCC_DSICLKSOURCE_PLLSAI2 PLLSAI2 R divider clock selected as DSI clock

__HAL_RCC_OSPI_CONFIG

Description:

- Macro to configure the OctoSPI clock.

Parameters:

- __OSPI_CLKSOURCE__: specifies the OctoSPI clock source. This parameter can be one of the following values:
  - RCC_OSPICLKSOURCE_SYSCLK System Clock selected as OctoSPI clock
  - RCC_OSPICLKSOURCE_MSI MSI clock selected as OctoSPI clock
  - RCC_OSPICLKSOURCE_PLL PLL Q divider clock selected as OctoSPI clock

Return value:

- None

__HAL_RCC_GET_OSPI_SOURCE

Description:

- Macro to get the OctoSPI clock source.

Return value:

- The: clock source can be one of the following values:
  - RCC_OSPICLKSOURCE_SYSCLK System Clock selected as OctoSPI clock
  - RCC_OSPICLKSOURCE_MSI MSI clock selected as OctoSPI clock
  - RCC_OSPICLKSOURCE_PLL PLL Q divider clock selected as OctoSPI clock

RCC LSE CSS external interrupt line

RCC_EXTI_LINE_LSECSS

External interrupt line 19 connected to the LSE CSS EXTI Line

Flags Interrupts Management

__HAL_RCC_PLLSAI1_ENABLE_IT

Description:

- Enable PLLSAI1RDY interrupt.

Return value:

- None

__HAL_RCC_PLLSAI1_DISABLE_IT

Description:

- Disable PLLSAI1RDY interrupt.

Return value:

- None

__HAL_RCC_PLLSAI1_CLEAR_IT

Description:

- Clear the PLLSAI1RDY interrupt pending bit.

Return value:

- None

__HAL_RCC_PLLSAI1_GET_IT_SOURCE

Description:

- Check whether PLLSAI1RDY interrupt has occurred or not.

Return value:

- TRUE: or FALSE.

__HAL_RCC_PLLSAI1_GET_FLAG

Description:

- Check whether the PLLSAI1RDY flag is set or not.

Return value:

- TRUE: or FALSE.

__HAL_RCC_PLLSAI2_ENABLE_IT

Description:

- Enable PLLSAI2RDY interrupt.

Return value:

- None

__HAL_RCC_PLLSAI2_DISABLE_IT

Description:

- Disable PLLSAI2RDY interrupt.

Return value:

- None

__HAL_RCC_PLLSAI2_CLEAR_IT

Description:

- Clear the PLLSAI2RDY interrupt pending bit.

Return value:

- None

__HAL_RCC_PLLSAI2_GET_IT_SOURCE

Description:

- Check whether the PLLSAI2RDY interrupt has occurred or not.

Return value:

- TRUE: or FALSE.

__HAL_RCC_PLLSAI2_GET_FLAG

Description:

- Check whether the PLLSAI2RDY flag is set or not.

Return value:

- TRUE: or FALSE.

__HAL_RCC_LSECSS_EXTI_ENABLE_IT

Description:

- Enable the RCC LSE CSS Extended Interrupt Line.

Return value:

- None

__HAL_RCC_LSECSS_EXTI_DISABLE_IT

Description:

- Disable the RCC LSE CSS Extended Interrupt Line.

Return value:

- None

__HAL_RCC_LSECSS_EXTI_ENABLE_EVENT

Description:

- Enable the RCC LSE CSS Event Line.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_DISABLE_EVENT

Description:

- Disable the RCC LSE CSS Event Line.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable the RCC LSE CSS Extended Interrupt Falling Trigger.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable the RCC LSE CSS Extended Interrupt Falling Trigger.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_ENABLE_RISING_EDGE

Description:

- Enable the RCC LSE CSS Extended Interrupt Rising Trigger.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_DISABLE_RISING_EDGE

Description:

- Disable the RCC LSE CSS Extended Interrupt Rising Trigger.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable the RCC LSE CSS Extended Interrupt Rising & Falling Trigger.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable the RCC LSE CSS Extended Interrupt Rising & Falling Trigger.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_GET_FLAG

Description:

- Check whether the specified RCC LSE CSS EXTI interrupt flag is set or not.

Return value:

- EXTI: RCC LSE CSS Line Status.

__HAL_RCC_LSECSS_EXTI_CLEAR_FLAG

Description:

- Clear the RCC LSE CSS EXTI flag.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on the RCC LSE CSS EXTI line.

Return value:

- None.

__HAL_RCC_CRS_ENABLE_IT

Description:

- Enable the specified CRS interrupts.

Parameters:

- __INTERRUPT__: specifies the CRS interrupt sources to be enabled. This parameter can be any combination of the following values:
  - RCC_CRS_IT_SYNCOK SYNC event OK interrupt
  - RCC_CRS_IT_SYNCWARN SYNC warning interrupt
  - RCC_CRS_IT_ERR Synchronization or trimming error interrupt
  - RCC_CRS_IT_ESYNC Expected SYNC interrupt

Return value:

- None

__HAL_RCC_CRS_DISABLE_IT

Description:

- Disable the specified CRS interrupts.

Parameters:

- __INTERRUPT__: specifies the CRS interrupt sources to be disabled. This parameter can be any combination of the following values:
  - RCC_CRS_IT_SYNCOK SYNC event OK interrupt
  - RCC_CRS_IT_SYNCWARN SYNC warning interrupt
  - RCC_CRS_IT_ERR Synchronization or trimming error interrupt
  - RCC_CRS_IT_ESYNC Expected SYNC interrupt

Return value:

- None

__HAL_RCC_CRS_GET_IT_SOURCE

Description:

- Check whether the CRS interrupt has occurred or not.

Parameters:

- __INTERRUPT__: specifies the CRS interrupt source to check. This parameter can be one of the following values:
  - RCC_CRS_IT_SYNCOK SYNC event OK interrupt
  - RCC_CRS_IT_SYNCWARN SYNC warning interrupt
  - RCC_CRS_IT_ERR Synchronization or trimming error interrupt
  - RCC_CRS_IT_ESYNC Expected SYNC interrupt

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

RCC_CRS_IT_ERROR_MASK

Description:

- Clear the CRS interrupt pending bits.

Parameters:

- __INTERRUPT__: specifies the interrupt pending bit to clear. This parameter can be any combination of the following values:
  - RCC_CRS_IT_SYNCOK SYNC event OK interrupt
  - RCC_CRS_IT_SYNCWARN SYNC warning interrupt
  - RCC_CRS_IT_ERR Synchronization or trimming error interrupt
  - RCC_CRS_IT_ESYNC Expected SYNC interrupt
  - RCC_CRS_IT_TRIMOVF Trimming overflow or underflow interrupt
  - RCC_CRS_IT_SYNCERR SYNC error interrupt
  - RCC_CRS_IT_SYNCMISS SYNC missed interrupt

__HAL_RCC_CRS_CLEAR_IT

__HAL_RCC_CRS_GET_FLAG

Description:

- Check whether the specified CRS flag is set or not.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - RCC_CRS_FLAG_SYNCOK SYNC event OK
  - RCC_CRS_FLAG_SYNCWARN SYNC warning
  - RCC_CRS_FLAG_ERR Error
  - RCC_CRS_FLAG_ESYNC Expected SYNC
  - RCC_CRS_FLAG_TRIMOVF Trimming overflow or underflow
  - RCC_CRS_FLAG_SYNCERR SYNC error
  - RCC_CRS_FLAG_SYNCMISS SYNC missed

Return value:

- The: new state of _FLAG_ (TRUE or FALSE).

RCC_CRS_FLAG_ERROR_MASK

Description:

- Clear the CRS specified FLAG.

Parameters:

- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - RCC_CRS_FLAG_SYNCOK SYNC event OK
  - RCC_CRS_FLAG_SYNCWARN SYNC warning
  - RCC_CRS_FLAG_ERR Error
  - RCC_CRS_FLAG_ESYNC Expected SYNC
  - RCC_CRS_FLAG_TRIMOVF Trimming overflow or underflow
  - RCC_CRS_FLAG_SYNCERR SYNC error
  - RCC_CRS_FLAG_SYNCMISS SYNC missed

Return value:

- None

Notes:

- RCC_CRS_FLAG_ERR clears RCC_CRS_FLAG_TRIMOVF, RCC_CRS_FLAG_SYNCERR, RCC_CRS_FLAG_SYNCMISS and consequently RCC_CRS_FLAG_ERR

__HAL_RCC_CRS_CLEAR_FLAG

I2C1 Clock Source

RCC_I2C1CLKSOURCE_PCLK1

RCC_I2C1CLKSOURCE_SYSCLK

RCC_I2C1CLKSOURCE_HSI

I2C2 Clock Source

RCC_I2C2CLKSOURCE_PCLK1

RCC_I2C2CLKSOURCE_SYSCLK

RCC_I2C2CLKSOURCE_HSI

I2C3 Clock Source

RCC_I2C3CLKSOURCE_PCLK1

RCC_I2C3CLKSOURCE_SYSCLK

RCC_I2C3CLKSOURCE_HSI

I2C4 Clock Source

RCC_I2C4CLKSOURCE_PCLK1

RCC_I2C4CLKSOURCE_SYSCLK

RCC_I2C4CLKSOURCE_HSI

LPTIM1 Clock Source

RCC_LPTIM1CLKSOURCE_PCLK1

RCC_LPTIM1CLKSOURCE_LSI

RCC_LPTIM1CLKSOURCE_HSI

RCC_LPTIM1CLKSOURCE_LSE

LPTIM2 Clock Source

RCC_LPTIM2CLKSOURCE_PCLK1

RCC_LPTIM2CLKSOURCE_LSI

RCC_LPTIM2CLKSOURCE_HSI

RCC_LPTIM2CLKSOURCE_LSE

LPUART1 Clock Source

RCC_LPUART1CLKSOURCE_PCLK1

RCC_LPUART1CLKSOURCE_SYSCLK

RCC_LPUART1CLKSOURCE_HSI

RCC_LPUART1CLKSOURCE_LSE

Low Speed Clock Source

RCC_LSCOSOURCE_LSI

LSI selection for low speed clock output

RCC_LSCOSOURCE_LSE

LSE selection for low speed clock output

LTDC Clock Source

RCC_LTDCCLKSOURCE_PLLSAI2_DIV2

RCC_LTDCCLKSOURCE_PLLSAI2_DIV4

RCC_LTDCCLKSOURCE_PLLSAI2_DIV8

RCC_LTDCCLKSOURCE_PLLSAI2_DIV16

OctoSPI Clock Source

RCC_OSPICLKSOURCE_SYSCLK

RCC_OSPICLKSOURCE_MSI

RCC_OSPICLKSOURCE_PLL

Periph Clock Selection

RCC_PERIPHCLK_USART1

RCC_PERIPHCLK_USART2

RCC_PERIPHCLK_USART3

RCC_PERIPHCLK_UART4

RCC_PERIPHCLK_UART5

RCC_PERIPHCLK_LPUART1

RCC_PERIPHCLK_I2C1

RCC_PERIPHCLK_I2C2

RCC_PERIPHCLK_I2C3

RCC_PERIPHCLK_LPTIM1

RCC_PERIPHCLK_LPTIM2

RCC_PERIPHCLK_SAI1

RCC_PERIPHCLK_SAI2

RCC_PERIPHCLK_USB

RCC_PERIPHCLK_ADC

RCC_PERIPHCLK_DFSDM1

RCC_PERIPHCLK_DFSDM1AUDIO

RCC_PERIPHCLK_RTC

RCC_PERIPHCLK_RNG

RCC_PERIPHCLK_SDMMC1

RCC_PERIPHCLK_I2C4

RCC_PERIPHCLK_LTDC

RCC_PERIPHCLK_DSI

RCC_PERIPHCLK_OSPI

RNG Clock Source

RCC_RNGCLKSOURCE_HSI48

RCC_RNGCLKSOURCE_PLLSAI1

RCC_RNGCLKSOURCE_PLL

RCC_RNGCLKSOURCE_MSI

SAI1 Clock Source

RCC_SAI1CLKSOURCE_PLLSAI1

RCC_SAI1CLKSOURCE_PLLSAI2

RCC_SAI1CLKSOURCE_PLL

RCC_SAI1CLKSOURCE_PIN

RCC_SAI1CLKSOURCE_HSI

SAI2 Clock Source

RCC_SAI2CLKSOURCE_PLLSAI1

RCC_SAI2CLKSOURCE_PLLSAI2

RCC_SAI2CLKSOURCE_PLL

RCC_SAI2CLKSOURCE_PIN

RCC_SAI2CLKSOURCE_HSI

SDMMC1 Clock Source

RCC_SDMMC1CLKSOURCE_HSI48
HSI48 clock selected as SDMMC1 clock

RCC_SDMMC1CLKSOURCE_PLLSAI1
PLLSAI1 "Q" clock selected as SDMMC1 clock

RCC_SDMMC1CLKSOURCE_PLL
PLL "Q" clock selected as SDMMC1 clock

RCC_SDMMC1CLKSOURCE_MSI
MSI clock selected as SDMMC1 clock

RCC_SDMMC1CLKSOURCE_PLLP
PLL "P" clock selected as SDMMC1 kernel clock

UART4 Clock Source

RCC_UART4CLKSOURCE_PCLK1

RCC_UART4CLKSOURCE_SYSCLK

RCC_UART4CLKSOURCE_HSI

RCC_UART4CLKSOURCE_LSE

UART5 Clock Source

RCC_UART5CLKSOURCE_PCLK1

RCC_UART5CLKSOURCE_SYSCLK

RCC_UART5CLKSOURCE_HSI

RCC_UART5CLKSOURCE_LSE

USART1 Clock Source

RCC_USART1CLKSOURCE_PCLK2

RCC_USART1CLKSOURCE_SYSCLK

RCC_USART1CLKSOURCE_HSI

RCC_USART1CLKSOURCE_LSE

USART2 Clock Source

RCC_USART2CLKSOURCE_PCLK1

RCC_USART2CLKSOURCE_SYSCLK

RCC_USART2CLKSOURCE_HSI

RCC_USART2CLKSOURCE_LSE

USART3 Clock Source

RCC_USART3CLKSOURCE_PCLK1

RCC_USART3CLKSOURCE_SYSCLK

RCC_USART3CLKSOURCE_HSI

RCC_USART3CLKSOURCE_LSE

USB Clock Source

RCC_USBCLKSOURCE_HSI48

RCC_USBCLKSOURCE_PLLSAI1

RCC_USBCLKSOURCE_PLL

RCC_USBCLKSOURCE_MSI

59 HAL RNG Generic Driver

59.1 RNG Firmware driver registers structures

59.1.1 RNG_InitTypeDef

RNG_InitTypeDef is defined in the stm32l4xx_hal_rng.h

Data Fields

- ***uint32_t ClockErrorDetection***

Field Documentation

- ***uint32_t RNG_InitTypeDef::ClockErrorDetection***
  CED Clock error detection

59.1.2 RNG_HandleTypeDef

RNG_HandleTypeDef is defined in the stm32l4xx_hal_rng.h

Data Fields

- ***RNG_TypeDef * Instance***
- ***RNG_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_RNG_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***uint32_t RandomNumber***

Field Documentation

- ***RNG_TypeDef* RNG_HandleTypeDef::Instance***
  Register base address
- ***RNG_InitTypeDef RNG_HandleTypeDef::Init***
  RNG configuration parameters
- ***HAL_LockTypeDef RNG_HandleTypeDef::Lock***
  RNG locking object
- ***__IO HAL_RNG_StateTypeDef RNG_HandleTypeDef::State***
  RNG communication state
- ***__IO uint32_t RNG_HandleTypeDef::ErrorCode***
  RNG Error code
- ***uint32_t RNG_HandleTypeDef::RandomNumber***
  Last Generated RNG Data

59.2 RNG Firmware driver API description

The following section lists the various functions of the RNG library.

59.2.1 How to use this driver

The RNG HAL driver can be used as follows:

1. Enable the RNG controller clock using __HAL_RCC_RNG_CLK_ENABLE() macro in HAL_RNG_MspInit().
2. Activate the RNG peripheral using HAL_RNG_Init() function.
3. Wait until the 32 bit Random Number Generator contains a valid random data using (polling/interrupt) mode.
4. Get the 32 bit random number using HAL_RNG_GenerateRandomNumber() function.

59.2.2 Callback registration

The compilation define USE_HAL_RNG_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_RNG_RegisterCallback() to register a user callback. Function @ref HAL_RNG_RegisterCallback() allows to register following callbacks:

- ErrorCallback : RNG Error Callback.
- MspInitCallback : RNG MspInit.
- MspDeInitCallback : RNG MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_RNG_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_RNG_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- ErrorCallback : RNG Error Callback.
- MspInitCallback : RNG MspInit.
- MspDeInitCallback : RNG MspDeInit.

For specific callback ReadyDataCallback, use dedicated register callbacks: respectively @ref HAL_RNG_RegisterReadyDataCallback() , @ref HAL_RNG_UnRegisterReadyDataCallback().

By default, after the @ref HAL_RNG_Init() and when the state is HAL_RNG_STATE_RESET all callbacks are set to the corresponding weak (surcharged) functions: example @ref HAL_RNG_ErrorCallback(). Exception done for MspInit and MspDeInit functions that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_RNG_Init() and @ref HAL_RNG_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_RNG_Init() and @ref HAL_RNG_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_RNG_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_RNG_STATE_READY or HAL_RNG_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_RNG_RegisterCallback() before calling @ref HAL_RNG_DeInit() or @ref HAL_RNG_Init() function.

When The compilation define USE_HAL_RNG_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and weak (surcharged) callbacks are used.

59.2.3 Initialization and configuration functions

This section provides functions allowing to:

- Initialize the RNG according to the specified parameters in the RNG_InitTypeDef and create the associated handle
- DeInitialize the RNG peripheral
- Initialize the RNG MSP
- DeInitialize RNG MSP

This section contains the following APIs:

- ***HAL_RNG_Init***
- ***HAL_RNG_DeInit***
- ***HAL_RNG_MspInit***
- ***HAL_RNG_MspDeInit***

59.2.4 Peripheral Control functions

This section provides functions allowing to:

- Get the 32 bit Random number
- Get the 32 bit Random number with interrupt enabled
- Handle RNG interrupt request

This section contains the following APIs:

- ***HAL_RNG_GenerateRandomNumber***
- ***HAL_RNG_GenerateRandomNumber_IT***
- ***HAL_RNG_GetRandomNumber***

- *HAL_RNG_GetRandomNumber_IT*
- *HAL_RNG_IRQHandler*
- *HAL_RNG_ReadLastRandomNumber*
- *HAL_RNG_ReadyDataCallback*
- *HAL_RNG_ErrorCallback*

59.2.5 Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.
This section contains the following APIs:

- *HAL_RNG_GetState*
- *HAL_RNG_GetError*

59.2.6 Detailed description of functions

`HAL_RNG_Init`

Function name

HAL_StatusTypeDef HAL_RNG_Init (RNG_HandleTypeDef * hrng)

Function description

Initializes the RNG peripheral and creates the associated handle.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **HAL:** status

`HAL_RNG_DeInit`

Function name

HAL_StatusTypeDef HAL_RNG_DeInit (RNG_HandleTypeDef * hrng)

Function description

DeInitializes the RNG peripheral.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **HAL:** status

`HAL_RNG_MspInit`

Function name

void HAL_RNG_MspInit (RNG_HandleTypeDef * hrng)

Function description

Initializes the RNG MSP.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **None:**

HAL_RNG_MspDeInit

Function name

void HAL_RNG_MspDeInit (RNG_HandleTypeDef * hrng)

Function description

DeInitializes the RNG MSP.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **None:**

HAL_RNG_GetRandomNumber

Function name

uint32_t HAL_RNG_GetRandomNumber (RNG_HandleTypeDef * hrng)

Function description

Returns generated random number in polling mode (Obsolete) Use HAL_RNG_GenerateRandomNumber() API instead.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **Random:** value

HAL_RNG_GetRandomNumber_IT

Function name

uint32_t HAL_RNG_GetRandomNumber_IT (RNG_HandleTypeDef * hrng)

Function description

Returns a 32-bit random number with interrupt enabled (Obsolete), Use HAL_RNG_GenerateRandomNumber_IT() API instead.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **32-bit:** random number

HAL_RNG_GenerateRandomNumber

Function name

HAL_StatusTypeDef HAL_RNG_GenerateRandomNumber (RNG_HandleTypeDef * hrng, uint32_t * random32bit)

Function description

Generates a 32-bit random number.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
- **random32bit:** pointer to generated random number variable if successful.

Return values

- **HAL:** status

Notes

- When several random data are output at the same time in an output buffer, this function checks value of RNG_FLAG_DRDY flag to know if valid random number is available in the DR register (RNG_FLAG_DRDY flag set whenever a random number is available through the RNG_DR register). After transitioning from 0 to 1 (random number available), RNG_FLAG_DRDY flag remains high until output buffer becomes empty after reading four words from the RNG_DR register, i.e. further function calls will immediately return a new u32 random number (additional words are available and can be read by the application, till RNG_FLAG_DRDY flag remains high). When no more random number data is available in DR register, RNG_FLAG_DRDY flag is automatically cleared. When random number are out on a single sample basis, each time the random number data is read the RNG_FLAG_DRDY flag is automatically cleared.

`HAL_RNG_GenerateRandomNumber_IT`

Function name

HAL_StatusTypeDef HAL_RNG_GenerateRandomNumber_IT (RNG_HandleTypeDef * hrng)

Function description

Generates a 32-bit random number in interrupt mode.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **HAL:** status

`HAL_RNG_ReadLastRandomNumber`

Function name

uint32_t HAL_RNG_ReadLastRandomNumber (RNG_HandleTypeDef * hrng)

Function description

Read latest generated random number.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **random:** value

`HAL_RNG_IRQHandler`

Function name

void HAL_RNG_IRQHandler (RNG_HandleTypeDef * hrng)

Function description

Handles RNG interrupt request.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **None:**

Notes

- In the case of a clock error, the RNG is no more able to generate random numbers because the PLL48CLK clock is not correct. User has to check that the clock controller is correctly configured to provide the RNG clock and clear the CEIS bit using __HAL_RNG_CLEAR_IT(). The clock error has no impact on the previously generated random numbers, and the RNG_DR register contents can be used.
- In the case of a seed error, the generation of random numbers is interrupted as long as the SECS bit is '1'. If a number is available in the RNG_DR register, it must not be used because it may not have enough entropy. In this case, it is recommended to clear the SEIS bit using __HAL_RNG_CLEAR_IT(), then disable and enable the RNG peripheral to reinitialize and restart the RNG.
- User-written HAL_RNG_ErrorCallback() API is called once whether SEIS or CEIS are set.

`HAL_RNG_ErrorCallback`

Function name

void HAL_RNG_ErrorCallback (RNG_HandleTypeDef * hrng)

Function description

RNG error callbacks.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **None:**

`HAL_RNG_ReadyDataCallback`

Function name

void HAL_RNG_ReadyDataCallback (RNG_HandleTypeDef * hrng, uint32_t random32bit)

Function description

Data Ready callback in non-blocking mode.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
- **random32bit:** generated random number.

Return values

- **None:**

Notes

- When several random data are output at the same time in an output buffer, When RNG_FLAG_DRDY flag value is set, first random number has been read from DR register in IRQ Handler and is provided as callback parameter. Depending on valid data available in the conditioning output buffer, additional words can be read by the application from DR register till DRDY bit remains high.

`HAL_RNG_GetState`

Function name

HAL_RNG_StateTypeDef HAL_RNG_GetState (RNG_HandleTypeDef * hrng)

Function description

Returns the RNG state.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **HAL:** state

`HAL_RNG_GetError`

Function name

uint32_t HAL_RNG_GetError (RNG_HandleTypeDef * hrng)

Function description

Return the RNG handle error code.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure.

Return values

- **RNG:** Error Code

59.3 RNG Firmware driver defines

The following section lists the various define and macros of the module.

59.3.1 RNG

RNG

RNG Error Definition

HAL_RNG_ERROR_NONE

No error

HAL_RNG_ERROR_TIMEOUT

Timeout error

HAL_RNG_ERROR_BUSY

Busy error

HAL_RNG_ERROR_SEED

Seed error

HAL_RNG_ERROR_CLOCK

Clock error

RNG Interrupt definition

RNG_IT_DRDY

Data Ready interrupt

RNG_IT_CEI

Clock error interrupt

RNG_IT_SEI

Seed error interrupt

RNG Flag definition

RNG_FLAG_DRDY

Data ready

RNG_FLAG_CECS

Clock error current status

RNG_FLAG_SECS

Seed error current status

RNG Clock Error Detection

RNG_CED_ENABLE

Clock error detection Enabled

RNG_CED_DISABLE

Clock error detection Disabled

RNG Exported Macros

__HAL_RNG_RESET_HANDLE_STATE

Description:

- Reset RNG handle state.

Parameters:

- __HANDLE__: RNG Handle

Return value:

- None

__HAL_RNG_ENABLE

Description:

- Enables the RNG peripheral.

Parameters:

- __HANDLE__: RNG Handle

Return value:

- None

__HAL_RNG_DISABLE

Description:

- Disables the RNG peripheral.

Parameters:

- __HANDLE__: RNG Handle

Return value:

- None

__HAL_RNG_GET_FLAG

Description:

- Check the selected RNG flag status.

Parameters:

- __HANDLE__: RNG Handle
- __FLAG__: RNG flag This parameter can be one of the following values:
  - RNG_FLAG_DRDY: Data ready
  - RNG_FLAG_CECS: Clock error current status
  - RNG_FLAG_SECS: Seed error current status

Return value:

- The: new state of __FLAG__ (SET or RESET).

__HAL_RNG_CLEAR_FLAG

Description:

- Clears the selected RNG flag status.

Parameters:

- __HANDLE__: RNG handle
- __FLAG__: RNG flag to clear

Return value:

- None

Notes:

- WARNING: This is a dummy macro for HAL code alignment, flags RNG_FLAG_DRDY, RNG_FLAG_CECS and RNG_FLAG_SECS are read-only.

__HAL_RNG_ENABLE_IT

Description:

- Enables the RNG interrupts.

Parameters:

- __HANDLE__: RNG Handle

Return value:

- None

__HAL_RNG_DISABLE_IT

Description:

- Disables the RNG interrupts.

Parameters:

- __HANDLE__: RNG Handle

Return value:

- None

__HAL_RNG_GET_IT

Description:

- Checks whether the specified RNG interrupt has occurred or not.

Parameters:

- __HANDLE__: RNG Handle
- __INTERRUPT__: specifies the RNG interrupt status flag to check. This parameter can be one of the following values:
  - RNG_IT_DRDY: Data ready interrupt
  - RNG_IT_CEI: Clock error interrupt
  - RNG_IT_SEI: Seed error interrupt

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_RNG_CLEAR_IT

Description:

- Clear the RNG interrupt status flags.

Parameters:

- __HANDLE__: RNG Handle
- __INTERRUPT__: specifies the RNG interrupt status flag to clear. This parameter can be one of the following values:
  - RNG_IT_CEI: Clock error interrupt
  - RNG_IT_SEI: Seed error interrupt

Return value:

- None

Notes:

- RNG_IT_DRDY flag is read-only, reading RNG_DR register automatically clears RNG_IT_DRDY.

60 HAL RNG Extension Driver

60.1 RNGEx Firmware driver registers structures

60.1.1 RNG_ConfigTypeDef

RNG_ConfigTypeDef is defined in the stm32l4xx_hal_rng_ex.h

Data Fields

- ***uint32_t Config1***
- ***uint32_t Config2***
- ***uint32_t Config3***
- ***uint32_t ClockDivider***
- ***uint32_t NistCompliance***

Field Documentation

- ***uint32_t RNG_ConfigTypeDef::Config1***
  Config1 must be a value between 0 and 0x3F
- ***uint32_t RNG_ConfigTypeDef::Config2***
  Config2 must be a value between 0 and 0x7
- ***uint32_t RNG_ConfigTypeDef::Config3***
  Config3 must be a value between 0 and 0xF
- ***uint32_t RNG_ConfigTypeDef::ClockDivider***
  Clock Divider factor.This parameter can be a value of Section 60.3.1 RNGEx
- ***uint32_t RNG_ConfigTypeDef::NistCompliance***
  NIST compliance.This parameter can be a value of Section 60.3.1 RNGEx

60.2 RNGEx Firmware driver API description

The following section lists the various functions of the RNGEx library.

60.2.1 Configuration and lock functions

This section provides functions allowing to:

- Configure the RNG with the specified parameters in the RNG_ConfigTypeDef
- Lock RNG configuration Allows user to lock a configuration until next reset.

This section contains the following APIs:

- ***`HAL_RNGEx_SetConfig`***
- ***`HAL_RNGEx_GetConfig`***
- ***`HAL_RNGEx_LockConfig`***

60.2.2 Detailed description of functions

`HAL_RNGEx_SetConfig`

Function name

HAL_StatusTypeDef HAL_RNGEx_SetConfig (RNG_HandleTypeDef * hrng, RNG_ConfigTypeDef * pConf)

Function description

Configure the RNG with the specified parameters in the RNG_ConfigTypeDef.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
- **pConf:** pointer to a RNG_ConfigTypeDef structure that contains the configuration information for RNG module

Return values

- **HAL:** status

`HAL_RNGEx_GetConfig`

Function name

HAL_StatusTypeDef HAL_RNGEx_GetConfig (RNG_HandleTypeDef * hrng, RNG_ConfigTypeDef * pConf)

Function description

Get the RNG Configuration and fill parameters in the RNG_ConfigTypeDef.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.
- **pConf:** pointer to a RNG_ConfigTypeDef structure that contains the configuration information for RNG module

Return values

- **HAL:** status

`HAL_RNGEx_LockConfig`

Function name

HAL_StatusTypeDef HAL_RNGEx_LockConfig (RNG_HandleTypeDef * hrng)

Function description

RNG current configuration lock.

Parameters

- **hrng:** pointer to a RNG_HandleTypeDef structure that contains the configuration information for RNG.

Return values

- **HAL:** status

Notes

- This function allows to lock RNG peripheral configuration. Once locked, HW RNG reset has to be perfomed prior any further configuration update.

60.3 RNGEx Firmware driver defines

The following section lists the various define and macros of the module.

60.3.1 RNGEx

RNGEx

61 HAL RTC Generic Driver

61.1 RTC Firmware driver registers structures

61.1.1 RTC_InitTypeDef

RTC_InitTypeDef is defined in the stm32l4xx_hal_rtc.h

Data Fields

- ***uint32_t HourFormat***
- ***uint32_t AsynchPrediv***
- ***uint32_t SynchPrediv***
- ***uint32_t OutPut***
- ***uint32_t OutPutRemap***
- ***uint32_t OutPutPolarity***
- ***uint32_t OutPutType***

Field Documentation

- ***uint32_t RTC_InitTypeDef::HourFormat***
  Specifies the RTC Hour Format. This parameter can be a value of RTC_Hour_Formats
- ***uint32_t RTC_InitTypeDef::AsynchPrediv***
  Specifies the RTC Asynchronous Predivider value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7F
- ***uint32_t RTC_InitTypeDef::SynchPrediv***
  Specifies the RTC Synchronous Predivider value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7FFF
- ***uint32_t RTC_InitTypeDef::OutPut***
  Specifies which signal will be routed to the RTC output. This parameter can be a value of ***RTCEx_Output_selection_Definitions***
- ***uint32_t RTC_InitTypeDef::OutPutRemap***
  Specifies the remap for RTC output. This parameter can be a value of ***RTC_Output_ALARM_OUT_Remap***
- ***uint32_t RTC_InitTypeDef::OutPutPolarity***
  Specifies the polarity of the output signal. This parameter can be a value of ***RTC_Output_Polarity_Definitions***
- ***uint32_t RTC_InitTypeDef::OutPutType***
  Specifies the RTC Output Pin mode. This parameter can be a value of ***RTC_Output_Type_ALARM_OUT***

61.1.2 RTC_TimeTypeDef

RTC_TimeTypeDef is defined in the stm32l4xx_hal_rtc.h

Data Fields

- ***uint8_t Hours***
- ***uint8_t Minutes***
- ***uint8_t Seconds***
- ***uint8_t TimeFormat***
- ***uint32_t SubSeconds***
- ***uint32_t SecondFraction***
- ***uint32_t DayLightSaving***
- ***uint32_t StoreOperation***

Field Documentation

- ***uint8_t RTC_TimeTypeDef::Hours***

  Specifies the RTC Time Hour. This parameter must be a number between Min_Data = 0 and Max_Data = 12 if the RTC_HourFormat_12 is selected. This parameter must be a number between Min_Data = 0 and Max_Data = 23 if the RTC_HourFormat_24 is selected
- ***uint8_t RTC_TimeTypeDef::Minutes***

  Specifies the RTC Time Minutes. This parameter must be a number between Min_Data = 0 and Max_Data = 59
- ***uint8_t RTC_TimeTypeDef::Seconds***

  Specifies the RTC Time Seconds. This parameter must be a number between Min_Data = 0 and Max_Data = 59
- ***uint8_t RTC_TimeTypeDef::TimeFormat***

  Specifies the RTC AM/PM Time. This parameter can be a value of ***RTC_AM_PM_Definitions***
- ***uint32_t RTC_TimeTypeDef::SubSeconds***

  Specifies the RTC_SSR RTC Sub Second register content. This parameter corresponds to a time unit range between [0-1] Second with [1 Sec / SecondFraction +1] granularity
- ***uint32_t RTC_TimeTypeDef::SecondFraction***

  Specifies the range or granularity of Sub Second register content corresponding to Synchronous pre-scaler factor value (PREDIV_S) This parameter corresponds to a time unit range between [0-1] Second with [1 Sec / SecondFraction +1] granularity. This field will be used only by HAL_RTC_GetTime function
- ***uint32_t RTC_TimeTypeDef::DayLightSaving***

  Specifies RTC_DayLightSaveOperation: the value of hour adjustment. This parameter can be a value of ***RTC_DayLightSaving_Definitions***
- ***uint32_t RTC_TimeTypeDef::StoreOperation***

  Specifies RTC_StoreOperation value to be written in the BKP bit in CR register to store the operation. This parameter can be a value of ***RTC_StoreOperation_Definitions***

61.1.3 RTC_DateTypeDef

RTC_DateTypeDef is defined in the stm32l4xx_hal_rtc.h

Data Fields

- ***uint8_t WeekDay***
- ***uint8_t Month***
- ***uint8_t Date***
- ***uint8_t Year***

Field Documentation

- ***uint8_t RTC_DateTypeDef::WeekDay***

  Specifies the RTC Date WeekDay. This parameter can be a value of ***RTC_WeekDay_Definitions***
- ***uint8_t RTC_DateTypeDef::Month***

  Specifies the RTC Date Month (in BCD format). This parameter can be a value of ***RTC_Month_Date_Definitions***
- ***uint8_t RTC_DateTypeDef::Date***

  Specifies the RTC Date. This parameter must be a number between Min_Data = 1 and Max_Data = 31
- ***uint8_t RTC_DateTypeDef::Year***

  Specifies the RTC Date Year. This parameter must be a number between Min_Data = 0 and Max_Data = 99

61.1.4 RTC_AlarmTypeDef

RTC_AlarmTypeDef is defined in the stm32l4xx_hal_rtc.h

Data Fields

- ***RTC_TimeTypeDef AlarmTime***
- ***uint32_t AlarmMask***
- ***uint32_t SubSeconds***
- ***uint32_t AlarmSubSecondMask***
- ***uint32_t AlarmDateWeekDaySel***

- ***uint8_t AlarmDateWeekDay***
- ***uint32_t Alarm***

Field Documentation

- ***RTC_TimeTypeDef RTC_AlarmTypeDef::AlarmTime***
  Specifies the RTC Alarm Time members
- ***uint32_t RTC_AlarmTypeDef::AlarmMask***
  Specifies the RTC Alarm Masks. This parameter can be a value of ***RTC_AlarmMask_Definitions***
- ***uint32_t RTC_AlarmTypeDef::SubSeconds***
  Specifies the RTC_SSR RTC Sub Second register content.
- ***uint32_t RTC_AlarmTypeDef::AlarmSubSecondMask***
  Specifies the RTC Alarm SubSeconds Masks. This parameter can be a value of ***RTC_Alarm_Sub_Seconds_Masks_Definitions***
- ***uint32_t RTC_AlarmTypeDef::AlarmDateWeekDaySel***
  Specifies the RTC Alarm is on Date or WeekDay. This parameter can be a value of ***RTC_AlarmDateWeekDay_Definitions***
- ***uint8_t RTC_AlarmTypeDef::AlarmDateWeekDay***
  Specifies the RTC Alarm Date/WeekDay. If the Alarm Date is selected, this parameter must be set to a value in the 1-31 range. If the Alarm WeekDay is selected, this parameter can be a value of ***RTC_WeekDay_Definitions***
- ***uint32_t RTC_AlarmTypeDef::Alarm***
  Specifies the alarm . This parameter can be a value of ***RTC_Alarms_Definitions***

61.1.5 RTC_HandleTypeDef

RTC_HandleTypeDef is defined in the stm32l4xx_hal_rtc.h

Data Fields

- ***RTC_TypeDef * Instance***
- ***RTC_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_RTCStateTypeDef State***

Field Documentation

- ***RTC_TypeDef* RTC_HandleTypeDef::Instance***
  Register base address
- ***RTC_InitTypeDef RTC_HandleTypeDef::Init***
  RTC required parameters
- ***HAL_LockTypeDef RTC_HandleTypeDef::Lock***
  RTC locking object
- ***__IO HAL_RTCStateTypeDef RTC_HandleTypeDef::State***
  Time communication state

61.2 RTC Firmware driver API description

The following section lists the various functions of the RTC library.

61.2.1 RTC Operating Condition

The real-time clock (RTC) and the RTC backup registers can be powered from the VBAT voltage when the main VDD supply is powered off. To retain the content of the RTC backup registers and supply the RTC when VDD is turned off, VBAT pin can be connected to an optional standby voltage supplied by a battery or by another source.

61.2.2 Backup Domain Reset

The backup domain reset sets all RTC registers and the RCC_BDCR register to their reset values. A backup domain reset is generated when one of the following events occurs:

1. Software reset, triggered by setting the BDRST bit in the RCC Backup domain control register (RCC_BDCR).
2. VDD or VBAT power on, if both supplies have previously been powered off.
3. Tamper detection event resets all data backup registers.

61.2.3 Backup Domain Access

After reset, the backup domain (RTC registers and RTC backup data registers) is protected against possible unwanted write accesses.

To enable access to the RTC Domain and RTC registers, proceed as follows:

- Enable the Power Controller (PWR) APB1 interface clock using the __HAL_RCC_PWR_CLK_ENABLE() function.
- Enable access to RTC domain using the HAL_PWR_EnableBkUpAccess() function.
- Select the RTC clock source using the __HAL_RCC_RTC_CONFIG() function.
- Enable RTC Clock using the __HAL_RCC_RTC_ENABLE() function.

To enable access to the RTC Domain and RTC registers, proceed as follows:

1. Call the function HAL_RCCEx_PeriphCLKConfig with RCC_PERIPHCLK_RTC for PeriphClockSelection and select RTCClockSelection (LSE, LSI or HSEdiv32)
2. Enable RTC Clock using the __HAL_RCC_RTC_ENABLE() macro.

61.2.4 How to use RTC Driver

- Enable the RTC domain access (see description in the section above).
- Configure the RTC Prescaler (Asynchronous and Synchronous) and RTC hour format using the HAL_RTC_Init() function.

Time and Date configuration

- To configure the RTC Calendar (Time and Date) use the HAL_RTC_SetTime() and HAL_RTC_SetDate() functions.
- To read the RTC Calendar, use the HAL_RTC_GetTime() and HAL_RTC_GetDate() functions.

Alarm configuration

- To configure the RTC Alarm use the HAL_RTC_SetAlarm() function. You can also configure the RTC Alarm with interrupt mode using the HAL_RTC_SetAlarm_IT() function.
- To read the RTC Alarm, use the HAL_RTC_GetAlarm() function.

61.2.5 RTC and low power modes

The MCU can be woken up from a low power mode by an RTC alternate function.

The RTC alternate functions are the RTC alarms (Alarm A and Alarm B), RTC wakeup, RTC tamper event detection and RTC time stamp event detection. These RTC alternate functions can wake up the system from the Stop and Standby low power modes.

The system can also wake up from low power modes without depending on an external interrupt (Auto-wakeup mode), by using the RTC alarm or the RTC wakeup events.

The RTC provides a programmable time base for waking up from the Stop or Standby mode at regular intervals. Wakeup from STOP and STANDBY modes is possible only when the RTC clock source is LSE or LSI.

Callback registration

When The compilation define USE_HAL_RTC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions. This is the recommended configuration in order to optimize memory/code consumption footprint/performances.

The compilation define USE_RTC_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Function @ref HAL_RTC_RegisterCallback() to register an interrupt callback.

Function @ref HAL_RTC_RegisterCallback() allows to register following callbacks:

- AlarmAEventCallback : RTC Alarm A Event callback.

- AlarmBEventCallback : RTC Alarm B Event callback.
- TimeStampEventCallback : RTC TimeStamp Event callback.
- WakeUpTimerEventCallback : RTC WakeUpTimer Event callback. #if defined (STM32L4P5xx) || defined (STM32L4Q5xx)
- SSRUEventCallback : RTC SSRU Event callback. #endif
- Tamper1EventCallback : RTC Tamper 1 Event callback.
- Tamper2EventCallback : RTC Tamper 2 Event callback.
- Tamper3EventCallback : RTC Tamper 3 Event callback.
- MspInitCallback : RTC MspInit callback.
- MspDeInitCallback : RTC MspDeInit callback. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_RTC_UnRegisterCallback() to reset a callback to the default weak function. @ref HAL_RTC_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- AlarmAEventCallback : RTC Alarm A Event callback.
- AlarmBEventCallback : RTC Alarm B Event callback.
- TimeStampEventCallback : RTC TimeStamp Event callback.
- WakeUpTimerEventCallback : RTC WakeUpTimer Event callback. #if defined (STM32L4P5xx) || defined (STM32L4Q5xx)
- SSRUEventCallback : RTC SSRU Event callback. #endif
- Tamper1EventCallback : RTC Tamper 1 Event callback.
- Tamper2EventCallback : RTC Tamper 2 Event callback.
- Tamper3EventCallback : RTC Tamper 3 Event callback.
- MspInitCallback : RTC MspInit callback.
- MspDeInitCallback : RTC MspDeInit callback.

By default, after the @ref HAL_RTC_Init() and when the state is HAL_RTC_STATE_RESET, all callbacks are set to the corresponding weak functions : examples @ref AlarmAEventCallback(), @ref TimeStampEventCallback(). Exception done for MspInit and MspDeInit callbacks that are reset to the legacy weak function in the @ref HAL_RTC_Init()/@ref HAL_RTC_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, @ref HAL_RTC_Init()/@ref HAL_RTC_DeInit() keep and use the user MspInit/ MspDeInit callbacks (registered beforehand)

Callbacks can be registered/unregistered in HAL_RTC_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_RTC_STATE_READY or HAL_RTC_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_RTC_RegisterCallback() before calling @ref HAL_RTC_DeInit() or @ref HAL_RTC_Init() function.

When The compilation define USE_HAL_RTC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

61.2.6 Initialization and de-initialization functions

This section provides functions allowing to initialize and configure the RTC Prescaler (Synchronous and Asynchronous), RTC Hour format, disable RTC registers Write protection, enter and exit the RTC initialization mode, RTC registers synchronization check and reference clock detection enable.

1. The RTC Prescaler is programmed to generate the RTC 1Hz time base. It is split into 2 programmable prescalers to minimize power consumption.
   – A 7-bit asynchronous prescaler and a 15-bit synchronous prescaler.
   – When both prescalers are used, it is recommended to configure the asynchronous prescaler to a high value to minimize power consumption.
2. All RTC registers are Write protected. Writing to the RTC registers is enabled by writing a key into the Write Protection register, RTC_WPR.
3. To configure the RTC Calendar, user application should enter initialization mode. In this mode, the calendar counter is stopped and its value can be updated. When the initialization sequence is complete, the calendar restarts counting after 4 RTCCLK cycles.

4. To read the calendar through the shadow registers after Calendar initialization, calendar update or after wakeup from low power modes the software must first clear the RSF flag. The software must then wait until it is set again before reading the calendar, which means that the calendar registers have been correctly copied into the RTC_TR and RTC_DR shadow registers.The HAL_RTC_WaitForSynchro() function implements the above software sequence (RSF clear and RSF check).

This section contains the following APIs:

- ***HAL_RTC_Init***
- ***HAL_RTC_DeInit***
- ***HAL_RTC_MspInit***
- ***HAL_RTC_MspDeInit***

61.2.7 RTC Time and Date functions

This section provides functions allowing to configure Time and Date features

This section contains the following APIs:

- ***HAL_RTC_SetTime***
- ***HAL_RTC_GetTime***
- ***HAL_RTC_SetDate***
- ***HAL_RTC_GetDate***

61.2.8 RTC Alarm functions

This section provides functions allowing to configure Alarm feature

This section contains the following APIs:

- ***HAL_RTC_SetAlarm***
- ***HAL_RTC_SetAlarm_IT***
- ***HAL_RTC_DeactivateAlarm***
- ***HAL_RTC_GetAlarm***
- ***HAL_RTC_AlarmIRQHandler***
- ***HAL_RTC_AlarmAEventCallback***
- ***HAL_RTC_PollForAlarmAEvent***

61.2.9 Peripheral Control functions

This subsection provides functions allowing to

- Wait for RTC Time and Date Synchronization

This section contains the following APIs:

- ***HAL_RTC_WaitForSynchro***

61.2.10 Peripheral State functions

This subsection provides functions allowing to

- Get RTC state

This section contains the following APIs:

- ***HAL_RTC_GetState***

61.2.11 Detailed description of functions

`HAL_RTC_Init`

Function name

HAL_StatusTypeDef HAL_RTC_Init (RTC_HandleTypeDef * hrtc)

Function description

Initialize the RTC peripheral.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

`HAL_RTC_DeInit`

Function name

HAL_StatusTypeDef HAL_RTC_DeInit (RTC_HandleTypeDef * hrtc)

Function description

DeInitialize the RTC peripheral.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

Notes

- This function does not reset the RTC Backup Data registers.

`HAL_RTC_MspInit`

Function name

void HAL_RTC_MspInit (RTC_HandleTypeDef * hrtc)

Function description

Initialize the RTC MSP.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTC_MspDeInit`

Function name

void HAL_RTC_MspDeInit (RTC_HandleTypeDef * hrtc)

Function description

DeInitialize the RTC MSP.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTC_SetTime`

Function name

HAL_StatusTypeDef HAL_RTC_SetTime (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTime, uint32_t Format)

Function description

Set RTC current time.

Parameters

- **hrtc:** RTC handle
- **sTime:** Pointer to Time structure
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
  – RTC_FORMAT_BIN: Binary data format
  – RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

`HAL_RTC_GetTime`

Function name

HAL_StatusTypeDef HAL_RTC_GetTime (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTime, uint32_t Format)

Function description

Get RTC current time.

Parameters

- **hrtc:** RTC handle
- **sTime:** Pointer to Time structure with Hours, Minutes and Seconds fields returned with input format (BIN or BCD), also SubSeconds field returning the RTC_SSR register content and SecondFraction field the Synchronous pre-scaler factor to be used for second fraction ratio computation.
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
  – RTC_FORMAT_BIN: Binary data format
  – RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

Notes

- You can use SubSeconds and SecondFraction (sTime structure fields returned) to convert SubSeconds value in second fraction ratio with time unit following generic formula: Second fraction ratio * time_unit= [(SecondFraction-SubSeconds)/(SecondFraction+1)] * time_unit This conversion can be performed only if no shift operation is pending (ie. SHFP=0) when PREDIV_S ≥ SS
- You must call HAL_RTC_GetDate() after HAL_RTC_GetTime() to unlock the values in the higher-order calendar shadow registers to ensure consistency between the time and date values. Reading RTC current time locks the values in calendar shadow registers until Current date is read to ensure consistency between the time and date values.

`HAL_RTC_SetDate`

Function name

HAL_StatusTypeDef HAL_RTC_SetDate (RTC_HandleTypeDef * hrtc, RTC_DateTypeDef * sDate, uint32_t Format)

Function description

Set RTC current date.

Parameters

- **hrtc:** RTC handle
- **sDate:** Pointer to date structure
- **Format:** specifies the format of the entered parameters. This parameter can be one of the following values:
  - RTC_FORMAT_BIN: Binary data format
  - RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

`HAL_RTC_GetDate`

Function name

HAL_StatusTypeDef HAL_RTC_GetDate (RTC_HandleTypeDef * hrtc, RTC_DateTypeDef * sDate, uint32_t Format)

Function description

Get RTC current date.

Parameters

- **hrtc:** RTC handle
- **sDate:** Pointer to Date structure
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
  - RTC_FORMAT_BIN: Binary data format
  - RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

Notes

- You must call HAL_RTC_GetDate() after HAL_RTC_GetTime() to unlock the values in the higher-order calendar shadow registers to ensure consistency between the time and date values. Reading RTC current time locks the values in calendar shadow registers until Current date is read.

`HAL_RTC_SetAlarm`

Function name

HAL_StatusTypeDef HAL_RTC_SetAlarm (RTC_HandleTypeDef * hrtc, RTC_AlarmTypeDef * sAlarm, uint32_t Format)

Function description

Set the specified RTC Alarm.

Parameters

- **hrtc:** RTC handle
- **sAlarm:** Pointer to Alarm structure
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
  - RTC_FORMAT_BIN: Binary data format
  - RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

HAL_RTC_SetAlarm_IT

Function name

HAL_StatusTypeDef HAL_RTC_SetAlarm_IT (RTC_HandleTypeDef * hrtc, RTC_AlarmTypeDef * sAlarm, uint32_t Format)

Function description

Set the specified RTC Alarm with Interrupt.

Parameters

- **hrtc:** RTC handle
- **sAlarm:** Pointer to Alarm structure
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
  - RTC_FORMAT_BIN: Binary data format
  - RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

Notes

- The Alarm register can only be written when the corresponding Alarm is disabled (Use the HAL_RTC_DeactivateAlarm()).
- The HAL_RTC_SetTime() must be called before enabling the Alarm feature.

HAL_RTC_DeactivateAlarm

Function name

HAL_StatusTypeDef HAL_RTC_DeactivateAlarm (RTC_HandleTypeDef * hrtc, uint32_t Alarm)

Function description

Deactivate the specified RTC Alarm.

Parameters

- **hrtc:** RTC handle
- **Alarm:** Specifies the Alarm. This parameter can be one of the following values:
  - RTC_ALARM_A: AlarmA
  - RTC_ALARM_B: AlarmB

Return values

- **HAL:** status

HAL_RTC_GetAlarm

Function name

HAL_StatusTypeDef HAL_RTC_GetAlarm (RTC_HandleTypeDef * hrtc, RTC_AlarmTypeDef * sAlarm, uint32_t Alarm, uint32_t Format)

Function description

Get the RTC Alarm value and masks.

Parameters

- **hrtc:** RTC handle
- **sAlarm:** Pointer to Date structure
- **Alarm:** Specifies the Alarm. This parameter can be one of the following values:
  - RTC_ALARM_A: AlarmA
  - RTC_ALARM_B: AlarmB
- **Format:** Specifies the format of the entered parameters. This parameter can be one of the following values:
  - RTC_FORMAT_BIN: Binary data format
  - RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

`HAL_RTC_AlarmIRQHandler`

Function name

void HAL_RTC_AlarmIRQHandler (RTC_HandleTypeDef * hrtc)

Function description

Handle Alarm interrupt request.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTC_AlarmAEventCallback`

Function name

void HAL_RTC_AlarmAEventCallback (RTC_HandleTypeDef * hrtc)

Function description

Alarm A callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTC_PollForAlarmAEvent`

Function name

HAL_StatusTypeDef HAL_RTC_PollForAlarmAEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle AlarmA Polling request.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTC_WaitForSynchro

Function name

HAL_StatusTypeDef HAL_RTC_WaitForSynchro (RTC_HandleTypeDef * hrtc)

Function description

Wait until the RTC Time and Date registers (RTC_TR and RTC_DR) are synchronized with RTC APB clock.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

Notes

- The RTC Resynchronization mode is write protected, use the __HAL_RTC_WRITEPROTECTION_DISABLE() before calling this function.
- To read the calendar through the shadow registers after Calendar initialization, calendar update or after wakeup from low power modes the software must first clear the RSF flag. The software must then wait until it is set again before reading the calendar, which means that the calendar registers have been correctly copied into the RTC_TR and RTC_DR shadow registers.

HAL_RTC_GetState

Function name

HAL_RTCStateTypeDef HAL_RTC_GetState (RTC_HandleTypeDef * hrtc)

Function description

Return the RTC handle state.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** state

RTC_EnterInitMode

Function name

HAL_StatusTypeDef RTC_EnterInitMode (RTC_HandleTypeDef * hrtc)

Function description

Enter the RTC Initialization mode.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

Notes

- The RTC Initialization mode is write protected, use the __HAL_RTC_WRITEPROTECTION_DISABLE() before calling this function.

RTC_ExitInitMode

Function name

HAL_StatusTypeDef RTC_ExitInitMode (RTC_HandleTypeDef * hrtc)

Function description

Exit the RTC Initialization mode.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

RTC_ByteToBcd2

Function name

uint8_t RTC_ByteToBcd2 (uint8_t Value)

Function description

Convert a 2 digit decimal to BCD format.

Parameters

- **Value:** Byte to be converted

Return values

- **Converted:** byte

RTC_Bcd2ToByte

Function name

uint8_t RTC_Bcd2ToByte (uint8_t Value)

Function description

Convert from 2 digit BCD to Binary.

Parameters

- **Value:** BCD value to be converted

Return values

- **Converted:** word

61.3 RTC Firmware driver defines

The following section lists the various define and macros of the module.

61.3.1 RTC

RTC

RTC AlarmDateWeekDay Definitions

RTC_ALARMDATEWEEKDAYSEL_DATE

RTC_ALARMDATEWEEKDAYSEL_WEEKDAY

RTC AlarmMask Definitions

RTC_ALARMMASK_NONE

RTC_ALARMMASK_DATEWEEKDAY

RTC_ALARMMASK_HOURS

RTC_ALARMMASK_MINUTES

RTC_ALARMMASK_SECONDS

RTC_ALARMMASK_ALL

RTC Alarms Definitions

RTC_ALARM_A

RTC_ALARM_B

RTC Alarm Sub Seconds Masks Definitions

RTC_ALARMSUBSECONDMASK_ALL

All Alarm SS fields are masked. There is no comparison on sub seconds for Alarm

RTC_ALARMSUBSECONDMASK_SS14_1

SS[14:1] are don't care in Alarm comparison. Only SS[0] is compared.

RTC_ALARMSUBSECONDMASK_SS14_2

SS[14:2] are don't care in Alarm comparison. Only SS[1:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_3

SS[14:3] are don't care in Alarm comparison. Only SS[2:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_4

SS[14:4] are don't care in Alarm comparison. Only SS[3:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_5

SS[14:5] are don't care in Alarm comparison. Only SS[4:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_6

SS[14:6] are don't care in Alarm comparison. Only SS[5:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_7

SS[14:7] are don't care in Alarm comparison. Only SS[6:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_8

SS[14:8] are don't care in Alarm comparison. Only SS[7:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_9

SS[14:9] are don't care in Alarm comparison. Only SS[8:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_10

SS[14:10] are don't care in Alarm comparison. Only SS[9:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_11

SS[14:11] are don't care in Alarm comparison. Only SS[10:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_12

SS[14:12] are don't care in Alarm comparison.Only SS[11:0] are compared

RTC_ALARMSUBSECONDMASK_SS14_13

SS[14:13] are don't care in Alarm comparison. Only SS[12:0] are compared

RTC_ALARMSUBSECONDMASK_SS14

SS[14] is don't care in Alarm comparison.Only SS[13:0] are compared

RTC_ALARMSUBSECONDMASK_NONE

SS[14:0] are compared and must match to activate alarm.

RTC AM PM Definitions

RTC_HOURFORMAT12_AM

RTC_HOURFORMAT12_PM

RTC DayLightSaving Definitions

RTC_DAYLIGHTSAVING_SUB1H

RTC_DAYLIGHTSAVING_ADD1H

RTC_DAYLIGHTSAVING_NONE

RTC Exported Macros

__HAL_RTC_RESET_HANDLE_STATE

Description:

- Reset RTC handle state.

Parameters:

- __HANDLE__: RTC handle.

Return value:

- None

__HAL_RTC_WRITEPROTECTION_DISABLE

Description:

- Disable the write protection for RTC registers.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_WRITEPROTECTION_ENABLE

Description:

- Enable the write protection for RTC registers.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_DAYLIGHT_SAVING_TIME_ADD1H

Description:

- Add 1 hour (summer time change).

Parameters:

- __HANDLE__: specifies the RTC handle.
- __BKP__: Backup This parameter can be:
  - RTC_STOREOPERATION_RESET
  - RTC_STOREOPERATION_SET

Return value:

- None

__HAL_RTC_DAYLIGHT_SAVING_TIME_SUB1H

Description:

- Subtract 1 hour (winter time change).

Parameters:

- __HANDLE__: specifies the RTC handle.
- __BKP__: Backup This parameter can be:
  - RTC_STOREOPERATION_RESET
  - RTC_STOREOPERATION_SET

Return value:

- None

__HAL_RTC_ALARMA_ENABLE

Description:

- Enable the RTC ALARMA peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_ALARMA_DISABLE

Description:

- Disable the RTC ALARMA peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_ALARMB_ENABLE

Description:

- Enable the RTC ALARMB peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_ALARMB_DISABLE

Description:

- Disable the RTC ALARMB peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_ALARM_ENABLE_IT

Description:

- Enable the RTC Alarm interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Alarm interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
  - RTC_IT_ALRA Alarm A interrupt
  - RTC_IT_ALRB Alarm B interrupt

Return value:

- None

__HAL_RTC_ALARM_DISABLE_IT

Description:

- Disable the RTC Alarm interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Alarm interrupt sources to be enabled or disabled. This parameter can be any combination of the following values:
  - RTC_IT_ALRA Alarm A interrupt
  - RTC_IT_ALRB Alarm B interrupt

Return value:

- None

__HAL_RTC_ALARM_GET_IT

Description:

- Check whether the specified RTC Alarm interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Alarm interrupt sources to check. This parameter can be:
  - RTC_IT_ALRA Alarm A interrupt
  - RTC_IT_ALRB Alarm B interrupt

Return value:

- None

__HAL_RTC_ALARM_GET_IT_SOURCE

Description:

- Check whether the specified RTC Alarm interrupt has been enabled or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Alarm interrupt sources to check. This parameter can be:
  - RTC_IT_ALRA Alarm A interrupt
  - RTC_IT_ALRB Alarm B interrupt

Return value:

- None

__HAL_RTC_ALARM_GET_FLAG

Description:

- Get the selected RTC Alarm's flag status.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Alarm Flag sources to check. This parameter can be:
  - RTC_FLAG_ALRAF
  - RTC_FLAG_ALRBF
  - RTC_FLAG_ALRAWF
  - RTC_FLAG_ALRBWF

Return value:

- None

__HAL_RTC_ALARM_CLEAR_FLAG

Description:

- Clear the RTC Alarm's pending flags.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Alarm Flag sources to clear. This parameter can be:
  - RTC_FLAG_ALRAF
  - RTC_FLAG_ALRBF

Return value:

- None

__HAL_RTC_ALARM_EXTI_ENABLE_IT

Description:

- Enable interrupt on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_DISABLE_IT

Description:

- Disable interrupt on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_ENABLE_EVENT

Description:

- Enable event on the RTC Alarm associated Exti line.

Return value:

- None.

__HAL_RTC_ALARM_EXTI_DISABLE_EVENT

Description:

- Disable event on the RTC Alarm associated Exti line.

Return value:

- None.

__HAL_RTC_ALARM_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable falling edge trigger on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable falling edge trigger on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_ENABLE_RISING_EDGE

Description:

- Enable rising edge trigger on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_DISABLE_RISING_EDGE

Description:

- Disable rising edge trigger on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable rising & falling edge trigger on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable rising & falling edge trigger on the RTC Alarm associated Exti line.

Return value:

- None

__HAL_RTC_ALARM_EXTI_GET_FLAG

Description:

- Check whether the RTC Alarm associated Exti line interrupt flag is set or not.

Return value:

- Line: Status.

__HAL_RTC_ALARM_EXTI_CLEAR_FLAG

Description:

- Clear the RTC Alarm associated Exti line flag.

Return value:

- None

__HAL_RTC_ALARM_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on RTC Alarm associated Exti line.

Return value:

- None

RTC Flags Definitions

RTC_FLAG_RECALPF

RTC_FLAG_TSOVF

RTC_FLAG_TSF

RTC_FLAG_ITSF

RTC_FLAG_WUTF

RTC_FLAG_ALRBF

RTC_FLAG_ALRAF

RTC_FLAG_INITF

RTC_FLAG_RSF

RTC_FLAG_INITS

RTC_FLAG_SHPF

RTC_FLAG_WUTWF

RTC_FLAG_ALRBWF

RTC_FLAG_ALRAWF

RTC Hour Formats Definitions

RTC_HOURFORMAT_24

RTC_HOURFORMAT_12

RTC Input Parameter Format Definitions

RTC_FORMAT_BIN

RTC_FORMAT_BCD

RTC Interrupts Definitions

RTC_IT_TS

Enable Timestamp Interrupt

RTC_IT_WUT

Enable Wakeup timer Interrupt

RTC_IT_ALRA

Enable Alarm A Interrupt

RTC_IT_ALRB

Enable Alarm B Interrupt

RTC Private macros to check input parameters

IS_RTC_OUTPUT

IS_RTC_HOUR_FORMAT

IS_RTC_OUTPUT_POL

IS_RTC_OUTPUT_TYPE

IS_RTC_OUTPUT_REMAP

IS_RTC_HOURFORMAT12

IS_RTC_DAYLIGHT_SAVING

IS_RTC_STORE_OPERATION

IS_RTC_FORMAT

IS_RTC_YEAR

IS_RTC_MONTH

IS_RTC_DATE

IS_RTC_WEEKDAY

IS_RTC_ALARM_DATE_WEEKDAY_DATE

IS_RTC_ALARM_DATE_WEEKDAY_WEEKDAY

IS_RTC_ALARM_DATE_WEEKDAY_SEL

IS_RTC_ALARM_MASK

IS_RTC_ALARM

IS_RTC_ALARM_SUB_SECOND_VALUE

IS_RTC_ALARM_SUB_SECOND_MASK

IS_RTC_ASYNCH_PREDIV

IS_RTC_SYNCH_PREDIV

IS_RTC_HOUR12

IS_RTC_HOUR24

IS_RTC_MINUTES

IS_RTC_SECONDS

RTC Month Date Definitions (in BCD format)

RTC_MONTH_JANUARY

RTC_MONTH_FEBRUARY

RTC_MONTH_MARCH

RTC_MONTH_APRIL

RTC_MONTH_MAY

RTC_MONTH_JUNE

RTC_MONTH_JULY

RTC_MONTH_AUGUST

RTC_MONTH_SEPTEMBER

RTC_MONTH_OCTOBER

RTC_MONTH_NOVEMBER

RTC_MONTH_DECEMBER

RTC Output ALARM OUT Remap

RTC_OUTPUT_REMAP_NONE

RTC_OUTPUT_REMAP_POS1

RTC Output Polarity Definitions

RTC_OUTPUT_POLARITY_HIGH

RTC_OUTPUT_POLARITY_LOW

RTC Output Type ALARM OUT

RTC_OUTPUT_TYPE_PUSHPULL

RTC_OUTPUT_TYPE_OPENDRAIN

RTC StoreOperation Definitions

RTC_STOREOPERATION_RESET

RTC_STOREOPERATION_SET

RTC WeekDay Definitions

RTC_WEEKDAY_MONDAY

RTC_WEEKDAY_TUESDAY

RTC_WEEKDAY_WEDNESDAY

RTC_WEEKDAY_THURSDAY

RTC_WEEKDAY_FRIDAY

RTC_WEEKDAY_SATURDAY

RTC_WEEKDAY_SUNDAY

62 HAL RTC Extension Driver

62.1 RTCEx Firmware driver registers structures

62.1.1 RTC_TamperTypeDef

RTC_TamperTypeDef is defined in the stm32l4xx_hal_rtc_ex.h

Data Fields

- ***uint32_t Tamper***
- ***uint32_t Interrupt***
- ***uint32_t Trigger***
- ***uint32_t NoErase***
- ***uint32_t MaskFlag***
- ***uint32_t Filter***
- ***uint32_t SamplingFrequency***
- ***uint32_t PrechargeDuration***
- ***uint32_t TamperPullUp***
- ***uint32_t TimeStampOnTamperDetection***

Field Documentation

- ***uint32_t RTC_TamperTypeDef::Tamper***
  Specifies the Tamper Pin. This parameter can be a value of ***RTCEx_Tamper_Pins_Definitions***
- ***uint32_t RTC_TamperTypeDef::Interrupt***
  Specifies the Tamper Interrupt. This parameter can be a value of ***RTCEx_Tamper_Interrupt_Definitions***
- ***uint32_t RTC_TamperTypeDef::Trigger***
  Specifies the Tamper Trigger. This parameter can be a value of ***RTCEx_Tamper_Trigger_Definitions***
- ***uint32_t RTC_TamperTypeDef::NoErase***
  Specifies the Tamper no erase mode. This parameter can be a value of ***RTCEx_Tamper_EraseBackUp_Definitions***
- ***uint32_t RTC_TamperTypeDef::MaskFlag***
  Specifies the Tamper Flag masking. This parameter can be a value of ***RTCEx_Tamper_MaskFlag_Definitions***
- ***uint32_t RTC_TamperTypeDef::Filter***
  Specifies the TAMP Filter Tamper. This parameter can be a value of ***RTCEx_Tamper_Filter_Definitions***
- ***uint32_t RTC_TamperTypeDef::SamplingFrequency***
  Specifies the sampling frequency. This parameter can be a value of ***RTCEx_Tamper_Sampling_Frequencies_Definitions***
- ***uint32_t RTC_TamperTypeDef::PrechargeDuration***
  Specifies the Precharge Duration . This parameter can be a value of ***RTCEx_Tamper_Pin_Precharge_Duration_Definitions***
- ***uint32_t RTC_TamperTypeDef::TamperPullUp***
  Specifies the Tamper PullUp . This parameter can be a value of ***RTCEx_Tamper_Pull_UP_Definitions***
- ***uint32_t RTC_TamperTypeDef::TimeStampOnTamperDetection***
  Specifies the TimeStampOnTamperDetection. This parameter can be a value of ***RTCEx_Tamper_TimeStampOnTamperDetection_Definitions***

62.2 RTCEx Firmware driver API description

The following section lists the various functions of the RTCEx library.

62.2.1 How to use this driver

- Enable the RTC domain access.
- Configure the RTC Prescaler (Asynchronous and Synchronous) and RTC hour format using the HAL_RTC_Init() function.

RTC Wakeup configuration

- To configure the RTC Wakeup Clock source and Counter use the HAL_RTCEx_SetWakeUpTimer() function. You can also configure the RTC Wakeup timer with interrupt mode using the HAL_RTCEx_SetWakeUpTimer_IT() function.
- To read the RTC WakeUp Counter register, use the HAL_RTCEx_GetWakeUpTimer() function.

Outputs configuration

The RTC has 2 different outputs:

- RTC_ALARM: this output is used to manage the RTC Alarm A, Alarm B and WaKeUp signals. To output the selected RTC signal, use the HAL_RTC_Init() function.
- RTC_CALIB: this output is 512Hz signal or 1Hz. To enable the RTC_CALIB, use the HAL_RTCEx_SetCalibrationOutPut() function.
- Two pins can be used as RTC_ALARM or RTC_CALIB (PC13, PB2) managed on the RTC_OR register.
- When the RTC_CALIB or RTC_ALARM output is selected, the RTC_OUT pin is automatically configured in output alternate function.

Smooth digital Calibration configuration

- Configure the RTC Original Digital Calibration Value and the corresponding calibration cycle period (32s,16s and 8s) using the HAL_RTCEx_SetSmoothCalib() function.

TimeStamp configuration

- Enable the RTC TimeStamp using the HAL_RTCEx_SetTimeStamp() function. You can also configure the RTC TimeStamp with interrupt mode using the HAL_RTCEx_SetTimeStamp_IT() function.
- To read the RTC TimeStamp Time and Date register, use the HAL_RTCEx_GetTimeStamp() function.

Internal TimeStamp configuration

- Enable the RTC internal TimeStamp using the HAL_RTCEx_SetInternalTimeStamp() function. User has to check internal timestamp occurrence using __HAL_RTC_INTERNAL_TIMESTAMP_GET_FLAG.
- To read the RTC TimeStamp Time and Date register, use the HAL_RTCEx_GetTimeStamp() function.

Tamper configuration

- Enable the RTC Tamper and configure the Tamper filter count, trigger Edge or Level according to the Tamper filter (if equal to 0 Edge else Level) value, sampling frequency, NoErase, MaskFlag, precharge or discharge and Pull-UP using the HAL_RTCEx_SetTamper() function. You can configure RTC Tamper with interrupt mode using HAL_RTCEx_SetTamper_IT() function.
- The default configuration of the Tamper erases the backup registers. To avoid erase, enable the NoErase field on the RTC_TAMPCR register.
- STM32L412xx and STM32L422xx only : With new RTC tamper configuration, you have to call HAL_RTC_Init() in order to perform TAMP base address offset calculation.
- STM32L412xx and STM32L422xx only : If you don't intend to have tamper using RTC clock, you can bypass its initialization by setting ClockEnable inti field to RTC_CLOCK_DISABLE.
- STM32L412xx and STM32L422xx only : Enable Internal tamper using HAL_RTCEx_SetInternalTamper. IT mode can be chosen using setting Interrupt field.

Backup Data Registers configuration

- To write to the RTC Backup Data registers, use the HAL_RTCEx_BKUPWrite() function.
- To read the RTC Backup Data registers, use the HAL_RTCEx_BKUPRead() function.
- STM32L412xx and STM32L422xx only : Before calling these functions you have to call HAL_RTC_Init() in order to perform TAMP base address offset calculation.

62.2.2 RTC TimeStamp and Tamper functions

This section provides functions allowing to configure TimeStamp feature
This section contains the following APIs:

- ***HAL_RTCEx_SetTimeStamp***
- ***HAL_RTCEx_SetTimeStamp_IT***
- ***HAL_RTCEx_DeactivateTimeStamp***
- ***HAL_RTCEx_SetInternalTimeStamp***
- ***HAL_RTCEx_DeactivateInternalTimeStamp***
- ***HAL_RTCEx_GetTimeStamp***
- ***HAL_RTCEx_TamperTimeStampIRQHandler***
- ***HAL_RTCEx_TimeStampEventCallback***
- ***HAL_RTCEx_PollForTimeStampEvent***

62.2.3 RTC Wake-up functions

This section provides functions allowing to configure Wake-up feature
This section contains the following APIs:

- ***HAL_RTCEx_SetWakeUpTimer***
- ***HAL_RTCEx_SetWakeUpTimer_IT***
- ***HAL_RTCEx_DeactivateWakeUpTimer***
- ***HAL_RTCEx_GetWakeUpTimer***
- ***HAL_RTCEx_WakeUpTimerIRQHandler***
- ***HAL_RTCEx_WakeUpTimerEventCallback***
- ***HAL_RTCEx_PollForWakeUpTimerEvent***

62.2.4 Extended Peripheral Control functions

This subsection provides functions allowing to

- Write a data in a specified RTC Backup data register
- Read a data in a specified RTC Backup data register
- Set the Coarse calibration parameters.
- Deactivate the Coarse calibration parameters
- Set the Smooth calibration parameters.
- STM32L412xx and STM32L422xx only : Set Low Power calibration parameter.
- Configure the Synchronization Shift Control Settings.
- Configure the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
- Deactivate the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
- Enable the RTC reference clock detection.
- Disable the RTC reference clock detection.
- Enable the Bypass Shadow feature.
- Disable the Bypass Shadow feature.

This section contains the following APIs:

- ***HAL_RTCEx_SetSmoothCalib***
- ***HAL_RTCEx_SetSynchroShift***
- ***HAL_RTCEx_SetCalibrationOutPut***
- ***HAL_RTCEx_DeactivateCalibrationOutPut***
- ***HAL_RTCEx_SetRefClock***
- ***HAL_RTCEx_DeactivateRefClock***
- ***HAL_RTCEx_EnableBypassShadow***
- ***HAL_RTCEx_DisableBypassShadow***

62.2.5 Extended features functions

This section provides functions allowing to:

- RTC Alarm B callback
- RTC Poll for Alarm B request

This section contains the following APIs:

- ***HAL_RTCEx_AlarmBEventCallback***
- ***HAL_RTCEx_PollForAlarmBEvent***

62.2.6 Tamper functions

- Before calling any tamper or internal tamper function, you have to call first HAL_RTC_Init() function.
- In that ine you can select to output tamper event on RTC pin.
- Enable the Tamper and configure the Tamper filter count, trigger Edge or Level according to the Tamper filter (if equal to 0 Edge else Level) value, sampling frequency, NoErase, MaskFlag, precharge or discharge and Pull-UP, timestamp using the HAL_RTCEx_SetTamper() function. You can configure Tamper with interrupt mode using HAL_RTCEx_SetTamper_IT() function.
- The default configuration of the Tamper erases the backup registers. To avoid erase, enable the NoErase field on the TAMP_TAMPCR register.
- Enable Internal Tamper and configure it with interrupt, timestamp using the HAL_RTCEx_SetInternalTamper() function.

This section contains the following APIs:

- ***HAL_RTCEx_SetTamper***
- ***HAL_RTCEx_SetTamper_IT***
- ***HAL_RTCEx_DeactivateTamper***
- ***HAL_RTCEx_PollForTamper1Event***
- ***HAL_RTCEx_PollForTamper2Event***
- ***HAL_RTCEx_PollForTamper3Event***
- ***HAL_RTCEx_Tamper1EventCallback***
- ***HAL_RTCEx_Tamper2EventCallback***
- ***HAL_RTCEx_Tamper3EventCallback***

62.2.7 Extended RTC Backup register functions

- Before calling any tamper or internal tamper function, you have to call first HAL_RTC_Init() function.
- In that ine you can select to output tamper event on RTC pin.

This subsection provides functions allowing to

- Write a data in a specified RTC Backup data register
- Read a data in a specified RTC Backup data register

This section contains the following APIs:

- ***HAL_RTCEx_BKUPWrite***
- ***HAL_RTCEx_BKUPRead***

62.2.8 Detailed description of functions

`HAL_RTCEx_SetTimeStamp`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetTimeStamp (RTC_HandleTypeDef * hrtc, uint32_t TimeStampEdge, uint32_t RTC_TimeStampPin)

Function description

Set TimeStamp.

Parameters

- **hrtc:** RTC handle
- **TimeStampEdge:** Specifies the pin edge on which the TimeStamp is activated. This parameter can be one of the following values:
  - RTC_TIMESTAMPEDGE_RISING: the Time stamp event occurs on the rising edge of the related pin.
  - RTC_TIMESTAMPEDGE_FALLING: the Time stamp event occurs on the falling edge of the related pin.
- **RTC_TimeStampPin:** specifies the RTC TimeStamp Pin. This parameter can be one of the following values:
  - RTC_TIMESTAMPPIN_DEFAULT: PC13 is selected as RTC TimeStamp Pin. The RTC TimeStamp Pin is per default PC13, but for reasons of compatibility, this parameter is required.

Return values

- **HAL:** status

Notes

- This API must be called before enabling the TimeStamp feature.

`HAL_RTCEx_SetTimeStamp_IT`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetTimeStamp_IT (RTC_HandleTypeDef * hrtc, uint32_t TimeStampEdge, uint32_t RTC_TimeStampPin)

Function description

Set TimeStamp with Interrupt.

Parameters

- **hrtc:** RTC handle
- **TimeStampEdge:** Specifies the pin edge on which the TimeStamp is activated. This parameter can be one of the following values:
  - RTC_TIMESTAMPEDGE_RISING: the Time stamp event occurs on the rising edge of the related pin.
  - RTC_TIMESTAMPEDGE_FALLING: the Time stamp event occurs on the falling edge of the related pin.
- **RTC_TimeStampPin:** Specifies the RTC TimeStamp Pin. This parameter can be one of the following values:
  - RTC_TIMESTAMPPIN_DEFAULT: PC13 is selected as RTC TimeStamp Pin. The RTC TimeStamp Pin is per default PC13, but for reasons of compatibility, this parameter is required.

Return values

- **HAL:** status

Notes

- This API must be called before enabling the TimeStamp feature.

`HAL_RTCEx_DeactivateTimeStamp`

Function name

HAL_StatusTypeDef HAL_RTCEx_DeactivateTimeStamp (RTC_HandleTypeDef * hrtc)

Function description

Deactivate TimeStamp.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

`HAL_RTCEx_SetInternalTimeStamp`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetInternalTimeStamp (RTC_HandleTypeDef * hrtc)

Function description

Set Internal TimeStamp.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

Notes

- This API must be called before enabling the internal TimeStamp feature.

`HAL_RTCEx_DeactivateInternalTimeStamp`

Function name

HAL_StatusTypeDef HAL_RTCEx_DeactivateInternalTimeStamp (RTC_HandleTypeDef * hrtc)

Function description

Deactivate Internal TimeStamp.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

`HAL_RTCEx_GetTimeStamp`

Function name

HAL_StatusTypeDef HAL_RTCEx_GetTimeStamp (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTimeStamp, RTC_DateTypeDef * sTimeStampDate, uint32_t Format)

Function description

Get the RTC TimeStamp value.

Parameters

- **hrtc:** RTC handle
- **sTimeStamp:** Pointer to Time structure
- **sTimeStampDate:** Pointer to Date structure
- **Format:** specifies the format of the entered parameters. This parameter can be one of the following values:
  - RTC_FORMAT_BIN: Binary data format
  - RTC_FORMAT_BCD: BCD data format

Return values

- **HAL:** status

HAL_RTCEx_TamperTimeStampIRQHandler

Function name

void HAL_RTCEx_TamperTimeStampIRQHandler (RTC_HandleTypeDef * hrtc)

Function description

Handle TimeStamp interrupt request.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

HAL_RTCEx_TimeStampEventCallback

Function name

void HAL_RTCEx_TimeStampEventCallback (RTC_HandleTypeDef * hrtc)

Function description

TimeStamp callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

HAL_RTCEx_PollForTimeStampEvent

Function name

HAL_StatusTypeDef HAL_RTCEx_PollForTimeStampEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle TimeStamp polling request.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_SetWakeUpTimer

Function name

HAL_StatusTypeDef HAL_RTCEx_SetWakeUpTimer (RTC_HandleTypeDef * hrtc, uint32_t WakeUpCounter, uint32_t WakeUpClock)

Function description

Set wake up timer.

Parameters

- **hrtc:** RTC handle
- **WakeUpCounter:** Wake up counter
- **WakeUpClock:** Wake up clock

Return values

- **HAL:** status

HAL_RTCEx_SetWakeUpTimer_IT

Function name

HAL_StatusTypeDef HAL_RTCEx_SetWakeUpTimer_IT (RTC_HandleTypeDef * hrtc, uint32_t WakeUpCounter, uint32_t WakeUpClock)

Function description

Set wake up timer with interrupt.

Parameters

- **hrtc:** RTC handle
- **WakeUpCounter:** Wake up counter
- **WakeUpClock:** Wake up clock
- **WakeUpAutoClr:** Wake up auto clear value (look at WUTOCLR in reference manual)
  - Only available for STM32L412xx and STM32L422xx
  - No effect if WakeUpAutoClr is set to zero
  - This feature is meaningful in case of Low power mode to avoid any RTC software execution after Wake Up. That is why when WakeUpAutoClr is set, EXTI is configured as EVENT instead of Interrupt to avoid useless IRQ handler execution.

Return values

- **HAL:** status

HAL_RTCEx_DeactivateWakeUpTimer

Function name

HAL_StatusTypeDef HAL_RTCEx_DeactivateWakeUpTimer (RTC_HandleTypeDef * hrtc)

Function description

Deactivate wake up timer counter.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

HAL_RTCEx_GetWakeUpTimer

Function name

uint32_t HAL_RTCEx_GetWakeUpTimer (RTC_HandleTypeDef * hrtc)

Function description

Get wake up timer counter.

Parameters

- **hrtc:** RTC handle

Return values

- **Counter:** value

`HAL_RTCEx_WakeUpTimerIRQHandler`

Function name

void HAL_RTCEx_WakeUpTimerIRQHandler (RTC_HandleTypeDef * hrtc)

Function description

Handle Wake Up Timer interrupt request.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTCEx_WakeUpTimerEventCallback`

Function name

void HAL_RTCEx_WakeUpTimerEventCallback (RTC_HandleTypeDef * hrtc)

Function description

Wake Up Timer callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTCEx_PollForWakeUpTimerEvent`

Function name

HAL_StatusTypeDef HAL_RTCEx_PollForWakeUpTimerEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle Wake Up Timer Polling.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_RTCEx_SetSmoothCalib`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetSmoothCalib (RTC_HandleTypeDef * hrtc, uint32_t SmoothCalibPeriod, uint32_t SmoothCalibPlusPulses, uint32_t SmoothCalibMinusPulsesValue)

Function description

Set the Smooth calibration parameters.

Parameters

- **hrtc:** RTC handle
- **SmoothCalibPeriod:** Select the Smooth Calibration Period. This parameter can be can be one of the following values :
  - RTC_SMOOTHCALIB_PERIOD_32SEC: The smooth calibration period is 32s.
  - RTC_SMOOTHCALIB_PERIOD_16SEC: The smooth calibration period is 16s.
  - RTC_SMOOTHCALIB_PERIOD_8SEC: The smooth calibration period is 8s.
- **SmoothCalibPlusPulses:** Select to Set or reset the CALP bit. This parameter can be one of the following values:
  - RTC_SMOOTHCALIB_PLUSPULSES_SET: Add one RTCCLK pulse every 2*11 pulses.
  - RTC_SMOOTHCALIB_PLUSPULSES_RESET: No RTCCLK pulses are added.
- **SmoothCalibMinusPulsesValue:** Select the value of CALM[8:0] bits. This parameter can be one any value from 0 to 0x000001FF.

Return values

- **HAL:** status

Notes

- To deactivate the smooth calibration, the field SmoothCalibPlusPulses must be equal to SMOOTHCALIB_PLUSPULSES_RESET and the field SmoothCalibMinusPulsesValue must be equal to 0.

`HAL_RTCEx_SetSynchroShift`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetSynchroShift (RTC_HandleTypeDef * hrtc, uint32_t ShiftAdd1S, uint32_t ShiftSubFS)

Function description

Configure the Synchronization Shift Control Settings.

Parameters

- **hrtc:** RTC handle
- **ShiftAdd1S:** Select to add or not 1 second to the time calendar. This parameter can be one of the following values:
  - RTC_SHIFTADD1S_SET: Add one second to the clock calendar.
  - RTC_SHIFTADD1S_RESET: No effect.
- **ShiftSubFS:** Select the number of Second Fractions to substitute. This parameter can be one any value from 0 to 0x7FFF.

Return values

- **HAL:** status

Notes

- When REFCKON is set, firmware must not write to Shift control register.

`HAL_RTCEx_SetCalibrationOutPut`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetCalibrationOutPut (RTC_HandleTypeDef * hrtc, uint32_t CalibOutput)

Function description

Configure the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).

Parameters

- **hrtc:** RTC handle
- **CalibOutput:** Select the Calibration output Selection . This parameter can be one of the following values:
  - RTC_CALIBOUTPUT_512HZ: A signal has a regular waveform at 512Hz.
  - RTC_CALIBOUTPUT_1HZ: A signal has a regular waveform at 1Hz.

Return values

- **HAL:** status

`HAL_RTCEx_DeactivateCalibrationOutPut`

Function name

HAL_StatusTypeDef HAL_RTCEx_DeactivateCalibrationOutPut (RTC_HandleTypeDef * hrtc)

Function description

Deactivate the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

`HAL_RTCEx_SetRefClock`

Function name

HAL_StatusTypeDef HAL_RTCEx_SetRefClock (RTC_HandleTypeDef * hrtc)

Function description

Enable the RTC reference clock detection.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

`HAL_RTCEx_DeactivateRefClock`

Function name

HAL_StatusTypeDef HAL_RTCEx_DeactivateRefClock (RTC_HandleTypeDef * hrtc)

Function description

Disable the RTC reference clock detection.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

`HAL_RTCEx_EnableBypassShadow`

Function name

HAL_StatusTypeDef HAL_RTCEx_EnableBypassShadow (RTC_HandleTypeDef * hrtc)

Function description

Enable the Bypass Shadow feature.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

Notes

- When the Bypass Shadow is enabled the calendar value are taken directly from the Calendar counter.

HAL_RTCEx_DisableBypassShadow

Function name

HAL_StatusTypeDef HAL_RTCEx_DisableBypassShadow (RTC_HandleTypeDef * hrtc)

Function description

Disable the Bypass Shadow feature.

Parameters

- **hrtc:** RTC handle

Return values

- **HAL:** status

Notes

- When the Bypass Shadow is enabled the calendar value are taken directly from the Calendar counter.

HAL_RTCEx_AlarmBEventCallback

Function name

void HAL_RTCEx_AlarmBEventCallback (RTC_HandleTypeDef * hrtc)

Function description

Alarm B callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

HAL_RTCEx_PollForAlarmBEvent

Function name

HAL_StatusTypeDef HAL_RTCEx_PollForAlarmBEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle Alarm B Polling request.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_SetTamper

Function name

HAL_StatusTypeDef HAL_RTCEx_SetTamper (RTC_HandleTypeDef * hrtc, RTC_TamperTypeDef * sTamper)

Function description

Set Tamper.

Parameters

- **hrtc:** RTC handle
- **sTamper:** Pointer to Tamper Structure.

Return values

- **HAL:** status

Notes

- By calling this API we disable the tamper interrupt for all tampers.

HAL_RTCEx_SetTamper_IT

Function name

HAL_StatusTypeDef HAL_RTCEx_SetTamper_IT (RTC_HandleTypeDef * hrtc, RTC_TamperTypeDef * sTamper)

Function description

Set Tamper with interrupt.

Parameters

- **hrtc:** RTC handle
- **sTamper:** Pointer to Tamper Structure.

Return values

- **HAL:** status

HAL_RTCEx_DeactivateTamper

Function name

HAL_StatusTypeDef HAL_RTCEx_DeactivateTamper (RTC_HandleTypeDef * hrtc, uint32_t Tamper)

Function description

Deactivate Tamper.

Parameters

- **hrtc:** RTC handle
- **Tamper:** Selected tamper pin. This parameter can be any combination of the following values:
  - RTC_TAMPER_1
  - RTC_TAMPER_2
  - RTC_TAMPER_3

Return values

- **HAL:** status

HAL_RTCEx_PollForTamper1Event

Function name

HAL_StatusTypeDef HAL_RTCEx_PollForTamper1Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle Tamper 1 Polling.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_PollForTamper2Event

Function name

HAL_StatusTypeDef HAL_RTCEx_PollForTamper2Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle Tamper 2 Polling.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_PollForTamper3Event

Function name

HAL_StatusTypeDef HAL_RTCEx_PollForTamper3Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)

Function description

Handle Tamper 3 Polling.

Parameters

- **hrtc:** RTC handle
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_RTCEx_Tamper1EventCallback

Function name

void HAL_RTCEx_Tamper1EventCallback (RTC_HandleTypeDef * hrtc)

Function description

Tamper 1 callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTCEx_Tamper2EventCallback`

Function name

void HAL_RTCEx_Tamper2EventCallback (RTC_HandleTypeDef * hrtc)

Function description

Tamper 2 callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTCEx_Tamper3EventCallback`

Function name

void HAL_RTCEx_Tamper3EventCallback (RTC_HandleTypeDef * hrtc)

Function description

Tamper 3 callback.

Parameters

- **hrtc:** RTC handle

Return values

- **None:**

`HAL_RTCEx_BKUPWrite`

Function name

void HAL_RTCEx_BKUPWrite (RTC_HandleTypeDef * hrtc, uint32_t BackupRegister, uint32_t Data)

Function description

Write a data in a specified RTC Backup data register.

Parameters

- **hrtc:** RTC handle
- **BackupRegister:** RTC Backup data Register number. This parameter can be: RTC_BKP_DRx where x can be from 0 to 31 to specify the register.
- **Data:** Data to be written in the specified Backup data register.

Return values

- **None:**

`HAL_RTCEx_BKUPRead`

Function name

uint32_t HAL_RTCEx_BKUPRead (RTC_HandleTypeDef * hrtc, uint32_t BackupRegister)

Function description

Read data from the specified RTC Backup data Register.

Parameters

- **hrtc:** RTC handle
- **BackupRegister:** RTC Backup data Register number. This parameter can be: RTC_BKP_DRx where x can be from 0 to 31 to specify the register.

Return values

- **Read:** value

62.3 RTCEx Firmware driver defines

The following section lists the various define and macros of the module.

62.3.1 RTCEx

RTCEx

RTC Add 1 Second Parameter Definitions

RTC_SHIFTADD1S_RESET

RTC_SHIFTADD1S_SET

RTCEx Backup Data Registers Definitions

RTC_BKP_DR0

RTC_BKP_DR1

RTC_BKP_DR2

RTC_BKP_DR3

RTC_BKP_DR4

RTC_BKP_DR5

RTC_BKP_DR6

RTC_BKP_DR7

RTC_BKP_DR8

RTC_BKP_DR9

RTC_BKP_DR10

RTC_BKP_DR11

RTC_BKP_DR12

RTC_BKP_DR13

RTC_BKP_DR14

RTC_BKP_DR15

RTC_BKP_DR16

RTC_BKP_DR17

RTC_BKP_DR18

RTC_BKP_DR19

RTC_BKP_DR20

RTC_BKP_DR21

RTC_BKP_DR22

RTC_BKP_DR23

RTC_BKP_DR24

RTC_BKP_DR25

RTC_BKP_DR26

RTC_BKP_DR27

RTC_BKP_DR28

RTC_BKP_DR29

RTC_BKP_DR30

RTC_BKP_DR31

RTC Backup Data Registers Number Definitions

BKP_REG_NUMBER

RTC Calibration

__HAL_RTC_CALIBRATION_OUTPUT_ENABLE

Description:

- Enable the RTC calibration output.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_CALIBRATION_OUTPUT_DISABLE

Description:

- Disable the calibration output.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_CLOCKREF_DETECTION_ENABLE

Description:

- Enable the clock reference detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_CLOCKREF_DETECTION_DISABLE

Description:

- Disable the clock reference detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_SHIFT_GET_FLAG

Description:

- Get the selected RTC shift operation's flag status.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC shift operation Flag is pending or not. This parameter can be:
  - RTC_FLAG_SHPF

Return value:

- None

RTCEx Calib Output Selection Definitions

RTC_CALIBOUTPUT_512HZ

RTC_CALIBOUTPUT_1HZ

RTCEx Flags

RTC_FLAG_TAMP1F

RTC_FLAG_TAMP2F

RTC_FLAG_TAMP3F

Private macros to check input parameters

IS_TIMESTAMP_EDGE

IS_RTC_TAMPER_INTERRUPT

IS_RTC_TIMESTAMP_PIN

IS_RTC_WAKEUP_CLOCK

IS_RTC_WAKEUP_COUNTER

IS_RTC_SMOOTH_CALIB_PERIOD

IS_RTC_SMOOTH_CALIB_PLUS

IS_RTC_SMOOTH_CALIB_MINUS

IS_RTC_TAMPER

IS_RTC_TAMPER_TRIGGER

IS_RTC_TAMPER_ERASE_MODE

IS_RTC_TAMPER_MASKFLAG_STATE

IS_RTC_TAMPER_FILTER

IS_RTC_TAMPER_SAMPLING_FREQ

IS_RTC_TAMPER_PRECHARGE_DURATION

IS_RTC_TAMPER_PULLUP_STATE

IS_RTC_TAMPER_TIMESTAMPONTAMPER_DETECTION

IS_RTC_BKP

IS_RTC_SHIFT_ADD1S

IS_RTC_SHIFT_SUBFS

IS_RTC_CALIB_OUTPUT

RTCEx Output Selection Definitions

RTC_OUTPUT_DISABLE

RTC_OUTPUT_ALARMA

RTC_OUTPUT_ALARMB

RTC_OUTPUT_WAKEUP

RTCEx Smooth Calib Period Definitions

RTC_SMOOTHCALIB_PERIOD_32SEC

If RTCCLK = 32768 Hz, Smooth calibration period is 32s, else 2exp20 RTCCLK pulses

RTC_SMOOTHCALIB_PERIOD_16SEC

If RTCCLK = 32768 Hz, Smooth calibration period is 16s, else 2exp19 RTCCLK pulses

RTC_SMOOTHCALIB_PERIOD_8SEC

If RTCCLK = 32768 Hz, Smooth calibration period is 8s, else 2exp18 RTCCLK pulses

RTCEx Smooth calib Plus pulses Definitions

RTC_SMOOTHCALIB_PLUSPULSES_SET

The number of RTCCLK pulses added during a X -second window = Y - CALM[8:0] with Y = 512, 256, 128 when X = 32, 16, 8

RTC_SMOOTHCALIB_PLUSPULSES_RESET

The number of RTCCLK pulses subbstited during a 32-second window = CALM[8:0]

RTCEx tamper

__HAL_RTC_TAMPER1_ENABLE

Description:

- Enable the RTC Tamper1 input detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TAMPER1_DISABLE

Description:

- Disable the RTC Tamper1 input detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TAMPER2_ENABLE

Description:

- Enable the RTC Tamper2 input detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TAMPER2_DISABLE

Description:

- Disable the RTC Tamper2 input detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TAMPER3_ENABLE

Description:

- Enable the RTC Tamper3 input detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TAMPER3_DISABLE

Description:

- Disable the RTC Tamper3 input detection.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TAMPER_ENABLE_IT

Description:

- Enable the TAMP Tamper interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Tamper interrupt sources to be enabled. This parameter can be any combination of the following values:
  - RTC_IT_TAMPALL: All tampers interrupts
  - RTC_IT_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt
  - RTC_IT_TAMP3: Tamper3 interrupt

Return value:

- None

__HAL_RTC_TAMPER_DISABLE_IT

Description:

- Disable the TAMP Tamper interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Tamper interrupt sources to be disabled. This parameter can be any combination of the following values:
  - RTC_IT_TAMPALL: All tampers interrupts
  - RTC_IT_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt
  - RTC_IT_TAMP3: Tamper3 interrupt

Return value:

- None

__HAL_RTC_TAMPER_GET_IT

Description:

- Check whether the specified RTC Tamper interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Tamper interrupt to check. This parameter can be:
  - RTC_IT_TAMPALL: All tampers interrupts
  - RTC_IT_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt
  - RTC_IT_TAMP3: Tamper3 interrupt

Return value:

- None

__HAL_RTC_TAMPER_GET_IT_SOURCE

Description:

- Check whether the specified RTC Tamper interrupt has been enabled or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Tamper interrupt source to check. This parameter can be:
  - RTC_IT_TAMPALL: All tampers interrupts
  - RTC_IT_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt
  - RTC_IT_TAMP3: Tamper3 interrupt

Return value:

- None

__HAL_RTC_TAMPER_GET_FLAG

Description:

- Get the selected RTC Tamper's flag status.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Tamper Flag is pending or not. This parameter can be:
  - RTC_FLAG_TAMP1F: Tamper1 flag
  - RTC_FLAG_TAMP2F: Tamper2 flag
  - RTC_FLAG_TAMP3F: Tamper3 flag

Return value:

- None

__HAL_RTC_TAMPER_CLEAR_FLAG

Description:

- Clear the RTC Tamper's pending flags.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Tamper Flag to clear. This parameter can be:
  - RTC_FLAG_TAMP1F: Tamper1 flag
  - RTC_FLAG_TAMP2F: Tamper2 flag
  - RTC_FLAG_TAMP3F: Tamper3 flag

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_IT

Description:

- Enable interrupt on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_IT

Description:

- Disable interrupt on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_EVENT

Description:

- Enable event on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_EVENT

Description:

- Disable event on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_RISING_EDGE

Description:

- Enable rising edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_RISING_EDGE

Description:

- Disable rising edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable rising & falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable rising & falling edge trigger on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_GET_FLAG

Description:

- Check whether the RTC Tamper and Timestamp associated Exti line interrupt flag is set or not.

Return value:

- Line: Status.

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_CLEAR_FLAG

Description:

- Clear the RTC Tamper and Timestamp associated Exti line flag.

Return value:

- None

__HAL_RTC_TAMPER_TIMESTAMP_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on the RTC Tamper and Timestamp associated Exti line.

Return value:

- None

RTCEx Tamper EraseBackUp Definitions

RTC_TAMPER_ERASE_BACKUP_ENABLE

RTC_TAMPER_ERASE_BACKUP_DISABLE

RTCEx Tamper Filter Definitions

RTC_TAMPERFILTER_DISABLE

Tamper filter is disabled

RTC_TAMPERFILTER_2SAMPLE

Tamper is activated after 2 consecutive samples at the active level

RTC_TAMPERFILTER_4SAMPLE

Tamper is activated after 4 consecutive samples at the active level

RTC_TAMPERFILTER_8SAMPLE

Tamper is activated after 8 consecutive samples at the active level.

RTC Tamper Interrupts Definitions

RTC_IT_TAMP

Enable all Tamper Interrupt

RTC_IT_TAMP1

Enable Tamper 1 Interrupt

RTC_IT_TAMP2

Enable Tamper 2 Interrupt

RTC_IT_TAMP3

Enable Tamper 3 Interrupt

RTC_IT_TAMPALL

RTC_TAMPER1_INTERRUPT

RTC_TAMPER2_INTERRUPT

RTC_TAMPER3_INTERRUPT

RTC_ALL_TAMPER_INTERRUPT

RTCEx Tamper Mask Flag Definitions

RTC_TAMPERMASK_FLAG_DISABLE

RTC_TAMPERMASK_FLAG_ENABLE

RTCEx Tamper Pins Definitions

RTC_TAMPER_1

RTC_TAMPER_2

RTC_TAMPER_3

RTCEx Tamper Pin Precharge Duration Definitions

RTC_TAMPERPRECHARGEDURATION_1RTCCLK

Tamper pins are pre-charged before sampling during 1 RTCCLK cycle

RTC_TAMPERPRECHARGEDURATION_2RTCCLK

Tamper pins are pre-charged before sampling during 2 RTCCLK cycles

RTC_TAMPERPRECHARGEDURATION_4RTCCLK

Tamper pins are pre-charged before sampling during 4 RTCCLK cycles

RTC_TAMPERPRECHARGEDURATION_8RTCCLK

Tamper pins are pre-charged before sampling during 8 RTCCLK cycles

RTC_TAMPERPRECHARGEDURATION_MASK

Masking all bits except those of field TAMPPRCH[1:0]

RTCEx Tamper Pull Up Definitions

RTC_TAMPER_PULLUP_ENABLE

TimeStamp on Tamper Detection event saved

RTC_TAMPER_PULLUP_DISABLE

TimeStamp on Tamper Detection event is not saved

RTCEx Tamper Sampling Frequencies Definitions

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV32768

Each of the tamper inputs are sampled with a frequency = RTCCLK / 32768

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV16384

Each of the tamper inputs are sampled with a frequency = RTCCLK / 16384

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV8192

Each of the tamper inputs are sampled with a frequency = RTCCLK / 8192

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV4096

Each of the tamper inputs are sampled with a frequency = RTCCLK / 4096

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV2048

Each of the tamper inputs are sampled with a frequency = RTCCLK / 2048

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV1024

Each of the tamper inputs are sampled with a frequency = RTCCLK / 1024

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV512

Each of the tamper inputs are sampled with a frequency = RTCCLK / 512

RTC_TAMPERSAMPLINGFREQ_RTCCLK_DIV256

Each of the tamper inputs are sampled with a frequency = RTCCLK / 256

RTC_TAMPERSAMPLINGFREQ_RTCCLK_MASK

Masking all bits except those of field TAMPFREQ[2:0]

RTCEx Tamper TimeStamp On Tamper Detection Definitions

RTC_TIMESTAMPONTAMPERDETECTION_DISABLE

TimeStamp on Tamper Detection event is not saved

RTC_TIMESTAMPONTAMPERDETECTION_ENABLE

TimeStamp on Tamper Detection event saved

RTCEx Tamper Triggers Definitions

RTC_TAMPERTRIGGER_RISINGEDGE

RTC_TAMPERTRIGGER_FALLINGEDGE

RTC_TAMPERTRIGGER_LOWLEVEL

RTC_TAMPERTRIGGER_HIGHLEVEL

RTC Timestamp

__HAL_RTC_TIMESTAMP_ENABLE

Description:

- Enable the RTC TimeStamp peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TIMESTAMP_DISABLE

Description:

- Disable the RTC TimeStamp peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TIMESTAMP_ENABLE_IT

Description:

- Enable the RTC TimeStamp interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC TimeStamp interrupt source to be enabled. This parameter can be:
  - RTC_IT_TS TimeStamp interrupt

Return value:

- None

__HAL_RTC_TIMESTAMP_DISABLE_IT

Description:

- Disable the RTC TimeStamp interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC TimeStamp interrupt source to be disabled. This parameter can be:
  - RTC_IT_TS TimeStamp interrupt

Return value:

- None

__HAL_RTC_TIMESTAMP_GET_IT

Description:

- Check whether the specified RTC TimeStamp interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC TimeStamp interrupt source to check. This parameter can be:
  - RTC_IT_TS TimeStamp interrupt

Return value:

- None

__HAL_RTC_TIMESTAMP_GET_IT_SOURCE

Description:

- Check whether the specified RTC Time Stamp interrupt has been enabled or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Time Stamp interrupt source to check. This parameter can be:
  - RTC_IT_TS TimeStamp interrupt

Return value:

- None

__HAL_RTC_TIMESTAMP_GET_FLAG

Description:

- Get the selected RTC TimeStamp's flag status.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC TimeStamp Flag is pending or not. This parameter can be:
  - RTC_FLAG_TSF
  - RTC_FLAG_TSOVF

Return value:

- Flag: status

__HAL_RTC_TIMESTAMP_CLEAR_FLAG

Description:

- Clear the RTC Time Stamps pending flags.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC TimeStamp Flag to clear. This parameter can be:
  - RTC_FLAG_TSF
  - RTC_FLAG_TSOVF

Return value:

- None

__HAL_RTC_INTERNAL_TIMESTAMP_ENABLE

Description:

- Enable the RTC internal TimeStamp peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_INTERNAL_TIMESTAMP_DISABLE

Description:

- Disable the RTC internal TimeStamp peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_INTERNAL_TIMESTAMP_GET_FLAG

Description:

- Get the selected RTC Internal Time Stamps flag status.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Internal Time Stamp Flag is pending or not. This parameter can be:
  - RTC_FLAG_ITSF

Return value:

- None

__HAL_RTC_INTERNAL_TIMESTAMP_CLEAR_FLAG

Description:

- Clear the RTC Internal Time Stamps pending flags.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Internal Time Stamp Flag source to clear. This parameter can be:
  - RTC_FLAG_ITSF

Return value:

- None

RTCEx TimeStamp Pin Selection

RTC_TIMESTAMPPIN_DEFAULT

RTCEx Time Stamp Edges Definitions

RTC_TIMESTAMPEDGE_RISING

RTC_TIMESTAMPEDGE_FALLING

RTC WakeUp Timer

__HAL_RTC_WAKEUPTIMER_ENABLE

Description:

- Enable the RTC WakeUp Timer peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_DISABLE

Description:

- Disable the RTC WakeUp Timer peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_ENABLE_IT

Description:

- Enable the RTC WakeUpTimer interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC WakeUpTimer interrupt sources to be enabled. This parameter can be:
  - RTC_IT_WUT WakeUpTimer interrupt

Return value:

- None

__HAL_RTC_WAKEUPTIMER_DISABLE_IT

Description:

- Disable the RTC WakeUpTimer interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC WakeUpTimer interrupt sources to be disabled. This parameter can be:
  - RTC_IT_WUT WakeUpTimer interrupt

Return value:

- None

__HAL_RTC_WAKEUPTIMER_GET_IT

Description:

- Check whether the specified RTC WakeUpTimer interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC WakeUpTimer interrupt sources to check. This parameter can be:
  - RTC_IT_WUT WakeUpTimer interrupt

Return value:

- None

__HAL_RTC_WAKEUPTIMER_GET_IT_SOURCE

Description:

- Check whether the specified RTC Wake Up timer interrupt has been enabled or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC Wake Up timer interrupt sources to check. This parameter can be:
  - RTC_IT_WUT WakeUpTimer interrupt

Return value:

- None

__HAL_RTC_WAKEUPTIMER_GET_FLAG

Description:

- Get the selected RTC WakeUpTimer's flag status.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC WakeUpTimer Flag is pending or not. This parameter can be:
  - RTC_FLAG_WUTF
  - RTC_FLAG_WUTWF

Return value:

- Flag: status

__HAL_RTC_WAKEUPTIMER_CLEAR_FLAG

Description:

- Clear the RTC Wake Up timers pending flags.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC WakeUpTimer Flag to clear. This parameter can be:
  - RTC_FLAG_WUTF

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_IT

Description:

- Enable interrupt on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_IT

Description:

- Disable interrupt on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_EVENT

Description:

- Enable event on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_EVENT

Description:

- Disable event on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_FALLING_EDGE

Description:

- Enable falling edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_FALLING_EDGE

Description:

- Disable falling edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_RISING_EDGE

Description:

- Enable rising edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_RISING_EDGE

Description:

- Disable rising edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_ENABLE_RISING_FALLING_EDGE

Description:

- Enable rising & falling edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_DISABLE_RISING_FALLING_EDGE

Description:

- Disable rising & falling edge trigger on the RTC WakeUp Timer associated Exti line.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_GET_FLAG

Description:

- Check whether the RTC WakeUp Timer associated Exti line interrupt flag is set or not.

Return value:

- Line: Status.

__HAL_RTC_WAKEUPTIMER_EXTI_CLEAR_FLAG

Description:

- Clear the RTC WakeUp Timer associated Exti line flag.

Return value:

- None

__HAL_RTC_WAKEUPTIMER_EXTI_GENERATE_SWIT

Description:

- Generate a Software interrupt on the RTC WakeUp Timer associated Exti line.

Return value:

- None

RTCEx Wakeup Timer Definitions

RTC_WAKEUPCLOCK_RTCCLK_DIV16

RTC_WAKEUPCLOCK_RTCCLK_DIV8

RTC_WAKEUPCLOCK_RTCCLK_DIV4

RTC_WAKEUPCLOCK_RTCCLK_DIV2

RTC_WAKEUPCLOCK_CK_SPRE_16BITS

RTC_WAKEUPCLOCK_CK_SPRE_17BITS

63 HAL SAI Generic Driver

63.1 SAI Firmware driver registers structures

63.1.1 SAI_PdmInitTypeDef

SAI_PdmInitTypeDef is defined in the stm32l4xx_hal_sai.h

Data Fields

- ***FunctionalState Activation***
- ***uint32_t MicPairsNbr***
- ***uint32_t ClockEnable***

Field Documentation

- ***FunctionalState SAI_PdmInitTypeDef::Activation***
  Enable/disable PDM interface
- ***uint32_t SAI_PdmInitTypeDef::MicPairsNbr***
  Specifies the number of microphone pairs used. This parameter must be a number between Min_Data = 1 and Max_Data = 3.
- ***uint32_t SAI_PdmInitTypeDef::ClockEnable***
  Specifies which clock must be enabled. This parameter can be a values combination of *SAI_PDM_ClockEnable*

63.1.2 SAI_InitTypeDef

SAI_InitTypeDef is defined in the stm32l4xx_hal_sai.h

Data Fields

- ***uint32_t AudioMode***
- ***uint32_t Synchro***
- ***uint32_t SynchroExt***
- ***uint32_t OutputDrive***
- ***uint32_t NoDivider***
- ***uint32_t FIFOThreshold***
- ***uint32_t AudioFrequency***
- ***uint32_t Mckdiv***
- ***uint32_t MckOverSampling***
- ***uint32_t MonoStereoMode***
- ***uint32_t CompandingMode***
- ***uint32_t TriState***
- ***SAI_PdmInitTypeDef PdmInit***
- ***uint32_t Protocol***
- ***uint32_t DataSize***
- ***uint32_t FirstBit***
- ***uint32_t ClockStrobing***

Field Documentation

- ***uint32_t SAI_InitTypeDef::AudioMode***
  Specifies the SAI Block audio Mode. This parameter can be a value of *SAI_Block_Mode*
- ***uint32_t SAI_InitTypeDef::Synchro***
  Specifies SAI Block synchronization This parameter can be a value of *SAI_Block_Synchronization*

- ***uint32_t SAI_InitTypeDef::SynchroExt***

  Specifies SAI external output synchronization, this setup is common for BlockA and BlockB This parameter can be a value of ***SAI_Block_SyncExt***

  Note:

  – If both audio blocks of same SAI are used, this parameter has to be set to the same value for each audio block
- ***uint32_t SAI_InitTypeDef::OutputDrive***

  Specifies when SAI Block outputs are driven. This parameter can be a value of ***SAI_Block_Output_Drive***

  Note:

  – This value has to be set before enabling the audio block but after the audio block configuration.
- ***uint32_t SAI_InitTypeDef::NoDivider***

  Specifies whether master clock will be divided or not. This parameter can be a value of ***SAI_Block_NoDivider***

  Note:

  – For STM32L4Rx/STM32L4Sx devices : If bit NOMCK in the SAI_xCR1 register is cleared, the frame length should be aligned to a number equal to a power of 2, from 8 to 256. If bit NOMCK in the SAI_xCR1 register is set, the frame length can take any of the values without constraint. There is no MCLK_x clock which can be output. For other devices : If bit NODIV in the SAI_xCR1 register is cleared, the frame length should be aligned to a number equal to a power of 2, from 8 to 256. If bit NODIV in the SAI_xCR1 register is set, the frame length can take any of the values without constraint since the input clock of the audio block should be equal to the bit clock. There is no MCLK_x clock which can be output.
- ***uint32_t SAI_InitTypeDef::FIFOThreshold***

  Specifies SAI Block FIFO threshold. This parameter can be a value of ***SAI_Block_Fifo_Threshold***
- ***uint32_t SAI_InitTypeDef::AudioFrequency***

  Specifies the audio frequency sampling. This parameter can be a value of ***SAI_Audio_Frequency***
- ***uint32_t SAI_InitTypeDef::Mckdiv***

  Specifies the master clock divider. This parameter must be a number between Min_Data = 0 and Max_Data = 63 on STM32L4Rx/STM32L4Sx devices. This parameter must be a number between Min_Data = 0 and Max_Data = 15 on other devices.

  Note:

  – This parameter is used only if AudioFrequency is set to SAI_AUDIO_FREQUENCY_MCKDIV otherwise it is internally computed.
- ***uint32_t SAI_InitTypeDef::MckOverSampling***

  Specifies the master clock oversampling. This parameter can be a value of ***SAI_Block_Mck_OverSampling***
- ***uint32_t SAI_InitTypeDef::MonoStereoMode***

  Specifies if the mono or stereo mode is selected. This parameter can be a value of ***SAI_Mono_Stereo_Mode***
- ***uint32_t SAI_InitTypeDef::CompandingMode***

  Specifies the companding mode type. This parameter can be a value of ***SAI_Block_Companding_Mode***
- ***uint32_t SAI_InitTypeDef::TriState***

  Specifies the companding mode type. This parameter can be a value of ***SAI_TRIState_Management***
- ***SAI_PdmInitTypeDef SAI_InitTypeDef::PdmInit***

  Specifies the PDM configuration.
- ***uint32_t SAI_InitTypeDef::Protocol***

  Specifies the SAI Block protocol. This parameter can be a value of ***SAI_Block_Protocol***
- ***uint32_t SAI_InitTypeDef::DataSize***

  Specifies the SAI Block data size. This parameter can be a value of ***SAI_Block_Data_Size***
- ***uint32_t SAI_InitTypeDef::FirstBit***

  Specifies whether data transfers start from MSB or LSB bit. This parameter can be a value of ***SAI_Block_MSB_LSB_transmission***

- ***uint32_t SAI_InitTypeDef::ClockStrobing***

  Specifies the SAI Block clock strobing edge sensitivity. This parameter can be a value of ***SAI_Block_Clock_Strobing***

63.1.3 SAI_FrameInitTypeDef

SAI_FrameInitTypeDef is defined in the stm32l4xx_hal_sai.h

Data Fields

- ***uint32_t FrameLength***
- ***uint32_t ActiveFrameLength***
- ***uint32_t FSDefinition***
- ***uint32_t FSPolarity***
- ***uint32_t FSOffset***

Field Documentation

- ***uint32_t SAI_FrameInitTypeDef::FrameLength***

  Specifies the Frame length, the number of SCK clocks for each audio frame. This parameter must be a number between Min_Data = 8 and Max_Data = 256.

  Note:

  – If master clock MCLK_x pin is declared as an output, the frame length should be aligned to a number equal to power of 2 in order to keep in an audio frame, an integer number of MCLK pulses by bit Clock.

- ***uint32_t SAI_FrameInitTypeDef::ActiveFrameLength***

  Specifies the Frame synchronization active level length. This Parameter specifies the length in number of bit clock (SCK + 1) of the active level of FS signal in audio frame. This parameter must be a number between Min_Data = 1 and Max_Data = 128

- ***uint32_t SAI_FrameInitTypeDef::FSDefinition***

  Specifies the Frame synchronization definition. This parameter can be a value of ***SAI_Block_FS_Definition***

- ***uint32_t SAI_FrameInitTypeDef::FSPolarity***

  Specifies the Frame synchronization Polarity. This parameter can be a value of ***SAI_Block_FS_Polarity***

- ***uint32_t SAI_FrameInitTypeDef::FSOffset***

  Specifies the Frame synchronization Offset. This parameter can be a value of ***SAI_Block_FS_Offset***

63.1.4 SAI_SlotInitTypeDef

SAI_SlotInitTypeDef is defined in the stm32l4xx_hal_sai.h

Data Fields

- ***uint32_t FirstBitOffset***
- ***uint32_t SlotSize***
- ***uint32_t SlotNumber***
- ***uint32_t SlotActive***

Field Documentation

- ***uint32_t SAI_SlotInitTypeDef::FirstBitOffset***

  Specifies the position of first data transfer bit in the slot. This parameter must be a number between Min_Data = 0 and Max_Data = 24

- ***uint32_t SAI_SlotInitTypeDef::SlotSize***

  Specifies the Slot Size. This parameter can be a value of ***SAI_Block_Slot_Size***

- ***uint32_t SAI_SlotInitTypeDef::SlotNumber***

  Specifies the number of slot in the audio frame. This parameter must be a number between Min_Data = 1 and Max_Data = 16

- ***uint32_t SAI_SlotInitTypeDef::SlotActive***

  Specifies the slots in audio frame that will be activated. This parameter can be a value of ***SAI_Block_Slot_Active***

63.1.5 __SAI_HandleTypeDef

__SAI_HandleTypeDef is defined in the stm32l4xx_hal_sai.h

Data Fields

- ***SAI_Block_TypeDef * Instance***
- ***SAI_InitTypeDef Init***
- ***SAI_FrameInitTypeDef FrameInit***
- ***SAI_SlotInitTypeDef SlotInit***
- ***uint8_t * pBuffPtr***
- ***uint16_t XferSize***
- ***uint16_t XferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***SAIcallback mutecallback***
- ***void(* InterruptServiceRoutine***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SAI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***SAI_Block_TypeDef* __SAI_HandleTypeDef::Instance***
  SAI Blockx registers base address
- ***SAI_InitTypeDef __SAI_HandleTypeDef::Init***
  SAI communication parameters
- ***SAI_FrameInitTypeDef __SAI_HandleTypeDef::FrameInit***
  SAI Frame configuration parameters
- ***SAI_SlotInitTypeDef __SAI_HandleTypeDef::SlotInit***
  SAI Slot configuration parameters
- ***uint8_t* __SAI_HandleTypeDef::pBuffPtr***
  Pointer to SAI transfer Buffer
- ***uint16_t __SAI_HandleTypeDef::XferSize***
  SAI transfer size
- ***uint16_t __SAI_HandleTypeDef::XferCount***
  SAI transfer counter
- ***DMA_HandleTypeDef* __SAI_HandleTypeDef::hdmatx***
  SAI Tx DMA handle parameters
- ***DMA_HandleTypeDef* __SAI_HandleTypeDef::hdmarx***
  SAI Rx DMA handle parameters
- ***SAIcallback __SAI_HandleTypeDef::mutecallback***
  SAI mute callback
- ***void(* __SAI_HandleTypeDef::InterruptServiceRoutine)(struct __SAI_HandleTypeDef *hsai)***
- ***HAL_LockTypeDef __SAI_HandleTypeDef::Lock***
  SAI locking object
- ***__IO HAL_SAI_StateTypeDef __SAI_HandleTypeDef::State***
  SAI communication state
- ***__IO uint32_t __SAI_HandleTypeDef::ErrorCode***
  SAI Error code

63.2 SAI Firmware driver API description

The following section lists the various functions of the SAI library.

63.2.1 How to use this driver

The SAI HAL driver can be used as follows:

1. Declare a SAI_HandleTypeDef handle structure (eg. SAI_HandleTypeDef hsai).
2. Initialize the SAI low level resources by implementing the HAL_SAI_MspInit() API:
   a. Enable the SAI interface clock.
   b. SAI pins configuration:
      - Enable the clock for the SAI GPIOs.
      - Configure these SAI pins as alternate function pull-up.
   c. NVIC configuration if you need to use interrupt process (HAL_SAI_Transmit_IT() and HAL_SAI_Receive_IT() APIs):
      - Configure the SAI interrupt priority.
      - Enable the NVIC SAI IRQ handle.
   d. DMA Configuration if you need to use DMA process (HAL_SAI_Transmit_DMA() and HAL_SAI_Receive_DMA() APIs):
      - Declare a DMA handle structure for the Tx/Rx stream.
      - Enable the DMAx interface clock.
      - Configure the declared DMA handle structure with the required Tx/Rx parameters.
      - Configure the DMA Tx/Rx Stream.
      - Associate the initialized DMA handle to the SAI DMA Tx/Rx handle.
      - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx Stream.
3. The initialization can be done by two ways
   a. Expert mode : Initialize the structures Init, FrameInit and SlotInit and call HAL_SAI_Init().
   b. Simplified mode : Initialize the high part of Init Structure and call HAL_SAI_InitProtocol().

Note: The specific SAI interrupts (FIFO request and Overrun underrun interrupt) will be managed using the macros __HAL_SAI_ENABLE_IT() and __HAL_SAI_DISABLE_IT() inside the transmit and receive process.

Note: Make sure that either:

- *PLLSAI1CLK output is configured or*
- *PLLSAI2CLK output is configured or*
- *PLLSAI3CLK output is configured or*
- *External clock source is configured after setting correctly the define constant EXTERNAL_SAI1_CLOCK_VALUE or EXTERNAL_SAI2_CLOCK_VALUE in the stm32l4xx_hal_conf.h file.*

Note: In master Tx mode: enabling the audio block immediately generates the bit clock for the external slaves even if there is no data in the FIFO, However FS signal generation is conditioned by the presence of data in the FIFO.

Note: In master Rx mode: enabling the audio block immediately generates the bit clock and FS signal for the external slaves.

Note: It is mandatory to respect the following conditions in order to avoid bad SAI behavior:

- *First bit Offset <= (SLOT size - Data size)*
- *Data size <= SLOT size*
- *Number of SLOT x SLOT size = Frame length*
- *The number of slots should be even when SAI_FS_CHANNEL_IDENTIFICATION is selected.*

Note: For STM32L4Rx/STM32L4Sx devices, PDM interface can be activated through HAL_SAI_Init function. Please note that PDM interface is only available for SAI1 sub-block A. PDM microphone delays can be tuned with HAL_SAIEx_ConfigPdmMicDelay function.

Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_SAI_Transmit()
- Receive an amount of data in blocking mode using HAL_SAI_Receive()

Interrupt mode IO operation

- Send an amount of data in non-blocking mode using HAL_SAI_Transmit_IT()
- At transmission end of transfer HAL_SAI_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SAI_TxCpltCallback()
- Receive an amount of data in non-blocking mode using HAL_SAI_Receive_IT()
- At reception end of transfer HAL_SAI_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SAI_RxCpltCallback()
- In case of flag error, HAL_SAI_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SAI_ErrorCallback()

DMA mode IO operation

- Send an amount of data in non-blocking mode (DMA) using HAL_SAI_Transmit_DMA()
- At transmission end of transfer HAL_SAI_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SAI_TxCpltCallback()
- Receive an amount of data in non-blocking mode (DMA) using HAL_SAI_Receive_DMA()
- At reception end of transfer HAL_SAI_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SAI_RxCpltCallback()
- In case of flag error, HAL_SAI_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SAI_ErrorCallback()
- Pause the DMA Transfer using HAL_SAI_DMAPause()
- Resume the DMA Transfer using HAL_SAI_DMAResume()
- Stop the DMA Transfer using HAL_SAI_DMAStop()

SAI HAL driver additional function list

Below the list the others API available SAI HAL driver :

- HAL_SAI_EnableTxMuteMode(): Enable the mute in tx mode
- HAL_SAI_DisableTxMuteMode(): Disable the mute in tx mode
- HAL_SAI_EnableRxMuteMode(): Enable the mute in Rx mode
- HAL_SAI_DisableRxMuteMode(): Disable the mute in Rx mode
- HAL_SAI_FlushRxFifo(): Flush the rx fifo.
- HAL_SAI_Abort(): Abort the current transfer

SAI HAL driver macros list

Below the list of most used macros in SAI HAL driver :

- __HAL_SAI_ENABLE(): Enable the SAI peripheral
- __HAL_SAI_DISABLE(): Disable the SAI peripheral
- __HAL_SAI_ENABLE_IT(): Enable the specified SAI interrupts
- __HAL_SAI_DISABLE_IT(): Disable the specified SAI interrupts
- __HAL_SAI_GET_IT_SOURCE(): Check if the specified SAI interrupt source is enabled or disabled
- __HAL_SAI_GET_FLAG(): Check whether the specified SAI flag is set or not

Callback registration

The compilation define USE_HAL_SAI_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use functions HAL_SAI_RegisterCallback() to register a user callback.

Function HAL_SAI_RegisterCallback() allows to register following callbacks:

- RxCpltCallback : SAI receive complete.
- RxHalfCpltCallback : SAI receive half complete.
- TxCpltCallback : SAI transmit complete.
- TxHalfCpltCallback : SAI transmit half complete.

- ErrorCallback : SAI error.
- MspInitCallback : SAI MspInit.
- MspDeInitCallback : SAI MspDeInit.

This function takes as parameters the HAL peripheral handle, the callback ID and a pointer to the user callback function.

Use function HAL_SAI_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. HAL_SAI_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the callback ID.

This function allows to reset following callbacks:

- RxCpltCallback : SAI receive complete.
- RxHalfCpltCallback : SAI receive half complete.
- TxCpltCallback : SAI transmit complete.
- TxHalfCpltCallback : SAI transmit half complete.
- ErrorCallback : SAI error.
- MspInitCallback : SAI MspInit.
- MspDeInitCallback : SAI MspDeInit.

By default, after the HAL_SAI_Init and if the state is HAL_SAI_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions: examples HAL_SAI_RxCpltCallback(), HAL_SAI_ErrorCallback(). Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the HAL_SAI_Init and HAL_SAI_DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the HAL_SAI_Init and HAL_SAI_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using HAL_SAI_RegisterCallback before calling HAL_SAI_DeInit or HAL_SAI_Init function.

When the compilation define USE_HAL_SAI_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

63.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the SAIx peripheral:

- User must implement HAL_SAI_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_SAI_Init() to configure the selected device with the selected configuration:
  - Mode (Master/slave TX/RX)
  - Protocol
  - Data Size
  - MCLK Output
  - Audio frequency
  - FIFO Threshold
  - Frame Config
  - Slot Config
  - PDM Config (only for STM32L4Rx/STM32L4Sx devices)
- Call the function HAL_SAI_DeInit() to restore the default configuration of the selected SAI peripheral.

This section contains the following APIs:

- ***HAL_SAI_InitProtocol***
- ***HAL_SAI_Init***
- ***HAL_SAI_DeInit***
- ***HAL_SAI_MspInit***
- ***HAL_SAI_MspDeInit***

63.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SAI data transfers.

- There are two modes of transfer:
  - Blocking mode : The communication is performed in the polling mode. The status of all data processing is returned by the same function after finishing transfer.
  - No-Blocking mode : The communication is performed using Interrupts or DMA. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated SAI IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
- Blocking mode functions are :
  - HAL_SAI_Transmit()
  - HAL_SAI_Receive()
- Non Blocking mode functions with Interrupt are :
  - HAL_SAI_Transmit_IT()
  - HAL_SAI_Receive_IT()
- Non Blocking mode functions with DMA are :
  - HAL_SAI_Transmit_DMA()
  - HAL_SAI_Receive_DMA()
- A set of Transfer Complete Callbacks are provided in non Blocking mode:
  - HAL_SAI_TxCpltCallback()
  - HAL_SAI_RxCpltCallback()
  - HAL_SAI_ErrorCallback()

This section contains the following APIs:

- ***HAL_SAI_Transmit***
- ***HAL_SAI_Receive***
- ***HAL_SAI_Transmit_IT***
- ***HAL_SAI_Receive_IT***
- ***HAL_SAI_DMAPause***
- ***HAL_SAI_DMAResume***
- ***HAL_SAI_DMAStop***
- ***HAL_SAI_Abort***
- ***HAL_SAI_Transmit_DMA***
- ***HAL_SAI_Receive_DMA***
- ***HAL_SAI_EnableTxMuteMode***
- ***HAL_SAI_DisableTxMuteMode***
- ***HAL_SAI_EnableRxMuteMode***
- ***HAL_SAI_DisableRxMuteMode***
- ***HAL_SAI_IRQHandler***
- ***HAL_SAI_TxCpltCallback***
- ***HAL_SAI_TxHalfCpltCallback***
- ***HAL_SAI_RxCpltCallback***
- ***HAL_SAI_RxHalfCpltCallback***
- ***HAL_SAI_ErrorCallback***

63.2.4 Peripheral State and Errors functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- ***HAL_SAI_GetState***
- ***HAL_SAI_GetError***

63.2.5 Detailed description of functions

`HAL_SAI_InitProtocol`

Function name

HAL_StatusTypeDef HAL_SAI_InitProtocol (SAI_HandleTypeDef * hsai, uint32_t protocol, uint32_t datasize, uint32_t nbslot)

Function description

Initialize the structure FrameInit, SlotInit and the low part of Init according to the specified parameters and call the function HAL_SAI_Init to initialize the SAI block.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **protocol:** one of the supported protocol SAI Supported protocol
- **datasize:** one of the supported datasize SAI protocol data size the configuration information for SAI module.
- **nbslot:** Number of slot.

Return values

- **HAL:** status

`HAL_SAI_Init`

Function name

HAL_StatusTypeDef HAL_SAI_Init (SAI_HandleTypeDef * hsai)

Function description

Initialize the SAI according to the specified parameters.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_DeInit`

Function name

HAL_StatusTypeDef HAL_SAI_DeInit (SAI_HandleTypeDef * hsai)

Function description

DeInitialize the SAI peripheral.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_MspInit`

Function name

void HAL_SAI_MspInit (SAI_HandleTypeDef * hsai)

Function description

Initialize the SAI MSP.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_MspDeInit`

Function name

void HAL_SAI_MspDeInit (SAI_HandleTypeDef * hsai)

Function description

DeInitialize the SAI MSP.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_Transmit`

Function name

HAL_StatusTypeDef HAL_SAI_Transmit (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Transmit an amount of data in blocking mode.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`HAL_SAI_Receive`

Function name

HAL_StatusTypeDef HAL_SAI_Receive (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SAI_Transmit_IT

Function name

HAL_StatusTypeDef HAL_SAI_Transmit_IT (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description

Transmit an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_SAI_Receive_IT

Function name

HAL_StatusTypeDef HAL_SAI_Receive_IT (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values

- **HAL:** status

HAL_SAI_Transmit_DMA

Function name

HAL_StatusTypeDef HAL_SAI_Transmit_DMA (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description

Transmit an amount of data in non-blocking mode with DMA.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values

- **HAL:** status

HAL_SAI_Receive_DMA

Function name

HAL_StatusTypeDef HAL_SAI_Receive_DMA (SAI_HandleTypeDef * hsai, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in non-blocking mode with DMA.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values

- **HAL:** status

`HAL_SAI_DMAPause`

Function name

HAL_StatusTypeDef HAL_SAI_DMAPause (SAI_HandleTypeDef * hsai)

Function description

Pause the audio stream playing from the Media.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_DMAResume`

Function name

HAL_StatusTypeDef HAL_SAI_DMAResume (SAI_HandleTypeDef * hsai)

Function description

Resume the audio stream playing from the Media.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_DMAStop`

Function name

HAL_StatusTypeDef HAL_SAI_DMAStop (SAI_HandleTypeDef * hsai)

Function description

Stop the audio stream playing from the Media.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_Abort`

Function name

HAL_StatusTypeDef HAL_SAI_Abort (SAI_HandleTypeDef * hsai)

Function description

Abort the current transfer and disable the SAI.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_EnableTxMuteMode`

Function name

HAL_StatusTypeDef HAL_SAI_EnableTxMuteMode (SAI_HandleTypeDef * hsai, uint16_t val)

Function description

Enable the Tx mute mode.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **val:** value sent during the mute SAI Block Mute Value

Return values

- **HAL:** status

`HAL_SAI_DisableTxMuteMode`

Function name

HAL_StatusTypeDef HAL_SAI_DisableTxMuteMode (SAI_HandleTypeDef * hsai)

Function description

Disable the Tx mute mode.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_EnableRxMuteMode`

Function name

HAL_StatusTypeDef HAL_SAI_EnableRxMuteMode (SAI_HandleTypeDef * hsai, SAIcallback callback, uint16_t counter)

Function description

Enable the Rx mute detection.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.
- **callback:** function called when the mute is detected.
- **counter:** number a data before mute detection max 63.

Return values

- **HAL:** status

`HAL_SAI_DisableRxMuteMode`

Function name

HAL_StatusTypeDef HAL_SAI_DisableRxMuteMode (SAI_HandleTypeDef * hsai)

Function description

Disable the Rx mute detection.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** status

`HAL_SAI_IRQHandler`

Function name

void HAL_SAI_IRQHandler (SAI_HandleTypeDef * hsai)

Function description

Handle SAI interrupt request.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_TxHalfCpltCallback`

Function name

void HAL_SAI_TxHalfCpltCallback (SAI_HandleTypeDef * hsai)

Function description

Tx Transfer Half completed callback.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_TxCpltCallback`

Function name

void HAL_SAI_TxCpltCallback (SAI_HandleTypeDef * hsai)

Function description

Tx Transfer completed callback.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_RxHalfCpltCallback`

Function name

void HAL_SAI_RxHalfCpltCallback (SAI_HandleTypeDef * hsai)

Function description

Rx Transfer half completed callback.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_RxCpltCallback`

Function name

void HAL_SAI_RxCpltCallback (SAI_HandleTypeDef * hsai)

Function description

Rx Transfer completed callback.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_ErrorCallback`

Function name

void HAL_SAI_ErrorCallback (SAI_HandleTypeDef * hsai)

Function description

SAI error callback.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **None:**

`HAL_SAI_GetState`

Function name

HAL_SAI_StateTypeDef HAL_SAI_GetState (SAI_HandleTypeDef * hsai)

Function description

Return the SAI handle state.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for SAI module.

Return values

- **HAL:** state

`HAL_SAI_GetError`

Function name

uint32_t HAL_SAI_GetError (SAI_HandleTypeDef * hsai)

Function description

Return the SAI error code.

Parameters

- **hsai:** pointer to a SAI_HandleTypeDef structure that contains the configuration information for the specified SAI Block.

Return values

- **SAI:** Error Code

63.3 SAI Firmware driver defines

The following section lists the various define and macros of the module.

63.3.1 SAI

SAI

SAI Audio Frequency

SAI_AUDIO_FREQUENCY_192K

SAI_AUDIO_FREQUENCY_96K

SAI_AUDIO_FREQUENCY_48K

SAI_AUDIO_FREQUENCY_44K

SAI_AUDIO_FREQUENCY_32K

SAI_AUDIO_FREQUENCY_22K

SAI_AUDIO_FREQUENCY_16K

SAI_AUDIO_FREQUENCY_11K

SAI_AUDIO_FREQUENCY_8K

SAI_AUDIO_FREQUENCY_MCKDIV

SAI Block Clock Strobing

SAI_CLOCKSTROBING_FALLINGEDGE

SAI_CLOCKSTROBING_RISINGEDGE

SAI Block Companding Mode

SAI_NOCOMPANDING

SAI_ULAW_1CPL_COMPANDING

SAI_ALAW_1CPL_COMPANDING

SAI_ULAW_2CPL_COMPANDING

SAI_ALAW_2CPL_COMPANDING

SAI Block Data Size

SAI_DATASIZE_8

SAI_DATASIZE_10

SAI_DATASIZE_16

SAI_DATASIZE_20

SAI_DATASIZE_24

SAI_DATASIZE_32

SAI Block Fifo Status Level

SAI_FIFOSTATUS_EMPTY

SAI_FIFOSTATUS_LESS1QUARTERFULL

SAI_FIFOSTATUS_1QUARTERFULL

SAI_FIFOSTATUS_HALFFULL

SAI_FIFOSTATUS_3QUARTERFULL

SAI_FIFOSTATUS_FULL

SAI Block Fifo Threshold

SAI_FIFOTHRESHOLD_EMPTY

SAI_FIFOTHRESHOLD_1QF

SAI_FIFOTHRESHOLD_HF

SAI_FIFOTHRESHOLD_3QF

SAI_FIFOTHRESHOLD_FULL

SAI Block Flags Definition

SAI_FLAG_OVRUDR

SAI_FLAG_MUTEDET

SAI_FLAG_WCKCFG

SAI_FLAG_FREQ

SAI_FLAG_CNRDY

SAI_FLAG_AFSDET

SAI_FLAG_LFSDET

SAI Block FS Definition

SAI_FS_STARTFRAME

SAI_FS_CHANNEL_IDENTIFICATION

SAI Block FS Offset

SAI_FS_FIRSTBIT

SAI_FS_BEFOREFIRSTBIT

SAI Block FS Polarity

SAI_FS_ACTIVE_LOW

SAI_FS_ACTIVE_HIGH

SAI Block Interrupts Definition

SAI_IT_OVRUDR

SAI_IT_MUTEDET

SAI_IT_WCKCFG

SAI_IT_FREQ

SAI_IT_CNRDY

SAI_IT_AFSDET

SAI_IT_LFSDET

SAI Block Master Clock OverSampling

SAI_MCK_OVERSAMPLING_DISABLE

SAI_MCK_OVERSAMPLING_ENABLE

SAI Block Mode

SAI_MODEMASTER_TX

SAI_MODEMASTER_RX

SAI_MODESLAVE_TX

SAI_MODESLAVE_RX

SAI Block MSB LSB transmission

SAI_FIRSTBIT_MSB

SAI_FIRSTBIT_LSB

SAI Block Mute Value

SAI_ZERO_VALUE

SAI_LAST_SENT_VALUE

SAI Block NoDivider

SAI_MASTERDIVIDER_ENABLE

SAI_MASTERDIVIDER_DISABLE

SAI Block Output Drive

SAI_OUTPUTDRIVE_DISABLE

SAI_OUTPUTDRIVE_ENABLE

SAI Block Protocol

SAI_FREE_PROTOCOL

SAI_SPDIF_PROTOCOL

SAI_AC97_PROTOCOL

SAI Block Slot Active

SAI_SLOT_NOTACTIVE

SAI_SLOTACTIVE_0

SAI_SLOTACTIVE_1

SAI_SLOTACTIVE_2

SAI_SLOTACTIVE_3

SAI_SLOTACTIVE_4

SAI_SLOTACTIVE_5

SAI_SLOTACTIVE_6

SAI_SLOTACTIVE_7

SAI_SLOTACTIVE_8

SAI_SLOTACTIVE_9

SAI_SLOTACTIVE_10

SAI_SLOTACTIVE_11

SAI_SLOTACTIVE_12

SAI_SLOTACTIVE_13

SAI_SLOTACTIVE_14

SAI_SLOTACTIVE_15

SAI_SLOTACTIVE_ALL

SAI Block Slot Size

SAI_SLOTSIZE_DATASIZE

SAI_SLOTSIZE_16B

SAI_SLOTSIZE_32B

SAI External synchronisation

SAI_SYNCEXT_DISABLE

SAI_SYNCEXT_OUTBLOCKA_ENABLE

SAI_SYNCEXT_OUTBLOCKB_ENABLE

SAI Block Synchronization

SAI_ASYNCHRONOUS

Asynchronous

SAI_SYNCHRONOUS

Synchronous with other block of same SAI

SAI_SYNCHRONOUS_EXT_SAI1

Synchronous with other SAI, SAI1

SAI_SYNCHRONOUS_EXT_SAI2

Synchronous with other SAI, SAI2

SAI Error Code

HAL_SAI_ERROR_NONE

No error

HAL_SAI_ERROR_OVR

Overrun Error

HAL_SAI_ERROR_UDR

Underrun error

HAL_SAI_ERROR_AFSDET

Anticipated Frame synchronisation detection

HAL_SAI_ERROR_LFSDET

Late Frame synchronisation detection

HAL_SAI_ERROR_CNREADY

codec not ready

HAL_SAI_ERROR_WCKCFG

Wrong clock configuration

HAL_SAI_ERROR_TIMEOUT

Timeout error

HAL_SAI_ERROR_DMA

DMA error

SAI Exported Macros

__HAL_SAI_RESET_HANDLE_STATE

Description:

- Reset SAI handle state.

Parameters:

- __HANDLE__: specifies the SAI Handle.

Return value:

- None

__HAL_SAI_ENABLE_IT

Description:

- Enable the specified SAI interrupts.

Parameters:

- __HANDLE__: specifies the SAI Handle.
- __INTERRUPT__: specifies the interrupt source to enable or disable. This parameter can be one of the following values:
  - SAI_IT_OVRUDR: Overrun underrun interrupt enable
  - SAI_IT_MUTEDET: Mute detection interrupt enable
  - SAI_IT_WCKCFG: Wrong Clock Configuration interrupt enable
  - SAI_IT_FREQ: FIFO request interrupt enable
  - SAI_IT_CNRDY: Codec not ready interrupt enable
  - SAI_IT_AFSDET: Anticipated frame synchronization detection interrupt enable
  - SAI_IT_LFSDET: Late frame synchronization detection interrupt enable

Return value:

- None

__HAL_SAI_DISABLE_IT

Description:

- Disable the specified SAI interrupts.

Parameters:

- __HANDLE__: specifies the SAI Handle.
- __INTERRUPT__: specifies the interrupt source to enable or disable. This parameter can be one of the following values:
  - SAI_IT_OVRUDR: Overrun underrun interrupt enable
  - SAI_IT_MUTEDET: Mute detection interrupt enable
  - SAI_IT_WCKCFG: Wrong Clock Configuration interrupt enable
  - SAI_IT_FREQ: FIFO request interrupt enable
  - SAI_IT_CNRDY: Codec not ready interrupt enable
  - SAI_IT_AFSDET: Anticipated frame synchronization detection interrupt enable
  - SAI_IT_LFSDET: Late frame synchronization detection interrupt enable

Return value:

- None

__HAL_SAI_GET_IT_SOURCE

Description:

- Check whether the specified SAI interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the SAI Handle.
- __INTERRUPT__: specifies the SAI interrupt source to check. This parameter can be one of the following values:
  - SAI_IT_OVRUDR: Overrun underrun interrupt enable
  - SAI_IT_MUTEDET: Mute detection interrupt enable
  - SAI_IT_WCKCFG: Wrong Clock Configuration interrupt enable
  - SAI_IT_FREQ: FIFO request interrupt enable
  - SAI_IT_CNRDY: Codec not ready interrupt enable
  - SAI_IT_AFSDET: Anticipated frame synchronization detection interrupt enable
  - SAI_IT_LFSDET: Late frame synchronization detection interrupt enable

Return value:

- The: new state of __INTERRUPT__ (TRUE or FALSE).

__HAL_SAI_GET_FLAG

Description:

- Check whether the specified SAI flag is set or not.

Parameters:

- __HANDLE__: specifies the SAI Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SAI_FLAG_OVRUDR: Overrun underrun flag.
  - SAI_FLAG_MUTEDET: Mute detection flag.
  - SAI_FLAG_WCKCFG: Wrong Clock Configuration flag.
  - SAI_FLAG_FREQ: FIFO request flag.
  - SAI_FLAG_CNRDY: Codec not ready flag.
  - SAI_FLAG_AFSDET: Anticipated frame synchronization detection flag.
  - SAI_FLAG_LFSDET: Late frame synchronization detection flag.

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_SAI_CLEAR_FLAG

Description:

- Clear the specified SAI pending flag.

Parameters:

- __HANDLE__: specifies the SAI Handle.
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - SAI_FLAG_OVRUDR: Clear Overrun underrun
  - SAI_FLAG_MUTEDET: Clear Mute detection
  - SAI_FLAG_WCKCFG: Clear Wrong Clock Configuration
  - SAI_FLAG_FREQ: Clear FIFO request
  - SAI_FLAG_CNRDY: Clear Codec not ready
  - SAI_FLAG_AFSDET: Clear Anticipated frame synchronization detection
  - SAI_FLAG_LFSDET: Clear Late frame synchronization detection

Return value:

- None

__HAL_SAI_ENABLE

Description:

- Enable SAI.

Parameters:

- __HANDLE__: specifies the SAI Handle.

Return value:

- None

__HAL_SAI_DISABLE

Description:

- Disable SAI.

Parameters:

- __HANDLE__: specifies the SAI Handle.

Return value:

- None

SAI Mono Stereo Mode

SAI_STEREOMODE

SAI_MONOMODE

SAI PDM Clock Enable

SAI_PDM_CLOCK1_ENABLE

SAI_PDM_CLOCK2_ENABLE

SAI Supported protocol

SAI_I2S_STANDARD

SAI_I2S_MSBJUSTIFIED

SAI_I2S_LSBJUSTIFIED

SAI_PCM_LONG

SAI_PCM_SHORT

SAI protocol data size

SAI_PROTOCOL_DATASIZE_16BIT

SAI_PROTOCOL_DATASIZE_16BITEXTENDED

SAI_PROTOCOL_DATASIZE_24BIT

SAI_PROTOCOL_DATASIZE_32BIT

SAI TRIState Management

SAI_OUTPUT_NOTRELEASED

SAI_OUTPUT_RELEASED

64 HAL SAI Extension Driver

64.1 SAIEx Firmware driver registers structures

64.1.1 SAIEx_PdmMicDelayParamTypeDef

SAIEx_PdmMicDelayParamTypeDef is defined in the stm32l4xx_hal_sai_ex.h

Data Fields

- ***uint32_t MicPair***
- ***uint32_t LeftDelay***
- ***uint32_t RightDelay***

Field Documentation

- ***uint32_t SAIEx_PdmMicDelayParamTypeDef::MicPair***

  Specifies which pair of microphones is selected. This parameter must be a number between Min_Data = 1 and Max_Data = 3.
- ***uint32_t SAIEx_PdmMicDelayParamTypeDef::LeftDelay***

  Specifies the delay in PDM clock unit to apply on left microphone. This parameter must be a number between Min_Data = 0 and Max_Data = 7.
- ***uint32_t SAIEx_PdmMicDelayParamTypeDef::RightDelay***

  Specifies the delay in PDM clock unit to apply on right microphone. This parameter must be a number between Min_Data = 0 and Max_Data = 7.

64.2 SAIEx Firmware driver API description

The following section lists the various functions of the SAIEx library.

64.2.1 Extended features functions

This section provides functions allowing to:

- Modify PDM microphone delays

This section contains the following APIs:

- ***`HAL_SAIEx_ConfigPdmMicDelay`***

64.2.2 Detailed description of functions

`HAL_SAIEx_ConfigPdmMicDelay`

Function name

HAL_StatusTypeDef HAL_SAIEx_ConfigPdmMicDelay (SAI_HandleTypeDef * hsai, SAIEx_PdmMicDelayParamTypeDef * pdmMicDelay)

Function description

Configure PDM microphone delays.

Parameters

- **hsai:** SAI handle.
- **pdmMicDelay:** Microphone delays configuration.

Return values

- **HAL:** status

65 HAL SD Generic Driver

65.1 SD Firmware driver registers structures

65.1.1 HAL_SD_CardInfoTypeDef

HAL_SD_CardInfoTypeDef is defined in the stm32l4xx_hal_sd.h

Data Fields

- ***uint32_t CardType***
- ***uint32_t CardVersion***
- ***uint32_t Class***
- ***uint32_t RelCardAdd***
- ***uint32_t BlockNbr***
- ***uint32_t BlockSize***
- ***uint32_t LogBlockNbr***
- ***uint32_t LogBlockSize***
- ***uint32_t CardSpeed***

Field Documentation

- ***uint32_t HAL_SD_CardInfoTypeDef::CardType***
  Specifies the card Type
- ***uint32_t HAL_SD_CardInfoTypeDef::CardVersion***
  Specifies the card version
- ***uint32_t HAL_SD_CardInfoTypeDef::Class***
  Specifies the class of the card class
- ***uint32_t HAL_SD_CardInfoTypeDef::RelCardAdd***
  Specifies the Relative Card Address
- ***uint32_t HAL_SD_CardInfoTypeDef::BlockNbr***
  Specifies the Card Capacity in blocks
- ***uint32_t HAL_SD_CardInfoTypeDef::BlockSize***
  Specifies one block size in bytes
- ***uint32_t HAL_SD_CardInfoTypeDef::LogBlockNbr***
  Specifies the Card logical Capacity in blocks
- ***uint32_t HAL_SD_CardInfoTypeDef::LogBlockSize***
  Specifies logical block size in bytes
- ***uint32_t HAL_SD_CardInfoTypeDef::CardSpeed***
  Specifies the card Speed

65.1.2 SD_HandleTypeDef

SD_HandleTypeDef is defined in the stm32l4xx_hal_sd.h

Data Fields

- ***SD_TypeDef * Instance***
- ***SD_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***uint8_t * pTxBuffPtr***
- ***uint32_t TxXferSize***
- ***uint8_t * pRxBuffPtr***
- ***uint32_t RxXferSize***
- ***__IO uint32_t Context***

- ***__IO HAL_SD_StateTypeDef State***
- ***__IO uint32_t ErrorCode***
- ***HAL_SD_CardInfoTypeDef SdCard***
- ***uint32_t CSD***
- ***uint32_t CID***

Field Documentation

- ***SD_TypeDef* SD_HandleTypeDef::Instance***
  SD registers base address
- ***SD_InitTypeDef SD_HandleTypeDef::Init***
  SD required parameters
- ***HAL_LockTypeDef SD_HandleTypeDef::Lock***
  SD locking object
- ***uint8_t* SD_HandleTypeDef::pTxBuffPtr***
  Pointer to SD Tx transfer Buffer
- ***uint32_t SD_HandleTypeDef::TxXferSize***
  SD Tx Transfer size
- ***uint8_t* SD_HandleTypeDef::pRxBuffPtr***
  Pointer to SD Rx transfer Buffer
- ***uint32_t SD_HandleTypeDef::RxXferSize***
  SD Rx Transfer size
- ***__IO uint32_t SD_HandleTypeDef::Context***
  SD transfer context
- ***__IO HAL_SD_StateTypeDef SD_HandleTypeDef::State***
  SD card State
- ***__IO uint32_t SD_HandleTypeDef::ErrorCode***
  SD Card Error codes
- ***HAL_SD_CardInfoTypeDef SD_HandleTypeDef::SdCard***
  SD Card information
- ***uint32_t SD_HandleTypeDef::CSD[4]***
  SD card specific data table
- ***uint32_t SD_HandleTypeDef::CID[4]***
  SD card identification number table

65.1.3 HAL_SD_CardCSDTypeDef

HAL_SD_CardCSDTypeDef is defined in the stm32l4xx_hal_sd.h

Data Fields

- ***__IO uint8_t CSDStruct***
- ***__IO uint8_t SysSpecVersion***
- ***__IO uint8_t Reserved1***
- ***__IO uint8_t TAAC***
- ***__IO uint8_t NSAC***
- ***__IO uint8_t MaxBusClkFrec***
- ***__IO uint16_t CardComdClasses***
- ***__IO uint8_t RdBlockLen***
- ***__IO uint8_t PartBlockRead***
- ***__IO uint8_t WrBlockMisalign***
- ***__IO uint8_t RdBlockMisalign***
- ***__IO uint8_t DSRImpl***
- ***__IO uint8_t Reserved2***

- ***__IO uint32_t DeviceSize***
- ***__IO uint8_t MaxRdCurrentVDDMin***
- ***__IO uint8_t MaxRdCurrentVDDMax***
- ***__IO uint8_t MaxWrCurrentVDDMin***
- ***__IO uint8_t MaxWrCurrentVDDMax***
- ***__IO uint8_t DeviceSizeMul***
- ***__IO uint8_t EraseGrSize***
- ***__IO uint8_t EraseGrMul***
- ***__IO uint8_t WrProtectGrSize***
- ***__IO uint8_t WrProtectGrEnable***
- ***__IO uint8_t ManDeflECC***
- ***__IO uint8_t WrSpeedFact***
- ***__IO uint8_t MaxWrBlockLen***
- ***__IO uint8_t WriteBlockPaPartial***
- ***__IO uint8_t Reserved3***
- ***__IO uint8_t ContentProtectAppli***
- ***__IO uint8_t FileFormatGroup***
- ***__IO uint8_t CopyFlag***
- ***__IO uint8_t PermWrProtect***
- ***__IO uint8_t TempWrProtect***
- ***__IO uint8_t FileFormat***
- ***__IO uint8_t ECC***
- ***__IO uint8_t CSD_CRC***
- ***__IO uint8_t Reserved4***

Field Documentation

- ***__IO uint8_t HAL_SD_CardCSDTypeDef::CSDStruct***
  CSD structure
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::SysSpecVersion***
  System specification version
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::Reserved1***
  Reserved
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::TAAC***
  Data read access time 1
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::NSAC***
  Data read access time 2 in CLK cycles
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::MaxBusClkFrec***
  Max. bus clock frequency
- ***__IO uint16_t HAL_SD_CardCSDTypeDef::CardComdClasses***
  Card command classes
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::RdBlockLen***
  Max. read data block length
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::PartBlockRead***
  Partial blocks for read allowed
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::WrBlockMisalign***
  Write block misalignment
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::RdBlockMisalign***
  Read block misalignment
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::DSRImpl***
  DSR implemented

- ***__IO uint8_t HAL_SD_CardCSDTypeDef::Reserved2***
  Reserved
- ***__IO uint32_t HAL_SD_CardCSDTypeDef::DeviceSize***
  Device Size
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::MaxRdCurrentVDDMin***
  Max. read current @ VDD min
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::MaxRdCurrentVDDMax***
  Max. read current @ VDD max
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::MaxWrCurrentVDDMin***
  Max. write current @ VDD min
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::MaxWrCurrentVDDMax***
  Max. write current @ VDD max
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::DeviceSizeMul***
  Device size multiplier
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::EraseGrSize***
  Erase group size
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::EraseGrMul***
  Erase group size multiplier
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::WrProtectGrSize***
  Write protect group size
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::WrProtectGrEnable***
  Write protect group enable
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::ManDeflECC***
  Manufacturer default ECC
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::WrSpeedFact***
  Write speed factor
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::MaxWrBlockLen***
  Max. write data block length
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::WriteBlockPaPartial***
  Partial blocks for write allowed
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::Reserved3***
  Reserved
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::ContentProtectAppli***
  Content protection application
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::FileFormatGroup***
  File format group
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::CopyFlag***
  Copy flag (OTP)
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::PermWrProtect***
  Permanent write protection
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::TempWrProtect***
  Temporary write protection
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::FileFormat***
  File format
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::ECC***
  ECC code
- ***__IO uint8_t HAL_SD_CardCSDTypeDef::CSD_CRC***
  CSD CRC

- ***__IO uint8_t HAL_SD_CardCSDTypeDef::Reserved4***
  Always 1

65.1.4 HAL_SD_CardCIDTypeDef

HAL_SD_CardCIDTypeDef is defined in the stm32l4xx_hal_sd.h

Data Fields

- ***__IO uint8_t ManufacturerID***
- ***__IO uint16_t OEM_AppliID***
- ***__IO uint32_t ProdName1***
- ***__IO uint8_t ProdName2***
- ***__IO uint8_t ProdRev***
- ***__IO uint32_t ProdSN***
- ***__IO uint8_t Reserved1***
- ***__IO uint16_t ManufactDate***
- ***__IO uint8_t CID_CRC***
- ***__IO uint8_t Reserved2***

Field Documentation

- ***__IO uint8_t HAL_SD_CardCIDTypeDef::ManufacturerID***
  Manufacturer ID
- ***__IO uint16_t HAL_SD_CardCIDTypeDef::OEM_AppliID***
  OEM/Application ID
- ***__IO uint32_t HAL_SD_CardCIDTypeDef::ProdName1***
  Product Name part1
- ***__IO uint8_t HAL_SD_CardCIDTypeDef::ProdName2***
  Product Name part2
- ***__IO uint8_t HAL_SD_CardCIDTypeDef::ProdRev***
  Product Revision
- ***__IO uint32_t HAL_SD_CardCIDTypeDef::ProdSN***
  Product Serial Number
- ***__IO uint8_t HAL_SD_CardCIDTypeDef::Reserved1***
  Reserved1
- ***__IO uint16_t HAL_SD_CardCIDTypeDef::ManufactDate***
  Manufacturing Date
- ***__IO uint8_t HAL_SD_CardCIDTypeDef::CID_CRC***
  CID CRC
- ***__IO uint8_t HAL_SD_CardCIDTypeDef::Reserved2***
  Always 1

65.1.5 HAL_SD_CardStatusTypeDef

HAL_SD_CardStatusTypeDef is defined in the stm32l4xx_hal_sd.h

Data Fields

- ***__IO uint8_t DataBusWidth***
- ***__IO uint8_t SecuredMode***
- ***__IO uint16_t CardType***
- ***__IO uint32_t ProtectedAreaSize***
- ***__IO uint8_t SpeedClass***
- ***__IO uint8_t PerformanceMove***
- ***__IO uint8_t AllocationUnitSize***
- ***__IO uint16_t EraseSize***
- ***__IO uint8_t EraseTimeout***

- ***__IO uint8_t EraseOffset***
- ***__IO uint8_t UhsSpeedGrade***
- ***__IO uint8_t UhsAllocationUnitSize***
- ***__IO uint8_t VideoSpeedClass***

Field Documentation

- ***__IO uint8_t HAL_SD_CardStatusTypeDef::DataBusWidth***
  Shows the currently defined data bus width
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::SecuredMode***
  Card is in secured mode of operation
- ***__IO uint16_t HAL_SD_CardStatusTypeDef::CardType***
  Carries information about card type
- ***__IO uint32_t HAL_SD_CardStatusTypeDef::ProtectedAreaSize***
  Carries information about the capacity of protected area
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::SpeedClass***
  Carries information about the speed class of the card
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::PerformanceMove***
  Carries information about the card's performance move
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::AllocationUnitSize***
  Carries information about the card's allocation unit size
- ***__IO uint16_t HAL_SD_CardStatusTypeDef::EraseSize***
  Determines the number of AUs to be erased in one operation
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::EraseTimeout***
  Determines the timeout for any number of AU erase
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::EraseOffset***
  Carries information about the erase offset
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::UhsSpeedGrade***
  Carries information about the speed grade of UHS card
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::UhsAllocationUnitSize***
  Carries information about the UHS card's allocation unit size
- ***__IO uint8_t HAL_SD_CardStatusTypeDef::VideoSpeedClass***
  Carries information about the Video Speed Class of UHS card

65.2 SD Firmware driver API description

The following section lists the various functions of the SD library.

65.2.1 How to use this driver

This driver implements a high level communication layer for read and write from/to this memory. The needed STM32 hardware resources (SDMMC and GPIO) are performed by the user in HAL_SD_MspInit() function (MSP layer). Basically, the MSP layer configuration should be the same as we provide in the examples. You can easily tailor this configuration according to hardware resources.

This driver is a generic layered driver for SDMMC memories which uses the HAL SDMMC driver functions to interface with SD and uSD cards devices. It is used as follows:

1. Initialize the SDMMC low level resources by implementing the HAL_SD_MspInit() API:
   a. Call the function HAL_RCCEx_PeriphCLKConfig with RCC_PERIPHCLK_SDMMC1 for PeriphClockSelection and select SDMMC1 clock source (MSI, main PLL or PLLSAI1)
   b. Enable the SDMMC interface clock using __HAL_RCC_SDMMC1_CLK_ENABLE();
   c. SDMMC pins configuration for SD card
      - Enable the clock for the SDMMC GPIOs using the functions __HAL_RCC_GPIOx_CLK_ENABLE();
      - Configure these SDMMC pins as alternate function pull-up using HAL_GPIO_Init() and according to your pin assignment;
   d. On STM32L4Rx/STM32L4Sxx devices, no DMA configuration is need, an internal DMA for SDMMC Peripheral is used.
   e. On other devices, perform DMA configuration if you need to use DMA process (HAL_SD_ReadBlocks_DMA() and HAL_SD_WriteBlocks_DMA() APIs).
      - Enable the DMAx interface clock using __HAL_RCC_DMAx_CLK_ENABLE();
      - Configure the DMA using the function HAL_DMA_Init() with predeclared and filled.
   f. NVIC configuration if you need to use interrupt process when using DMA transfer.
      - Configure the SDMMC and DMA interrupt priorities using functions HAL_NVIC_SetPriority(); DMA priority is superior to SDMMC's priority
      - Enable the NVIC DMA and SDMMC IRQs using function HAL_NVIC_EnableIRQ()
      - SDMMC interrupts are managed using the macros __HAL_SD_ENABLE_IT() and __HAL_SD_DISABLE_IT() inside the communication process.
      - SDMMC interrupts pending bits are managed using the macros __HAL_SD_GET_IT() and __HAL_SD_CLEAR_IT()
   g. NVIC configuration if you need to use interrupt process (HAL_SD_ReadBlocks_IT() and HAL_SD_WriteBlocks_IT() APIs).
      - Configure the SDMMC interrupt priorities using function HAL_NVIC_SetPriority();
      - Enable the NVIC SDMMC IRQs using function HAL_NVIC_EnableIRQ()
      - SDMMC interrupts are managed using the macros __HAL_SD_ENABLE_IT() and __HAL_SD_DISABLE_IT() inside the communication process.
      - SDMMC interrupts pending bits are managed using the macros __HAL_SD_GET_IT() and __HAL_SD_CLEAR_IT()
2. At this stage, you can perform SD read/write/erase operations after SD card initialization

SD Card Initialization and configuration

To initialize the SD Card, use the HAL_SD_Init() function. It Initializes SDMMC Peripheral(STM32 side) and the SD Card, and put it into StandBy State (Ready for data transfer). This function provide the following operations:

1. Apply the SD Card initialization process at 400KHz and check the SD Card type (Standard Capacity or High Capacity). You can change or adapt this frequency by adjusting the "ClockDiv" field. The SD Card frequency (SDMMC_CK) is computed as follows: SDMMC_CK = SDMMCCLK / (2 * ClockDiv) on STM32L4Rx/ STM32L4Sxx devices SDMMC_CK = SDMMCCLK / (ClockDiv + 2) on other devices In initialization mode and according to the SD Card standard, make sure that the SDMMC_CK frequency doesn't exceed 400KHz. This phase of initialization is done through SDMMC_Init() and SDMMC_PowerState_ON() SDMMC low level APIs.
2. Initialize the SD card. The API used is HAL_SD_InitCard(). This phase allows the card initialization and identification and check the SD Card type (Standard Capacity or High Capacity) The initialization flow is compatible with SD standard. This API (HAL_SD_InitCard()) could be used also to reinitialize the card in case of plug-off plug-in.
3. Configure the SD Card Data transfer frequency. You can change or adapt this frequency by adjusting the "ClockDiv" field. In transfer mode and according to the SD Card standard, make sure that the SDMMC_CK frequency doesn't exceed 25MHz and 100MHz in High-speed mode switch.
4. Select the corresponding SD Card according to the address read with the step 2.
5. Configure the SD Card in wide bus mode: 4-bits data.

SD Card Read operation

- You can read from SD card in polling mode by using function HAL_SD_ReadBlocks(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state.
- You can read from SD card in DMA mode by using function HAL_SD_ReadBlocks_DMA(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state. You could also check the DMA transfer process through the SD Rx interrupt event.
- You can read from SD card in Interrupt mode by using function HAL_SD_ReadBlocks_IT(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state. You could also check the IT transfer process through the SD Rx interrupt event.

SD Card Write operation

- You can write to SD card in polling mode by using function HAL_SD_WriteBlocks(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state.
- You can write to SD card in DMA mode by using function HAL_SD_WriteBlocks_DMA(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state. You could also check the DMA transfer process through the SD Tx interrupt event.
- You can write to SD card in Interrupt mode by using function HAL_SD_WriteBlocks_IT(). This function support only 512-bytes block length (the block size should be chosen as 512 bytes). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to ensure that the transfer is done correctly. The check is done through HAL_SD_GetCardState() function for SD card state. You could also check the IT transfer process through the SD Tx interrupt event.

SD card status

- The SD Status contains status bits that are related to the SD Memory Card proprietary features. To get SD card status use the HAL_SD_GetCardStatus().

SD card information

- To get SD card information, you can use the function HAL_SD_GetCardInfo(). It returns useful information about the SD card such as block size, card type, block number ...

SD card CSD register

SD card CID register

SD HAL driver macros list

Note: You can refer to the SD HAL driver header file for more useful macros

Callback registration

The compilation define USE_HAL_SD_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_SD_RegisterCallback() to register a user callback, it allows to register following callbacks:

- TxCpltCallback : callback when a transmission transfer is completed.
- RxCpltCallback : callback when a reception transfer is completed.
- ErrorCallback : callback when error occurs.
- AbortCpltCallback : callback when abort is completed.
- Read_DMADblBuf0CpltCallback : callback when the DMA reception of first buffer is completed.
- Read_DMADblBuf1CpltCallback : callback when the DMA reception of second buffer is completed.
- Write_DMADblBuf0CpltCallback : callback when the DMA transmission of first buffer is completed.
- Write_DMADblBuf1CpltCallback : callback when the DMA transmission of second buffer is completed.
- MspInitCallback : SD MspInit.
- MspDeInitCallback : SD MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. For specific callbacks TransceiverCallback use dedicated register callbacks: respectively @ref HAL_SD_RegisterTransceiverCallback(). Use function @ref HAL_SD_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. It allows to reset following callbacks:
- TxCpltCallback : callback when a transmission transfer is completed.
- RxCpltCallback : callback when a reception transfer is completed.
- ErrorCallback : callback when error occurs.
- AbortCpltCallback : callback when abort is completed.
- Read_DMADblBuf0CpltCallback : callback when the DMA reception of first buffer is completed.
- Read_DMADblBuf1CpltCallback : callback when the DMA reception of second buffer is completed.
- Write_DMADblBuf0CpltCallback : callback when the DMA transmission of first buffer is completed.
- Write_DMADblBuf1CpltCallback : callback when the DMA transmission of second buffer is completed.
- MspInitCallback : SD MspInit.
- MspDeInitCallback : SD MspDeInit. This function) takes as parameters the HAL peripheral handle and the Callback ID. For specific callbacks TransceiverCallback use dedicated unregister callbacks: respectively @ref HAL_SD_UnRegisterTransceiverCallback(). By default, after the @ref HAL_SD_Init and if the state is HAL_SD_STATE_RESET all callbacks are reset to the corresponding legacy weak (surcharged) functions. Exception done for MspInit and MspDeInit callbacks that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_SD_Init and @ref HAL_SD_DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_SD_Init and @ref HAL_SD_DeInit keep and use the user MspInit/MspDeInit callbacks (registered beforehand) Callbacks can be registered/unregistered in READY state only. Exception done for MspInit/MspDeInit callbacks that can be registered/unregistered in READY or RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_SD_RegisterCallback before calling @ref HAL_SD_DeInit or @ref HAL_SD_Init function. When The compilation define USE_HAL_SD_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

65.2.2 Initialization and de-initialization functions

This section provides functions allowing to initialize/de-initialize the SD card device to be ready for use.

This section contains the following APIs:

- ***HAL_SD_Init***
- ***HAL_SD_InitCard***
- ***HAL_SD_DeInit***
- ***HAL_SD_MspInit***
- ***HAL_SD_MspDeInit***

65.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the data transfer from/to SD card.

This section contains the following APIs:

- *HAL_SD_ReadBlocks*
- *HAL_SD_WriteBlocks*
- *HAL_SD_ReadBlocks_IT*
- *HAL_SD_WriteBlocks_IT*
- *HAL_SD_ReadBlocks_DMA*
- *HAL_SD_WriteBlocks_DMA*
- *HAL_SD_Erase*
- *HAL_SD_IRQHandler*
- *HAL_SD_GetState*
- *HAL_SD_GetError*
- *HAL_SD_TxCpltCallback*
- *HAL_SD_RxCpltCallback*
- *HAL_SD_ErrorCallback*
- *HAL_SD_AbortCallback*

65.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the SD card operations and get the related information

This section contains the following APIs:

- *HAL_SD_GetCardCID*
- *HAL_SD_GetCardCSD*
- *HAL_SD_GetCardStatus*
- *HAL_SD_GetCardInfo*
- *HAL_SD_ConfigWideBusOperation*
- *HAL_SD_ConfigSpeedBusOperation*
- *HAL_SD_GetCardState*
- *HAL_SD_Abort*
- *HAL_SD_Abort_IT*

65.2.5 Detailed description of functions

`HAL_SD_Init`

Function name

HAL_StatusTypeDef HAL_SD_Init (SD_HandleTypeDef * hsd)

Function description

Initializes the SD according to the specified parameters in the SD_HandleTypeDef and create the associated handle.

Parameters

- **hsd:** Pointer to the SD handle

Return values

- **HAL:** status

`HAL_SD_InitCard`

Function name

HAL_StatusTypeDef HAL_SD_InitCard (SD_HandleTypeDef * hsd)

Function description

Initializes the SD Card.

Parameters

- **hsd:** Pointer to SD handle

Return values

- **HAL:** status

Notes

- This function initializes the SD card. It could be used when a card re-initialization is needed.

`HAL_SD_DeInit`

Function name

HAL_StatusTypeDef HAL_SD_DeInit (SD_HandleTypeDef * hsd)

Function description

De-Initializes the SD card.

Parameters

- **hsd:** Pointer to SD handle

Return values

- **HAL:** status

`HAL_SD_MspInit`

Function name

void HAL_SD_MspInit (SD_HandleTypeDef * hsd)

Function description

Initializes the SD MSP.

Parameters

- **hsd:** Pointer to SD handle

Return values

- **None:**

`HAL_SD_MspDeInit`

Function name

void HAL_SD_MspDeInit (SD_HandleTypeDef * hsd)

Function description

De-Initialize SD MSP.

Parameters

- **hsd:** Pointer to SD handle

Return values

- **None:**

HAL_SD_ReadBlocks

Function name

HAL_StatusTypeDef HAL_SD_ReadBlocks (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hsd:** Pointer to SD handle
- **pData:** pointer to the buffer that will contain the received data
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Number of SD blocks to read
- **Timeout:** Specify timeout value

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().

HAL_SD_WriteBlocks

Function name

HAL_StatusTypeDef HAL_SD_WriteBlocks (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks, uint32_t Timeout)

Function description

Allows to write block(s) to a specified address in a card.

Parameters

- **hsd:** Pointer to SD handle
- **pData:** pointer to the buffer that will contain the data to transmit
- **BlockAdd:** Block Address where data will be written
- **NumberOfBlocks:** Number of SD blocks to write
- **Timeout:** Specify timeout value

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().

HAL_SD_Erase

Function name

HAL_StatusTypeDef HAL_SD_Erase (SD_HandleTypeDef * hsd, uint32_t BlockStartAdd, uint32_t BlockEndAdd)

Function description

Erases the specified memory area of the given SD card.

Parameters

- **hsd:** Pointer to SD handle
- **BlockStartAdd:** Start Block address
- **BlockEndAdd:** End Block address

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().

HAL_SD_ReadBlocks_IT

Function name

HAL_StatusTypeDef HAL_SD_ReadBlocks_IT (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hsd:** Pointer to SD handle
- **pData:** Pointer to the buffer that will contain the received data
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Number of blocks to read.

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().
- You could also check the IT transfer process through the SD Rx interrupt event.

HAL_SD_WriteBlocks_IT

Function name

HAL_StatusTypeDef HAL_SD_WriteBlocks_IT (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Writes block(s) to a specified address in a card.

Parameters

- **hsd:** Pointer to SD handle
- **pData:** Pointer to the buffer that will contain the data to transmit
- **BlockAdd:** Block Address where data will be written
- **NumberOfBlocks:** Number of blocks to write

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().
- You could also check the IT transfer process through the SD Tx interrupt event.

HAL_SD_ReadBlocks_DMA

Function name

HAL_StatusTypeDef HAL_SD_ReadBlocks_DMA (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hsd:** Pointer SD handle
- **pData:** Pointer to the buffer that will contain the received data
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Number of blocks to read.

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().
- You could also check the DMA transfer process through the SD Rx interrupt event.

HAL_SD_WriteBlocks_DMA

Function name

HAL_StatusTypeDef HAL_SD_WriteBlocks_DMA (SD_HandleTypeDef * hsd, uint8_t * pData, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Writes block(s) to a specified address in a card.

Parameters

- **hsd:** Pointer to SD handle
- **pData:** Pointer to the buffer that will contain the data to transmit
- **BlockAdd:** Block Address where data will be written
- **NumberOfBlocks:** Number of blocks to write

Return values

- **HAL:** status

Notes

- This API should be followed by a check on the card state through HAL_SD_GetCardState().
- You could also check the DMA transfer process through the SD Tx interrupt event.

HAL_SD_IRQHandler

Function name

void HAL_SD_IRQHandler (SD_HandleTypeDef * hsd)

Function description

This function handles SD card interrupt request.

Parameters

- **hsd:** Pointer to SD handle

Return values

- **None:**

`HAL_SD_TxCpltCallback`

Function name

void HAL_SD_TxCpltCallback (SD_HandleTypeDef * hsd)

Function description

Tx Transfer completed callbacks.

Parameters

- **hsd:** Pointer to SD handle

Return values

- **None:**

`HAL_SD_RxCpltCallback`

Function name

void HAL_SD_RxCpltCallback (SD_HandleTypeDef * hsd)

Function description

Rx Transfer completed callbacks.

Parameters

- **hsd:** Pointer SD handle

Return values

- **None:**

`HAL_SD_ErrorCallback`

Function name

void HAL_SD_ErrorCallback (SD_HandleTypeDef * hsd)

Function description

SD error callbacks.

Parameters

- **hsd:** Pointer SD handle

Return values

- **None:**

`HAL_SD_AbortCallback`

Function name

void HAL_SD_AbortCallback (SD_HandleTypeDef * hsd)

Function description

SD Abort callbacks.

Parameters

- **hsd:** Pointer SD handle

Return values

- **None:**

`HAL_SD_ConfigWideBusOperation`

Function name

HAL_StatusTypeDef HAL_SD_ConfigWideBusOperation (SD_HandleTypeDef * hsd, uint32_t WideMode)

Function description

Enables wide bus operation for the requested card if supported by card.

Parameters

- **hsd:** Pointer to SD handle
- **WideMode:** Specifies the SD card wide bus mode This parameter can be one of the following values:
  - SDMMC_BUS_WIDE_8B: 8-bit data transfer
  - SDMMC_BUS_WIDE_4B: 4-bit data transfer
  - SDMMC_BUS_WIDE_1B: 1-bit data transfer

Return values

- **HAL:** status

`HAL_SD_ConfigSpeedBusOperation`

Function name

HAL_StatusTypeDef HAL_SD_ConfigSpeedBusOperation (SD_HandleTypeDef * hsd, uint32_t SpeedMode)

Function description

Configure the speed bus mode.

Parameters

- **hsd:** Pointer to the SD handle
- **SpeedMode:** Specifies the SD card speed bus mode This parameter can be one of the following values:
  - SDMMC_SPEED_MODE_AUTO: Max speed mode supported by the card
  - SDMMC_SPEED_MODE_DEFAULT: Default Speed/SDR12 mode
  - SDMMC_SPEED_MODE_HIGH: High Speed/SDR25 mode
  - SDMMC_SPEED_MODE_ULTRA: Ultra high speed mode

Return values

- **HAL:** status

`HAL_SD_SendSDStatus`

Function name

HAL_StatusTypeDef HAL_SD_SendSDStatus (SD_HandleTypeDef * hsd, uint32_t * pSDstatus)

Function description

`HAL_SD_GetCardState`

Function name

HAL_SD_CardStateTypeDef HAL_SD_GetCardState (SD_HandleTypeDef * hsd)

Function description

Gets the current sd card data state.

Parameters

- **hsd:** pointer to SD handle

Return values

- **Card:** state

`HAL_SD_GetCardCID`

Function name

HAL_StatusTypeDef HAL_SD_GetCardCID (SD_HandleTypeDef * hsd, HAL_SD_CardCIDTypeDef * pCID)

Function description

Returns information the information of the card which are stored on the CID register.

Parameters

- **hsd:** Pointer to SD handle
- **pCID:** Pointer to a HAL_SD_CardCIDTypeDef structure that contains all CID register parameters

Return values

- **HAL:** status

`HAL_SD_GetCardCSD`

Function name

HAL_StatusTypeDef HAL_SD_GetCardCSD (SD_HandleTypeDef * hsd, HAL_SD_CardCSDTypeDef * pCSD)

Function description

Returns information the information of the card which are stored on the CSD register.

Parameters

- **hsd:** Pointer to SD handle
- **pCSD:** Pointer to a HAL_SD_CardCSDTypeDef structure that contains all CSD register parameters

Return values

- **HAL:** status

`HAL_SD_GetCardStatus`

Function name

HAL_StatusTypeDef HAL_SD_GetCardStatus (SD_HandleTypeDef * hsd, HAL_SD_CardStatusTypeDef * pStatus)

Function description

Gets the SD status info.

Parameters

- **hsd:** Pointer to SD handle
- **pStatus:** Pointer to the HAL_SD_CardStatusTypeDef structure that will contain the SD card status information

Return values

- **HAL:** status

HAL_SD_GetCardInfo

Function name

HAL_StatusTypeDef HAL_SD_GetCardInfo (SD_HandleTypeDef * hsd, HAL_SD_CardInfoTypeDef * pCardInfo)

Function description

Gets the SD card info.

Parameters

- **hsd:** Pointer to SD handle
- **pCardInfo:** Pointer to the HAL_SD_CardInfoTypeDef structure that will contain the SD card status information

Return values

- **HAL:** status

HAL_SD_GetState

Function name

HAL_SD_StateTypeDef HAL_SD_GetState (SD_HandleTypeDef * hsd)

Function description

return the SD state

Parameters

- **hsd:** Pointer to sd handle

Return values

- **HAL:** state

HAL_SD_GetError

Function name

uint32_t HAL_SD_GetError (SD_HandleTypeDef * hsd)

Function description

Return the SD error code.

Parameters

- **hsd:** : Pointer to a SD_HandleTypeDef structure that contains the configuration information.

Return values

- **SD:** Error Code

HAL_SD_Abort

Function name

HAL_StatusTypeDef HAL_SD_Abort (SD_HandleTypeDef * hsd)

Function description

Abort the current transfer and disable the SD.

Parameters

- **hsd:** pointer to a SD_HandleTypeDef structure that contains the configuration information for SD module.

Return values

- **HAL:** status

`HAL_SD_Abort_IT`

Function name

HAL_StatusTypeDef HAL_SD_Abort_IT (SD_HandleTypeDef * hsd)

Function description

Abort the current transfer and disable the SD (IT mode).

Parameters

- **hsd:** pointer to a SD_HandleTypeDef structure that contains the configuration information for SD module.

Return values

- **HAL:** status

65.3 SD Firmware driver defines

The following section lists the various define and macros of the module.

65.3.1 SD

SD

SD Error status enumeration Structure definition

HAL_SD_ERROR_NONE

No error

HAL_SD_ERROR_CMD_CRC_FAIL

Command response received (but CRC check failed)

HAL_SD_ERROR_DATA_CRC_FAIL

Data block sent/received (CRC check failed)

HAL_SD_ERROR_CMD_RSP_TIMEOUT

Command response timeout

HAL_SD_ERROR_DATA_TIMEOUT

Data timeout

HAL_SD_ERROR_TX_UNDERRUN

Transmit FIFO underrun

HAL_SD_ERROR_RX_OVERRUN

Receive FIFO overrun

HAL_SD_ERROR_ADDR_MISALIGNED

Misaligned address

HAL_SD_ERROR_BLOCK_LEN_ERR

Transferred block length is not allowed for the card or the number of transferred bytes does not match the block length

HAL_SD_ERROR_ERASE_SEQ_ERR

An error in the sequence of erase command occurs

HAL_SD_ERROR_BAD_ERASE_PARAM

An invalid selection for erase groups

HAL_SD_ERROR_WRITE_PROT_VIOLATION

Attempt to program a write protect block

HAL_SD_ERROR_LOCK_UNLOCK_FAILED

Sequence or password error has been detected in unlock command or if there was an attempt to access a locked card

HAL_SD_ERROR_COM_CRC_FAILED

CRC check of the previous command failed

HAL_SD_ERROR_ILLEGAL_CMD

Command is not legal for the card state

HAL_SD_ERROR_CARD_ECC_FAILED

Card internal ECC was applied but failed to correct the data

HAL_SD_ERROR_CC_ERR

Internal card controller error

HAL_SD_ERROR_GENERAL_UNKNOWN_ERR

General or unknown error

HAL_SD_ERROR_STREAM_READ_UNDERRUN

The card could not sustain data reading in stream rmode

HAL_SD_ERROR_STREAM_WRITE_OVERRUN

The card could not sustain data programming in stream mode

HAL_SD_ERROR_CID_CSD_OVERWRITE

CID/CSD overwrite error

HAL_SD_ERROR_WP_ERASE_SKIP

Only partial address space was erased

HAL_SD_ERROR_CARD_ECC_DISABLED

Command has been executed without using internal ECC

HAL_SD_ERROR_ERASE_RESET

Erase sequence was cleared before executing because an out of erase sequence command was received

HAL_SD_ERROR_AKE_SEQ_ERR

Error in sequence of authentication

HAL_SD_ERROR_INVALID_VOLTRANGE

Error in case of invalid voltage range

HAL_SD_ERROR_ADDR_OUT_OF_RANGE

Error when addressed block is out of range

HAL_SD_ERROR_REQUEST_NOT_APPLICABLE

Error when command request is not applicable

HAL_SD_ERROR_PARAM

the used parameter is not valid

HAL_SD_ERROR_UNSUPPORTED_FEATURE

Error when feature is not insupported

HAL_SD_ERROR_BUSY

Error when transfer process is busy

HAL_SD_ERROR_DMA

Error while DMA transfer

HAL_SD_ERROR_TIMEOUT

Timeout error

SD context enumeration

SD_CONTEXT_NONE

None

SD_CONTEXT_READ_SINGLE_BLOCK

Read single block operation

SD_CONTEXT_READ_MULTIPLE_BLOCK

Read multiple blocks operation

SD_CONTEXT_WRITE_SINGLE_BLOCK

Write single block operation

SD_CONTEXT_WRITE_MULTIPLE_BLOCK

Write multiple blocks operation

SD_CONTEXT_IT

Process in Interrupt mode

SD_CONTEXT_DMA

Process in DMA mode

SD Supported Memory Cards

CARD_NORMAL_SPEED

Normal Speed Card <12.5Mo/s , Spec Version 1.01

CARD_HIGH_SPEED

High Speed Card <25Mo/s , Spec version 2.00

CARD_ULTRA_HIGH_SPEED

UHS-I SD Card <50Mo/s for SDR50, DDR5 Cards and <104Mo/s for SDR104, Spec version 3.01

CARD_SDSC

SD Standard Capacity <2Go

CARD_SDHC_SDXC

SD High Capacity <32Go, SD Extended Capacity <2To

CARD_SECURED

SD Supported Version

CARD_V1_X

CARD_V2_X

Exported Constants

BLOCKSIZE

Block size is 512 bytes

SD Exported Macros

__HAL_SD_RESET_HANDLE_STATE

Description:

- Reset SD handle state.

Parameters:

- __HANDLE__: : SD handle.

Return value:

- None

__HAL_SD_ENABLE_IT

Description:

- Enable the SD device interrupt.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDMMC interrupt sources to be enabled. This parameter can be one or a combination of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_CMDACT: Command transfer in progress interrupt
  - SDMMC_IT_TXACT: Data transmit in progress interrupt
  - SDMMC_IT_RXACT: Data receive in progress interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SDIO interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- None

__HAL_SD_DISABLE_IT

Description:

- Disable the SD device interrupt.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDMMC interrupt sources to be disabled. This parameter can be one or a combination of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_CMDACT: Command transfer in progress interrupt
  - SDMMC_IT_TXACT: Data transmit in progress interrupt
  - SDMMC_IT_RXACT: Data receive in progress interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SDIO interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- None

__HAL_SD_GET_FLAG

Description:

- Check whether the specified SD flag is set or not.

Parameters:

- __HANDLE__: SD Handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
  - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
  - SDMMC_FLAG_CTIMEOUT: Command response timeout
  - SDMMC_FLAG_DTIMEOUT: Data timeout
  - SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
  - SDMMC_FLAG_RXOVERR: Received FIFO overrun error
  - SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
  - SDMMC_FLAG_CMDSENT: Command sent (no response required)
  - SDMMC_FLAG_DATAEND: Data end (data counter, DATACOUNT, is zero)
  - SDMMC_FLAG_DHOLD: Data transfer Hold
  - SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
  - SDMMC_FLAG_DABORT: Data transfer aborted by CMD12
  - SDMMC_FLAG_DPSMACT: Data path state machine active
  - SDMMC_FLAG_CPSMACT: Command path state machine active
  - SDMMC_FLAG_CMDACT: Command transfer in progress
  - SDMMC_FLAG_TXACT: Data transmit in progress
  - SDMMC_FLAG_RXACT: Data receive in progress
  - SDMMC_FLAG_TXFIFOHE: Transmit FIFO Half Empty
  - SDMMC_FLAG_RXFIFOHF: Receive FIFO Half Full
  - SDMMC_FLAG_TXFIFOF: Transmit FIFO full
  - SDMMC_FLAG_RXFIFOF: Receive FIFO full
  - SDMMC_FLAG_TXFIFOE: Transmit FIFO empty
  - SDMMC_FLAG_RXFIFOE: Receive FIFO empty
  - SDMMC_FLAG_BUSYD0: Inverted value of SDMMC_D0 line (Busy)
  - SDMMC_FLAG_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected
  - SDMMC_FLAG_TXDAVL: Data available in transmit FIFO
  - SDMMC_FLAG_RXDAVL: Data available in receive FIFO
  - SDMMC_FLAG_SDIOIT: SDIO interrupt received
  - SDMMC_FLAG_ACKFAIL: Boot Acknowledgment received
  - SDMMC_FLAG_ACKTIMEOUT: Boot Acknowledgment timeout
  - SDMMC_FLAG_VSWEND: Voltage switch critical timing section completion
  - SDMMC_FLAG_CKSTOP: SDMMC_CK stopped in Voltage switch procedure
  - SDMMC_FLAG_IDMATE: IDMA transfer error
  - SDMMC_FLAG_IDMABTC: IDMA buffer transfer complete

Return value:

- The: new state of SD FLAG (SET or RESET).

__HAL_SD_CLEAR_FLAG

Description:

- Clear the SD's pending flags.

Parameters:

- __HANDLE__: SD Handle
- __FLAG__: specifies the flag to clear. This parameter can be one or a combination of the following values:
  - SDMMC_FLAG_CCRCFAIL: Command response received (CRC check failed)
  - SDMMC_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
  - SDMMC_FLAG_CTIMEOUT: Command response timeout
  - SDMMC_FLAG_DTIMEOUT: Data timeout
  - SDMMC_FLAG_TXUNDERR: Transmit FIFO underrun error
  - SDMMC_FLAG_RXOVERR: Received FIFO overrun error
  - SDMMC_FLAG_CMDREND: Command response received (CRC check passed)
  - SDMMC_FLAG_CMDSENT: Command sent (no response required)
  - SDMMC_FLAG_DATAEND: Data end (data counter, DATACOUNT, is zero)
  - SDMMC_FLAG_DHOLD: Data transfer Hold
  - SDMMC_FLAG_DBCKEND: Data block sent/received (CRC check passed)
  - SDMMC_FLAG_DABORT: Data transfer aborted by CMD12
  - SDMMC_FLAG_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected
  - SDMMC_FLAG_SDIOIT: SDIO interrupt received
  - SDMMC_FLAG_ACKFAIL: Boot Acknowledgment received
  - SDMMC_FLAG_ACKTIMEOUT: Boot Acknowledgment timeout
  - SDMMC_FLAG_VSWEND: Voltage switch critical timing section completion
  - SDMMC_FLAG_CKSTOP: SDMMC_CK stopped in Voltage switch procedure
  - SDMMC_FLAG_IDMATE: IDMA transfer error
  - SDMMC_FLAG_IDMABTC: IDMA buffer transfer complete

Return value:

- None

__HAL_SD_GET_IT

Description:

- Check whether the specified SD interrupt has occurred or not.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDMMC interrupt source to check. This parameter can be one of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_CMDACT: Command transfer in progress interrupt
  - SDMMC_IT_TXACT: Data transmit in progress interrupt
  - SDMMC_IT_RXACT: Data receive in progress interrupt
  - SDMMC_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDMMC_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDMMC_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDMMC_IT_RXFIFOF: Receive FIFO full interrupt
  - SDMMC_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDMMC_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDMMC_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDMMC_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SDIO interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- The: new state of SD IT (SET or RESET).

__HAL_SD_CLEAR_IT

Description:

- Clear the SD's interrupt pending bits.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the interrupt pending bit to clear. This parameter can be one or a combination of the following values:
  - SDMMC_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDMMC_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDMMC_IT_CTIMEOUT: Command response timeout interrupt
  - SDMMC_IT_DTIMEOUT: Data timeout interrupt
  - SDMMC_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDMMC_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDMMC_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDMMC_IT_CMDSENT: Command sent (no response required) interrupt
  - SDMMC_IT_DATAEND: Data end (data counter, DATACOUNT, is zero) interrupt
  - SDMMC_IT_DHOLD: Data transfer Hold interrupt
  - SDMMC_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDMMC_IT_DABORT: Data transfer aborted by CMD12 interrupt
  - SDMMC_IT_BUSYD0END: End of SDMMC_D0 Busy following a CMD response detected interrupt
  - SDMMC_IT_SDIOIT: SDIO interrupt received interrupt
  - SDMMC_IT_ACKFAIL: Boot Acknowledgment received interrupt
  - SDMMC_IT_ACKTIMEOUT: Boot Acknowledgment timeout interrupt
  - SDMMC_IT_VSWEND: Voltage switch critical timing section completion interrupt
  - SDMMC_IT_CKSTOP: SDMMC_CK stopped in Voltage switch procedure interrupt
  - SDMMC_IT_IDMABTC: IDMA buffer transfer complete interrupt

Return value:

- None

SD Card State enumeration structure

HAL_SD_CARD_READY

Card state is ready

HAL_SD_CARD_IDENTIFICATION

Card is in identification state

HAL_SD_CARD_STANDBY

Card is in standby state

HAL_SD_CARD_TRANSFER

Card is in transfer state

HAL_SD_CARD_SENDING

Card is sending an operation

HAL_SD_CARD_RECEIVING

Card is receiving operation information

HAL_SD_CARD_PROGRAMMING

Card is in programming state

HAL_SD_CARD_DISCONNECTED

Card is disconnected

HAL_SD_CARD_ERROR

Card response Error

SD Handle Structure definition

SD_InitTypeDef

SD_TypeDef

66 HAL SD Extension Driver

66.1 SDEx Firmware driver API description

The following section lists the various functions of the SDEx library.

66.1.1 How to use this driver

The SD Extension HAL driver can be used as follows:

- Set card in High Speed mode using HAL_SDEx_HighSpeed() function.
- Configure Buffer0 and Buffer1 start address and Buffer size using HAL_SDEx_ConfigDMAMultiBuffer() function.
- Start Read and Write for multibuffer mode using HAL_SDEx_ReadBlocksDMAMultiBuffer() and HAL_SDEx_WriteBlocksDMAMultiBuffer() functions.

66.1.2 High Speed function

This section provides function allowing to configure the card in High Speed mode.

This section contains the following APIs:

- ***HAL_SDEx_HighSpeed***
- ***HAL_SDEx_DriveTransceiver_1_8V_Callback***

66.1.3 Multibuffer functions

This section provides functions allowing to configure the multibuffer mode and start read and write multibuffer mode for SD HAL driver.

This section contains the following APIs:

- ***HAL_SDEx_ConfigDMAMultiBuffer***
- ***HAL_SDEx_ReadBlocksDMAMultiBuffer***
- ***HAL_SDEx_WriteBlocksDMAMultiBuffer***
- ***HAL_SDEx_ChangeDMABuffer***
- ***HAL_SDEx_Read_DMADoubleBuffer0CpltCallback***
- ***HAL_SDEx_Read_DMADoubleBuffer1CpltCallback***
- ***HAL_SDEx_Write_DMADoubleBuffer0CpltCallback***
- ***HAL_SDEx_Write_DMADoubleBuffer1CpltCallback***

66.1.4 Detailed description of functions

`HAL_SDEx_HighSpeed`

Function name

uint32_t HAL_SDEx_HighSpeed (SD_HandleTypeDef * hsd)

Function description

Switches the SD card to High Speed mode.

Parameters

- **hsd:** SD handle

Return values

- **SD:** Card error state

Notes

- This operation should be followed by the configuration of PLL to have SDMMCCK clock between 50 and 120 MHz

HAL_SDEx_DriveTransceiver_1_8V_Callback

Function name

void HAL_SDEx_DriveTransceiver_1_8V_Callback (FlagStatus status)

Function description

Enable/Disable the SD Transceiver 1.8V Mode Callback.

Parameters

- **status:** Voltage Switch State

Return values

- **None:**

HAL_SDEx_ConfigDMAMultiBuffer

Function name

HAL_StatusTypeDef HAL_SDEx_ConfigDMAMultiBuffer (SD_HandleTypeDef * hsd, uint32_t * pDataBuffer0, uint32_t * pDataBuffer1, uint32_t BufferSize)

Function description

Configure DMA Dual Buffer mode.

Parameters

- **hsd:** SD handle
- **pDataBuffer0:** Pointer to the buffer0 that will contain/receive the transfered data
- **pDataBuffer1:** Pointer to the buffer1 that will contain/receive the transfered data
- **BufferSize:** Size of Buffer0 in Blocks. Buffer0 and Buffer1 must have the same size.

Return values

- **HAL:** status

HAL_SDEx_ReadBlocksDMAMultiBuffer

Function name

HAL_StatusTypeDef HAL_SDEx_ReadBlocksDMAMultiBuffer (SD_HandleTypeDef * hsd, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Reads block(s) from a specified address in a card.

Parameters

- **hsd:** SD handle
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Total number of blocks to read

Return values

- **HAL:** status

HAL_SDEx_WriteBlocksDMAMultiBuffer

Function name

HAL_StatusTypeDef HAL_SDEx_WriteBlocksDMAMultiBuffer (SD_HandleTypeDef * hsd, uint32_t BlockAdd, uint32_t NumberOfBlocks)

Function description

Write block(s) to a specified address in a card.

Parameters

- **hsd:** SD handle
- **BlockAdd:** Block Address from where data is to be read
- **NumberOfBlocks:** Total number of blocks to read

Return values

- **HAL:** status

HAL_SDEx_ChangeDMABuffer

Function name

HAL_StatusTypeDef HAL_SDEx_ChangeDMABuffer (SD_HandleTypeDef * hsd, HAL_SDEx_DMABuffer_MemoryTypeDef Buffer, uint32_t * pDataBuffer)

Function description

Change the DMA Buffer0 or Buffer1 address on the fly.

Parameters

- **hsd:** pointer to a SD_HandleTypeDef structure.
- **Buffer:** the buffer to be changed, This parameter can be one of the following values: SD_DMA_BUFFER0 or SD_DMA_BUFFER1
- **pDataBuffer:** The new address

Return values

- **HAL:** status

Notes

- The BUFFER0 address can be changed only when the current transfer use BUFFER1 and the BUFFER1 address can be changed only when the current transfer use BUFFER0.

HAL_SDEx_Read_DMADoubleBuffer0CpltCallback

Function name

void HAL_SDEx_Read_DMADoubleBuffer0CpltCallback (SD_HandleTypeDef * hsd)

Function description

Read DMA Buffer 0 Transfer completed callbacks.

Parameters

- **hsd:** SD handle

Return values

- **None:**

HAL_SDEx_Read_DMADoubleBuffer1CpltCallback

Function name

void HAL_SDEx_Read_DMADoubleBuffer1CpltCallback (SD_HandleTypeDef * hsd)

Function description

Read DMA Buffer 1 Transfer completed callbacks.

Parameters

- **hsd:** SD handle

Return values

- **None:**

`HAL_SDEx_Write_DMADoubleBuffer0CpltCallback`

Function name

void HAL_SDEx_Write_DMADoubleBuffer0CpltCallback (SD_HandleTypeDef * hsd)

Function description

Write DMA Buffer 0 Transfer completed callbacks.

Parameters

- **hsd:** SD handle

Return values

- **None:**

`HAL_SDEx_Write_DMADoubleBuffer1CpltCallback`

Function name

void HAL_SDEx_Write_DMADoubleBuffer1CpltCallback (SD_HandleTypeDef * hsd)

Function description

Write DMA Buffer 1 Transfer completed callbacks.

Parameters

- **hsd:** SD handle

Return values

- **None:**

67 HAL SMARTCARD Generic Driver

67.1 SMARTCARD Firmware driver registers structures

67.1.1 SMARTCARD_InitTypeDef

SMARTCARD_InitTypeDef is defined in the stm32l4xx_hal_smartcard.h

Data Fields

- ***uint32_t BaudRate***
- ***uint32_t WordLength***
- ***uint32_t StopBits***
- ***uint16_t Parity***
- ***uint16_t Mode***
- ***uint16_t CLKPolarity***
- ***uint16_t CLKPhase***
- ***uint16_t CLKLastBit***
- ***uint16_t OneBitSampling***
- ***uint8_t Prescaler***
- ***uint8_t GuardTime***
- ***uint16_t NACKEnable***
- ***uint32_t TimeOutEnable***
- ***uint32_t TimeOutValue***
- ***uint8_t BlockLength***
- ***uint8_t AutoRetryCount***
- ***uint32_t ClockPrescaler***

Field Documentation

- ***uint32_t SMARTCARD_InitTypeDef::BaudRate***

  Configures the SmartCard communication baud rate. The baud rate register is computed using the following formula: Baud Rate Register = ((usart_ker_ckpres) / ((hsmartcard->Init.BaudRate))) where usart_ker_ckpres is the USART input clock divided by a prescaler

- ***uint32_t SMARTCARD_InitTypeDef::WordLength***

  Specifies the number of data bits transmitted or received in a frame. This parameter ***SMARTCARD_Word_Length*** can only be set to 9 (8 data + 1 parity bits).

- ***uint32_t SMARTCARD_InitTypeDef::StopBits***

  Specifies the number of stop bits. This parameter can be a value of ***SMARTCARD_Stop_Bits***.

- ***uint16_t SMARTCARD_InitTypeDef::Parity***

  Specifies the parity mode. This parameter can be a value of ***SMARTCARD_Parity***

  Note:

  – The parity is enabled by default (PCE is forced to 1). Since the WordLength is forced to 8 bits + parity, M is forced to 1 and the parity bit is the 9th bit.

- ***uint16_t SMARTCARD_InitTypeDef::Mode***

  Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of ***SMARTCARD_Mode***

- ***uint16_t SMARTCARD_InitTypeDef::CLKPolarity***

  Specifies the steady state of the serial clock. This parameter can be a value of ***SMARTCARD_Clock_Polarity***

- ***uint16_t SMARTCARD_InitTypeDef::CLKPhase***

  Specifies the clock transition on which the bit capture is made. This parameter can be a value of ***SMARTCARD_Clock_Phase***

- ***uint16_t SMARTCARD_InitTypeDef::CLKLastBit***

  Specifies whether the clock pulse corresponding to the last transmitted data bit (MSB) has to be output on the SCLK pin in synchronous mode. This parameter can be a value of ***SMARTCARD_Last_Bit***
- ***uint16_t SMARTCARD_InitTypeDef::OneBitSampling***

  Specifies whether a single sample or three samples' majority vote is selected. Selecting the single sample method increases the receiver tolerance to clock deviations. This parameter can be a value of ***SMARTCARD_OneBit_Sampling***.
- ***uint8_t SMARTCARD_InitTypeDef::Prescaler***

  Specifies the SmartCard Prescaler. This parameter can be any value from 0x01 to 0x1F. Prescaler value is multiplied by 2 to give the division factor of the source clock frequency
- ***uint8_t SMARTCARD_InitTypeDef::GuardTime***

  Specifies the SmartCard Guard Time applied after stop bits.
- ***uint16_t SMARTCARD_InitTypeDef::NACKEnable***

  Specifies whether the SmartCard NACK transmission is enabled in case of parity error. This parameter can be a value of ***SMARTCARD_NACK_Enable***
- ***uint32_t SMARTCARD_InitTypeDef::TimeOutEnable***

  Specifies whether the receiver timeout is enabled. This parameter can be a value of ***SMARTCARD_Timeout_Enable***
- ***uint32_t SMARTCARD_InitTypeDef::TimeOutValue***

  Specifies the receiver time out value in number of baud blocks: it is used to implement the Character Wait Time (CWT) and Block Wait Time (BWT). It is coded over 24 bits.
- ***uint8_t SMARTCARD_InitTypeDef::BlockLength***

  Specifies the SmartCard Block Length in T=1 Reception mode. This parameter can be any value from 0x0 to 0xFF
- ***uint8_t SMARTCARD_InitTypeDef::AutoRetryCount***

  Specifies the SmartCard auto-retry count (number of retries in receive and transmit mode). When set to 0, retransmission is disabled. Otherwise, its maximum value is 7 (before signalling an error)
- ***uint32_t SMARTCARD_InitTypeDef::ClockPrescaler***

  Specifies the prescaler value used to divide the USART clock source. This parameter can be a value of ***SMARTCARD_ClockPrescaler***.

67.1.2 SMARTCARD_AdvFeatureInitTypeDef

SMARTCARD_AdvFeatureInitTypeDef is defined in the stm32l4xx_hal_smartcard.h

Data Fields

- ***uint32_t AdvFeatureInit***
- ***uint32_t TxPinLevelInvert***
- ***uint32_t RxPinLevelInvert***
- ***uint32_t DataInvert***
- ***uint32_t Swap***
- ***uint32_t OverrunDisable***
- ***uint32_t DMADisableonRxError***
- ***uint32_t MSBFirst***
- ***uint16_t TxCompletionIndication***

Field Documentation

- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::AdvFeatureInit***

  Specifies which advanced SMARTCARD features is initialized. Several advanced features may be initialized at the same time. This parameter can be a value of ***SMARTCARDEx_Advanced_Features_Initialization_Type***
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::TxPinLevelInvert***

  Specifies whether the TX pin active level is inverted. This parameter can be a value of ***SMARTCARD_Tx_Inv***

- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::RxPinLevelInvert***
  Specifies whether the RX pin active level is inverted. This parameter can be a value of *SMARTCARD_Rx_Inv*
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::DataInvert***
  Specifies whether data are inverted (positive/direct logic vs negative/inverted logic). This parameter can be a value of *SMARTCARD_Data_Inv*
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::Swap***
  Specifies whether TX and RX pins are swapped. This parameter can be a value of *SMARTCARD_Rx_Tx_Swap*
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::OverrunDisable***
  Specifies whether the reception overrun detection is disabled. This parameter can be a value of *SMARTCARD_Overrun_Disable*
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::DMADisableonRxError***
  Specifies whether the DMA is disabled in case of reception error. This parameter can be a value of *SMARTCARD_DMA_Disable_on_Rx_Error*
- ***uint32_t SMARTCARD_AdvFeatureInitTypeDef::MSBFirst***
  Specifies whether MSB is sent first on UART line. This parameter can be a value of *SMARTCARD_MSB_First*
- ***uint16_t SMARTCARD_AdvFeatureInitTypeDef::TxCompletionIndication***
  Specifies which transmission completion indication is used: before (when relevant flag is available) or once guard time period has elapsed. This parameter can be a value of *SMARTCARDEx_Transmission_Completion_Indication*.

67.1.3 __SMARTCARD_HandleTypeDef

__SMARTCARD_HandleTypeDef is defined in the stm32l4xx_hal_smartcard.h

Data Fields

- ***USART_TypeDef * Instance***
- ***SMARTCARD_InitTypeDef Init***
- ***SMARTCARD_AdvFeatureInitTypeDef AdvancedInit***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint16_t NbRxDataToProcess***
- ***uint16_t NbTxDataToProcess***
- ***uint32_t FifoMode***
- ***void(* RxISR***
- ***void(* TxISR***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SMARTCARD_StateTypeDef gState***
- ***__IO HAL_SMARTCARD_StateTypeDef RxState***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* __SMARTCARD_HandleTypeDef::Instance***
  USART registers base address
- ***SMARTCARD_InitTypeDef __SMARTCARD_HandleTypeDef::Init***
  SmartCard communication parameters

- ***SMARTCARD_AdvFeatureInitTypeDef __SMARTCARD_HandleTypeDef::AdvancedInit***
  SmartCard advanced features initialization parameters
- ***uint8_t* __SMARTCARD_HandleTypeDef::pTxBuffPtr***
  Pointer to SmartCard Tx transfer Buffer
- ***uint16_t __SMARTCARD_HandleTypeDef::TxXferSize***
  SmartCard Tx Transfer size
- ***__IO uint16_t __SMARTCARD_HandleTypeDef::TxXferCount***
  SmartCard Tx Transfer Counter
- ***uint8_t* __SMARTCARD_HandleTypeDef::pRxBuffPtr***
  Pointer to SmartCard Rx transfer Buffer
- ***uint16_t __SMARTCARD_HandleTypeDef::RxXferSize***
  SmartCard Rx Transfer size
- ***__IO uint16_t __SMARTCARD_HandleTypeDef::RxXferCount***
  SmartCard Rx Transfer Counter
- ***uint16_t __SMARTCARD_HandleTypeDef::NbRxDataToProcess***
  Number of data to process during RX ISR execution
- ***uint16_t __SMARTCARD_HandleTypeDef::NbTxDataToProcess***
  Number of data to process during TX ISR execution
- ***uint32_t __SMARTCARD_HandleTypeDef::FifoMode***
  Specifies if the FIFO mode will be used. This parameter can be a value of ***SMARTCARDEx_FIFO_mode***.
- ***void(* __SMARTCARD_HandleTypeDef::RxISR)(struct __SMARTCARD_HandleTypeDef *huart)***
  Function pointer on Rx IRQ handler
- ***void(* __SMARTCARD_HandleTypeDef::TxISR)(struct __SMARTCARD_HandleTypeDef *huart)***
  Function pointer on Tx IRQ handler
- ***DMA_HandleTypeDef* __SMARTCARD_HandleTypeDef::hdmatx***
  SmartCard Tx DMA Handle parameters
- ***DMA_HandleTypeDef* __SMARTCARD_HandleTypeDef::hdmarx***
  SmartCard Rx DMA Handle parameters
- ***HAL_LockTypeDef __SMARTCARD_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_SMARTCARD_StateTypeDef __SMARTCARD_HandleTypeDef::gState***
  SmartCard state information related to global Handle management and also related to Tx operations. This parameter can be a value of **HAL_SMARTCARD_StateTypeDef**
- ***__IO HAL_SMARTCARD_StateTypeDef __SMARTCARD_HandleTypeDef::RxState***
  SmartCard state information related to Rx operations. This parameter can be a value of **HAL_SMARTCARD_StateTypeDef**
- ***__IO uint32_t __SMARTCARD_HandleTypeDef::ErrorCode***
  SmartCard Error code

67.2 SMARTCARD Firmware driver API description

The following section lists the various functions of the SMARTCARD library.

67.2.1 How to use this driver

The SMARTCARD HAL driver can be used as follows:

1. Declare a SMARTCARD_HandleTypeDef handle structure (eg. SMARTCARD_HandleTypeDef hsmartcard).
2. Associate a USART to the SMARTCARD handle hsmartcard.

3. Initialize the SMARTCARD low level resources by implementing the HAL_SMARTCARD_MspInit() API:
   - Enable the USARTx interface clock.
   - USART pins configuration:
     - Enable the clock for the USART GPIOs.
     - Configure the USART pins (TX as alternate function pull-up, RX as alternate function Input).
   - NVIC configuration if you need to use interrupt process (HAL_SMARTCARD_Transmit_IT() and HAL_SMARTCARD_Receive_IT() APIs):
     - Configure the USARTx interrupt priority.
     - Enable the NVIC USART IRQ handle.
   - DMA Configuration if you need to use DMA process (HAL_SMARTCARD_Transmit_DMA() and HAL_SMARTCARD_Receive_DMA() APIs):
     - Declare a DMA handle structure for the Tx/Rx channel.
     - Enable the DMAx interface clock.
     - Configure the declared DMA handle structure with the required Tx/Rx parameters.
     - Configure the DMA Tx/Rx channel.
     - Associate the initialized DMA handle to the SMARTCARD DMA Tx/Rx handle.
     - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx channel.
4. Program the Baud Rate, Parity, Mode(Receiver/Transmitter), clock enabling/disabling and accordingly, the clock parameters (parity, phase, last bit), prescaler value, guard time and NACK on transmission error enabling or disabling in the hsmartcard handle Init structure.
5. If required, program SMARTCARD advanced features (TX/RX pins swap, TimeOut, auto-retry counter,...) in the hsmartcard handle AdvancedInit structure.
6. Initialize the SMARTCARD registers by calling the HAL_SMARTCARD_Init() API:
   - This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_SMARTCARD_MspInit() API.

Note: The specific SMARTCARD interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_SMARTCARD_ENABLE_IT() and __HAL_SMARTCARD_DISABLE_IT() inside the transmit and receive process.

Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_SMARTCARD_Transmit()
- Receive an amount of data in blocking mode using HAL_SMARTCARD_Receive()

Interrupt mode IO operation

- Send an amount of data in non-blocking mode using HAL_SMARTCARD_Transmit_IT()
- At transmission end of transfer HAL_SMARTCARD_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMARTCARD_TxCpltCallback()
- Receive an amount of data in non-blocking mode using HAL_SMARTCARD_Receive_IT()
- At reception end of transfer HAL_SMARTCARD_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMARTCARD_RxCpltCallback()
- In case of transfer Error, HAL_SMARTCARD_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SMARTCARD_ErrorCallback()

DMA mode IO operation

- Send an amount of data in non-blocking mode (DMA) using HAL_SMARTCARD_Transmit_DMA()
- At transmission end of transfer HAL_SMARTCARD_TxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMARTCARD_TxCpltCallback()
- Receive an amount of data in non-blocking mode (DMA) using HAL_SMARTCARD_Receive_DMA()

- At reception end of transfer HAL_SMARTCARD_RxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_SMARTCARD_RxCpltCallback()
- In case of transfer Error, HAL_SMARTCARD_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_SMARTCARD_ErrorCallback()

SMARTCARD HAL driver macros list

Below the list of most used macros in SMARTCARD HAL driver.

- __HAL_SMARTCARD_GET_FLAG : Check whether or not the specified SMARTCARD flag is set
- __HAL_SMARTCARD_CLEAR_FLAG : Clear the specified SMARTCARD pending flag
- __HAL_SMARTCARD_ENABLE_IT: Enable the specified SMARTCARD interrupt
- __HAL_SMARTCARD_DISABLE_IT: Disable the specified SMARTCARD interrupt
- __HAL_SMARTCARD_GET_IT_SOURCE: Check whether or not the specified SMARTCARD interrupt is enabled

Note: You can refer to the SMARTCARD HAL driver header file for more useful macros

67.2.2 Callback registration

The compilation define USE_HAL_SMARTCARD_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_SMARTCARD_RegisterCallback() to register a user callback. Function @ref HAL_SMARTCARD_RegisterCallback() allows to register following callbacks:

- TxCpltCallback : Tx Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- AbortTransmitCpltCallback : Abort Transmit Complete Callback.
- AbortReceiveCpltCallback : Abort Receive Complete Callback.
- RxFifoFullCallback : Rx Fifo Full Callback.
- TxFifoEmptyCallback : Tx Fifo Empty Callback.
- MspInitCallback : SMARTCARD MspInit.
- MspDeInitCallback : SMARTCARD MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_SMARTCARD_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_SMARTCARD_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- TxCpltCallback : Tx Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- AbortTransmitCpltCallback : Abort Transmit Complete Callback.
- AbortReceiveCpltCallback : Abort Receive Complete Callback.
- RxFifoFullCallback : Rx Fifo Full Callback.
- TxFifoEmptyCallback : Tx Fifo Empty Callback.
- MspInitCallback : SMARTCARD MspInit.
- MspDeInitCallback : SMARTCARD MspDeInit.

By default, after the @ref HAL_SMARTCARD_Init() and when the state is HAL_SMARTCARD_STATE_RESET all callbacks are set to the corresponding weak (surcharged) functions: examples @ref HAL_SMARTCARD_TxCpltCallback(), @ref HAL_SMARTCARD_RxCpltCallback(). Exception done for MspInit and MspDeInit functions that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_SMARTCARD_Init() and @ref HAL_SMARTCARD_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_SMARTCARD_Init() and @ref HAL_SMARTCARD_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_SMARTCARD_STATE_READY state only. Exception done MspInit/MspDeInit that can be registered/unregistered in HAL_SMARTCARD_STATE_READY or HAL_SMARTCARD_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_SMARTCARD_RegisterCallback() before calling @ref HAL_SMARTCARD_DeInit() or @ref HAL_SMARTCARD_Init() function.

When The compilation define USE_HAL_SMARTCARD_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and weak (surcharged) callbacks are used.

67.2.3 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx associated to the SmartCard.

- These parameters can be configured:
  - Baud Rate
  - Parity: parity should be enabled, frame Length is fixed to 8 bits plus parity
  - Receiver/transmitter modes
  - Synchronous mode (and if enabled, phase, polarity and last bit parameters)
  - Prescaler value
  - Guard bit time
  - NACK enabling or disabling on transmission error
- The following advanced features can be configured as well:
  - TX and/or RX pin level inversion
  - data logical level inversion
  - RX and TX pins swap
  - RX overrun detection disabling
  - DMA disabling on RX error
  - MSB first on communication line
  - Time out enabling (and if activated, timeout value)
  - Block length
  - Auto-retry counter

The HAL_SMARTCARD_Init() API follows the USART synchronous configuration procedures (details for the procedures are available in reference manual).

This section contains the following APIs:

- ***HAL_SMARTCARD_Init***
- ***HAL_SMARTCARD_DeInit***
- ***HAL_SMARTCARD_MspInit***
- ***HAL_SMARTCARD_MspDeInit***

67.2.4 IO operation functions

This subsection provides a set of functions allowing to manage the SMARTCARD data transfers.

Smartcard is a single wire half duplex communication protocol. The Smartcard interface is designed to support asynchronous protocol Smartcards as defined in the ISO 7816-3 standard. The USART should be configured as:

- 8 bits plus parity: where M=1 and PCE=1 in the USART_CR1 register
- 1.5 stop bits when transmitting and receiving: where STOP=11 in the USART_CR2 register.

(+) There are two modes of transfer: (++) Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer. (++) Non-Blocking mode: The communication is performed using Interrupts or DMA, the relevant API's return the HAL status. The end of the data processing will be indicated through the dedicated SMARTCARD IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. (++) The HAL_SMARTCARD_TxCpltCallback(), HAL_SMARTCARD_RxCpltCallback() user callbacks will be executed respectively at the end of the Transmit or Receive process The HAL_SMARTCARD_ErrorCallback() user callback will be executed when a communication error is detected. (+) Blocking mode APIs are : (++) HAL_SMARTCARD_Transmit() (++) HAL_SMARTCARD_Receive() (+) Non Blocking mode APIs with Interrupt are : (++) HAL_SMARTCARD_Transmit_IT() (++) HAL_SMARTCARD_Receive_IT() (++) HAL_SMARTCARD_IRQHandler() (+) Non Blocking mode functions with DMA are : (++) HAL_SMARTCARD_Transmit_DMA() (++) HAL_SMARTCARD_Receive_DMA() (+) A set of Transfer Complete Callbacks are provided in non Blocking mode: (++) HAL_SMARTCARD_TxCpltCallback() (++) HAL_SMARTCARD_RxCpltCallback() (++) HAL_SMARTCARD_ErrorCallback()

1. Non-Blocking mode transfers could be aborted using Abort API's : (+) HAL_SMARTCARD_Abort() (+) HAL_SMARTCARD_AbortTransmit() (+) HAL_SMARTCARD_AbortReceive() (+) HAL_SMARTCARD_Abort_IT() (+) HAL_SMARTCARD_AbortTransmit_IT() (+) HAL_SMARTCARD_AbortReceive_IT()
2. For Abort services based on interrupts (HAL_SMARTCARD_Abortxxx_IT), a set of Abort Complete Callbacks are provided: (+) HAL_SMARTCARD_AbortCpltCallback() (+) HAL_SMARTCARD_AbortTransmitCpltCallback() (+) HAL_SMARTCARD_AbortReceiveCpltCallback()
3. In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows : (+) Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_SMARTCARD_ErrorCallback() user callback is executed. Transfer is kept ongoing on SMARTCARD side. If user wants to abort it, Abort services should be called by user. (+) Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Frame Error in Interrupt mode tranmission, Overrun Error in Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_SMARTCARD_ErrorCallback() user callback is executed.

- There are two modes of transfer:
  - Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
  - Non-Blocking mode: The communication is performed using Interrupts or DMA, the relevant API's return the HAL status. The end of the data processing will be indicated through the dedicated SMARTCARD IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
  - The HAL_SMARTCARD_TxCpltCallback(), HAL_SMARTCARD_RxCpltCallback() user callbacks will be executed respectively at the end of the Transmit or Receive process The HAL_SMARTCARD_ErrorCallback() user callback will be executed when a communication error is detected.
- Blocking mode APIs are :
  - HAL_SMARTCARD_Transmit()
  - HAL_SMARTCARD_Receive()
- Non Blocking mode APIs with Interrupt are :
  - HAL_SMARTCARD_Transmit_IT()
  - HAL_SMARTCARD_Receive_IT()
  - HAL_SMARTCARD_IRQHandler()
- Non Blocking mode functions with DMA are :
  - HAL_SMARTCARD_Transmit_DMA()
  - HAL_SMARTCARD_Receive_DMA()
- A set of Transfer Complete Callbacks are provided in non Blocking mode:
  - HAL_SMARTCARD_TxCpltCallback()
  - HAL_SMARTCARD_RxCpltCallback()
  - HAL_SMARTCARD_ErrorCallback() (#) Non-Blocking mode transfers could be aborted using Abort API's :

- HAL_SMARTCARD_Abort()
- HAL_SMARTCARD_AbortTransmit()
- HAL_SMARTCARD_AbortReceive()
- HAL_SMARTCARD_Abort_IT()
- HAL_SMARTCARD_AbortTransmit_IT()
- HAL_SMARTCARD_AbortReceive_IT() (#) For Abort services based on interrupts (HAL_SMARTCARD_Abortxxx_IT), a set of Abort Complete Callbacks are provided:
- HAL_SMARTCARD_AbortCpltCallback()
- HAL_SMARTCARD_AbortTransmitCpltCallback()
- HAL_SMARTCARD_AbortReceiveCpltCallback() (#) In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows :
- Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_SMARTCARD_ErrorCallback() user callback is executed. Transfer is kept ongoing on SMARTCARD side. If user wants to abort it, Abort services should be called by user.
- Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Frame Error in Interrupt mode tranmission, Overrun Error in Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_SMARTCARD_ErrorCallback() user callback is executed.

This section contains the following APIs:

- ***HAL_SMARTCARD_Transmit***
- ***HAL_SMARTCARD_Receive***
- ***HAL_SMARTCARD_Transmit_IT***
- ***HAL_SMARTCARD_Receive_IT***
- ***HAL_SMARTCARD_Transmit_DMA***
- ***HAL_SMARTCARD_Receive_DMA***
- ***HAL_SMARTCARD_Abort***
- ***HAL_SMARTCARD_AbortTransmit***
- ***HAL_SMARTCARD_AbortReceive***
- ***HAL_SMARTCARD_Abort_IT***
- ***HAL_SMARTCARD_AbortTransmit_IT***
- ***HAL_SMARTCARD_AbortReceive_IT***
- ***HAL_SMARTCARD_IRQHandler***
- ***HAL_SMARTCARD_TxCpltCallback***
- ***HAL_SMARTCARD_RxCpltCallback***
- ***HAL_SMARTCARD_ErrorCallback***
- ***HAL_SMARTCARD_AbortCpltCallback***
- ***HAL_SMARTCARD_AbortTransmitCpltCallback***
- ***HAL_SMARTCARD_AbortReceiveCpltCallback***

67.2.5 Peripheral State and Errors functions

This subsection provides a set of functions allowing to return the State of SmartCard handle and also return Peripheral Errors occurred during communication process

- HAL_SMARTCARD_GetState() API can be helpful to check in run-time the state of the SMARTCARD peripheral.
- HAL_SMARTCARD_GetError() checks in run-time errors that could occur during communication.

This section contains the following APIs:

- ***HAL_SMARTCARD_GetState***
- ***HAL_SMARTCARD_GetError***

67.2.6 Detailed description of functions

`HAL_SMARTCARD_Init`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Init (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Initialize the SMARTCARD mode according to the specified parameters in the SMARTCARD_HandleTypeDef and initialize the associated handle.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

`HAL_SMARTCARD_DeInit`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_DeInit (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

DeInitialize the SMARTCARD peripheral.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

`HAL_SMARTCARD_MspInit`

Function name

void HAL_SMARTCARD_MspInit (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Initialize the SMARTCARD MSP.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_MspDeInit`

Function name

void HAL_SMARTCARD_MspDeInit (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

DeInitialize the SMARTCARD MSP.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_Transmit`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Transmit (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Send an amount of data in blocking mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be sent.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- When FIFO mode is enabled, writing a data in the TDR register adds one data to the TXFIFO. Write operations to the TDR register are performed when TXFNF flag is set. From hardware perspective, TXFNF flag and TXE are mapped on the same bit-field.

`HAL_SMARTCARD_Receive`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Receive (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be received.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- When FIFO mode is enabled, the RXFNE flag is set as long as the RXFIFO is not empty. Read operations from the RDR register are performed when RXFNE flag is set. From hardware perspective, RXFNE flag and RXNE are mapped on the same bit-field.

HAL_SMARTCARD_Transmit_IT

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Transmit_IT (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)

Function description

Send an amount of data in interrupt mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be sent.

Return values

- **HAL:** status

Notes

- When FIFO mode is disabled, USART interrupt is generated whenever USART_TDR register is empty, i.e one interrupt per data to transmit.
- When FIFO mode is enabled, USART interrupt is generated whenever TXFIFO threshold reached. In that case the interrupt rate depends on TXFIFO threshold configuration.
- This function sets the hsmartcard->TxIsr function pointer according to the FIFO mode (data transmission processing depends on FIFO mode).

HAL_SMARTCARD_Receive_IT

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Receive_IT (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in interrupt mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be received.

Return values

- **HAL:** status

Notes

- When FIFO mode is disabled, USART interrupt is generated whenever USART_RDR register can be read, i.e one interrupt per data to receive.
- When FIFO mode is enabled, USART interrupt is generated whenever RXFIFO threshold reached. In that case the interrupt rate depends on RXFIFO threshold configuration.
- This function sets the hsmartcard->RxIsr function pointer according to the FIFO mode (data reception processing depends on FIFO mode).

`HAL_SMARTCARD_Transmit_DMA`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Transmit_DMA (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)

Function description

Send an amount of data in DMA mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be sent.

Return values

- **HAL:** status

`HAL_SMARTCARD_Receive_DMA`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Receive_DMA (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in DMA mode.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **pData:** pointer to data buffer.
- **Size:** amount of data to be received.

Return values

- **HAL:** status

Notes

- The SMARTCARD-associated USART parity is enabled (PCE = 1), the received data contain the parity bit (MSB position).

`HAL_SMARTCARD_Abort`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Abort (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Abort ongoing transfers (blocking mode).

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_SMARTCARD_AbortTransmit`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_AbortTransmit (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Abort ongoing Transmit transfer (blocking mode).

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_SMARTCARD_AbortReceive`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_AbortReceive (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Abort ongoing Receive transfer (blocking mode).

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_SMARTCARD_Abort_IT`

Function name

HAL_StatusTypeDef HAL_SMARTCARD_Abort_IT (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Abort ongoing transfers (Interrupt mode).

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_SMARTCARD_AbortTransmit_IT

Function name

HAL_StatusTypeDef HAL_SMARTCARD_AbortTransmit_IT (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Abort ongoing Transmit transfer (Interrupt mode).

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_SMARTCARD_AbortReceive_IT

Function name

HAL_StatusTypeDef HAL_SMARTCARD_AbortReceive_IT (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Abort ongoing Receive transfer (Interrupt mode).

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable SMARTCARD Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

`HAL_SMARTCARD_IRQHandler`

Function name

void HAL_SMARTCARD_IRQHandler (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Handle SMARTCARD interrupt requests.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_TxCpltCallback`

Function name

void HAL_SMARTCARD_TxCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Tx Transfer completed callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_RxCpltCallback`

Function name

void HAL_SMARTCARD_RxCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Rx Transfer completed callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_ErrorCallback`

Function name

void HAL_SMARTCARD_ErrorCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

SMARTCARD error callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_AbortCpltCallback`

Function name

void HAL_SMARTCARD_AbortCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

SMARTCARD Abort Complete callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_AbortTransmitCpltCallback`

Function name

void HAL_SMARTCARD_AbortTransmitCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

SMARTCARD Abort Complete callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_AbortReceiveCpltCallback`

Function name

void HAL_SMARTCARD_AbortReceiveCpltCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

SMARTCARD Abort Receive Complete callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

`HAL_SMARTCARD_GetState`

Function name

HAL_SMARTCARD_StateTypeDef HAL_SMARTCARD_GetState (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Return the SMARTCARD handle state.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **SMARTCARD:** handle state

`HAL_SMARTCARD_GetError`

Function name

uint32_t HAL_SMARTCARD_GetError (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Return the SMARTCARD handle error code.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **SMARTCARD:** handle Error Code

67.3 SMARTCARD Firmware driver defines

The following section lists the various define and macros of the module.

67.3.1 SMARTCARD

SMARTCARD

Clock Prescaler

SMARTCARD_PRESCALER_DIV1

fclk_pres = fclk

SMARTCARD_PRESCALER_DIV2

fclk_pres = fclk/2

SMARTCARD_PRESCALER_DIV4

fclk_pres = fclk/4

SMARTCARD_PRESCALER_DIV6

fclk_pres = fclk/6

SMARTCARD_PRESCALER_DIV8

fclk_pres = fclk/8

SMARTCARD_PRESCALER_DIV10

fclk_pres = fclk/10

SMARTCARD_PRESCALER_DIV12

fclk_pres = fclk/12

SMARTCARD_PRESCALER_DIV16

fclk_pres = fclk/16

SMARTCARD_PRESCALER_DIV32

fclk_pres = fclk/32

SMARTCARD_PRESCALER_DIV64

fclk_pres = fclk/64

SMARTCARD_PRESCALER_DIV128

fclk_pres = fclk/128

SMARTCARD_PRESCALER_DIV256

fclk_pres = fclk/256

SMARTCARD Clock Phase

SMARTCARD_PHASE_1EDGE

SMARTCARD frame phase on first clock transition

SMARTCARD_PHASE_2EDGE

SMARTCARD frame phase on second clock transition

SMARTCARD Clock Polarity

SMARTCARD_POLARITY_LOW

SMARTCARD frame low polarity

SMARTCARD_POLARITY_HIGH

SMARTCARD frame high polarity

SMARTCARD advanced feature Binary Data inversion

SMARTCARD_ADVFEATURE_DATAINV_DISABLE

Binary data inversion disable

SMARTCARD_ADVFEATURE_DATAINV_ENABLE

Binary data inversion enable

SMARTCARD advanced feature DMA Disable on Rx Error

SMARTCARD_ADVFEATURE_DMA_ENABLEONRXERROR

DMA enable on Reception Error

SMARTCARD_ADVFEATURE_DMA_DISABLEONRXERROR

DMA disable on Reception Error

SMARTCARD Error Code Definition

HAL_SMARTCARD_ERROR_NONE

No error

HAL_SMARTCARD_ERROR_PE

Parity error

HAL_SMARTCARD_ERROR_NE

Noise error

HAL_SMARTCARD_ERROR_FE

frame error

HAL_SMARTCARD_ERROR_ORE

Overrun error

HAL_SMARTCARD_ERROR_DMA

DMA transfer error

HAL_SMARTCARD_ERROR_RTO

Receiver TimeOut error

SMARTCARD Exported Macros

__HAL_SMARTCARD_RESET_HANDLE_STATE

Description:

- Reset SMARTCARD handle states.

Parameters:

- __HANDLE__: SMARTCARD handle.

Return value:

- None

__HAL_SMARTCARD_FLUSH_DRREGISTER

Description:

- Flush the Smartcard Data registers.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_CLEAR_FLAG

Description:

- Clear the specified SMARTCARD pending flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - SMARTCARD_CLEAR_PEF Parity error clear flag
  - SMARTCARD_CLEAR_FEF Framing error clear flag
  - SMARTCARD_CLEAR_NEF Noise detected clear flag
  - SMARTCARD_CLEAR_OREF OverRun error clear flag
  - SMARTCARD_CLEAR_IDLEF Idle line detected clear flag
  - SMARTCARD_CLEAR_TCF Transmission complete clear flag
  - SMARTCARD_CLEAR_TCBGTF Transmission complete before guard time clear flag
  - SMARTCARD_CLEAR_RTOF Receiver timeout clear flag
  - SMARTCARD_CLEAR_EOBF End of block clear flag #if defined(USART_CR1_FIFOEN)
  - SMARTCARD_CLEAR_TXFECF TXFIFO empty Clear flag #endif

Return value:

- None

__HAL_SMARTCARD_CLEAR_PEFLAG

Description:

- Clear the SMARTCARD PE pending flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_CLEAR_FEFLAG

Description:

- Clear the SMARTCARD FE pending flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_CLEAR_NEFLAG

Description:

- Clear the SMARTCARD NE pending flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_CLEAR_OREFLAG

Description:

- Clear the SMARTCARD ORE pending flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_CLEAR_IDLEFLAG

Description:

- Clear the SMARTCARD IDLE pending flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_GET_FLAG

Description:

- Check whether the specified Smartcard flag is set or not.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SMARTCARD_FLAG_TCBGT Transmission complete before guard time flag (when flag available)
  - SMARTCARD_FLAG_REACK Receive enable acknowledge flag
  - SMARTCARD_FLAG_TEACK Transmit enable acknowledge flag
  - SMARTCARD_FLAG_BUSY Busy flag
  - SMARTCARD_FLAG_EOBF End of block flag
  - SMARTCARD_FLAG_RTOF Receiver timeout flag
  - SMARTCARD_FLAG_TXE Transmit data register empty flag
  - SMARTCARD_FLAG_TC Transmission complete flag
  - SMARTCARD_FLAG_RXNE Receive data register not empty flag
  - SMARTCARD_FLAG_IDLE Idle line detection flag
  - SMARTCARD_FLAG_ORE Overrun error flag
  - SMARTCARD_FLAG_NE Noise error flag
  - SMARTCARD_FLAG_FE Framing error flag
  - SMARTCARD_FLAG_PE Parity error flag
  - SMARTCARD_FLAG_TXFNF TXFIFO not full flag
  - SMARTCARD_FLAG_RXFNE RXFIFO not empty flag
  - SMARTCARD_FLAG_TXFE TXFIFO Empty flag
  - SMARTCARD_FLAG_RXFF RXFIFO Full flag
  - SMARTCARD_FLAG_RXFT SMARTCARD RXFIFO threshold flag
  - SMARTCARD_FLAG_TXFT SMARTCARD TXFIFO threshold flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_SMARTCARD_ENABLE_IT

Description:

- Enable the specified SmartCard interrupt.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __INTERRUPT__: specifies the SMARTCARD interrupt to enable. This parameter can be one of the following values:
  - SMARTCARD_IT_EOB End of block interrupt
  - SMARTCARD_IT_RTO Receive timeout interrupt
  - SMARTCARD_IT_TXE Transmit data register empty interrupt
  - SMARTCARD_IT_TC Transmission complete interrupt
  - SMARTCARD_IT_TCBGT Transmission complete before guard time interrupt (when interruption available)
  - SMARTCARD_IT_RXNE Receive data register not empty interrupt
  - SMARTCARD_IT_IDLE Idle line detection interrupt
  - SMARTCARD_IT_PE Parity error interrupt
  - SMARTCARD_IT_ERR Error interrupt(frame error, noise error, overrun error)
  - SMARTCARD_IT_TXFNF TX FIFO not full interruption
  - SMARTCARD_IT_RXFNE RXFIFO not empty interruption
  - SMARTCARD_IT_RXFF RXFIFO full interruption
  - SMARTCARD_IT_TXFE TXFIFO empty interruption
  - SMARTCARD_IT_RXFT RXFIFO threshold reached interruption
  - SMARTCARD_IT_TXFT TXFIFO threshold reached interruption

Return value:

- None

__HAL_SMARTCARD_DISABLE_IT

Description:

- Disable the specified SmartCard interrupt.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __INTERRUPT__: specifies the SMARTCARD interrupt to disable. This parameter can be one of the following values:
  - SMARTCARD_IT_EOB End of block interrupt
  - SMARTCARD_IT_RTO Receive timeout interrupt
  - SMARTCARD_IT_TXE Transmit data register empty interrupt
  - SMARTCARD_IT_TC Transmission complete interrupt
  - SMARTCARD_IT_TCBGT Transmission complete before guard time interrupt (when interruption available)
  - SMARTCARD_IT_RXNE Receive data register not empty interrupt
  - SMARTCARD_IT_IDLE Idle line detection interrupt
  - SMARTCARD_IT_PE Parity error interrupt
  - SMARTCARD_IT_ERR Error interrupt(frame error, noise error, overrun error)
  - SMARTCARD_IT_TXFNF TX FIFO not full interruption
  - SMARTCARD_IT_RXFNE RXFIFO not empty interruption
  - SMARTCARD_IT_RXFF RXFIFO full interruption
  - SMARTCARD_IT_TXFE TXFIFO empty interruption
  - SMARTCARD_IT_RXFT RXFIFO threshold reached interruption
  - SMARTCARD_IT_TXFT TXFIFO threshold reached interruption

Return value:

- None

__HAL_SMARTCARD_GET_IT

Description:

- Check whether the specified SmartCard interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __INTERRUPT__: specifies the SMARTCARD interrupt to check. This parameter can be one of the following values:
  - SMARTCARD_IT_EOB End of block interrupt
  - SMARTCARD_IT_RTO Receive timeout interrupt
  - SMARTCARD_IT_TXE Transmit data register empty interrupt
  - SMARTCARD_IT_TC Transmission complete interrupt
  - SMARTCARD_IT_TCBGT Transmission complete before guard time interrupt (when interruption available)
  - SMARTCARD_IT_RXNE Receive data register not empty interrupt
  - SMARTCARD_IT_IDLE Idle line detection interrupt
  - SMARTCARD_IT_PE Parity error interrupt
  - SMARTCARD_IT_ERR Error interrupt(frame error, noise error, overrun error)
  - SMARTCARD_IT_TXFNF TX FIFO not full interruption
  - SMARTCARD_IT_RXFNE RXFIFO not empty interruption
  - SMARTCARD_IT_RXFF RXFIFO full interruption
  - SMARTCARD_IT_TXFE TXFIFO empty interruption
  - SMARTCARD_IT_RXFT RXFIFO threshold reached interruption
  - SMARTCARD_IT_TXFT TXFIFO threshold reached interruption

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_SMARTCARD_GET_IT_SOURCE

Description:

- Check whether the specified SmartCard interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __INTERRUPT__: specifies the SMARTCARD interrupt source to check. This parameter can be one of the following values:
  - SMARTCARD_IT_EOB End of block interrupt
  - SMARTCARD_IT_RTO Receive timeout interrupt
  - SMARTCARD_IT_TXE Transmit data register empty interrupt
  - SMARTCARD_IT_TC Transmission complete interrupt
  - SMARTCARD_IT_TCBGT Transmission complete before guard time interrupt (when interruption available)
  - SMARTCARD_IT_RXNE Receive data register not empty interrupt
  - SMARTCARD_IT_IDLE Idle line detection interrupt
  - SMARTCARD_IT_PE Parity error interrupt
  - SMARTCARD_IT_ERR Error interrupt(frame error, noise error, overrun error)
  - SMARTCARD_IT_TXFNF TX FIFO not full interruption
  - SMARTCARD_IT_RXFNE RXFIFO not empty interruption
  - SMARTCARD_IT_RXFF RXFIFO full interruption
  - SMARTCARD_IT_TXFE TXFIFO empty interruption
  - SMARTCARD_IT_RXFT RXFIFO threshold reached interruption
  - SMARTCARD_IT_TXFT TXFIFO threshold reached interruption

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_SMARTCARD_CLEAR_IT

Description:

- Clear the specified SMARTCARD ISR flag, in setting the proper ICR register flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __IT_CLEAR__: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt. This parameter can be one of the following values:
  - SMARTCARD_CLEAR_PEF Parity error clear flag
  - SMARTCARD_CLEAR_FEF Framing error clear flag
  - SMARTCARD_CLEAR_NEF Noise detected clear flag
  - SMARTCARD_CLEAR_OREF OverRun error clear flag
  - SMARTCARD_CLEAR_IDLEF Idle line detection clear flag
  - SMARTCARD_CLEAR_TXFECF TXFIFO empty Clear Flag
  - SMARTCARD_CLEAR_TCF Transmission complete clear flag
  - SMARTCARD_CLEAR_TCBGTF Transmission complete before guard time clear flag (when flag available)
  - SMARTCARD_CLEAR_RTOF Receiver timeout clear flag
  - SMARTCARD_CLEAR_EOBF End of block clear flag

Return value:

- None

__HAL_SMARTCARD_SEND_REQ

Description:

- Set a specific SMARTCARD request flag.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.
- __REQ__: specifies the request flag to set This parameter can be one of the following values:
  - SMARTCARD_RXDATA_FLUSH_REQUEST Receive data flush Request
  - SMARTCARD_TXDATA_FLUSH_REQUEST Transmit data flush Request

Return value:

- None

__HAL_SMARTCARD_ONE_BIT_SAMPLE_ENABLE

Description:

- Enable the SMARTCARD one bit sample method.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_ONE_BIT_SAMPLE_DISABLE

Description:

- Disable the SMARTCARD one bit sample method.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_ENABLE

Description:

- Enable the USART associated to the SMARTCARD Handle.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

__HAL_SMARTCARD_DISABLE

Description:

- Disable the USART associated to the SMARTCARD Handle.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle.

Return value:

- None

SMARTCARD interruptions flags mask

SMARTCARD_IT_MASK

SMARTCARD interruptions flags mask

SMARTCARD_CR_MASK

SMARTCARD control register mask

SMARTCARD_CR_POS

SMARTCARD control register position

SMARTCARD_ISR_MASK

SMARTCARD ISR register mask

SMARTCARD_ISR_POS

SMARTCARD ISR register position

SMARTCARD Last Bit

SMARTCARD_LASTBIT_DISABLE

SMARTCARD frame last data bit clock pulse not output to SCLK pin

SMARTCARD_LASTBIT_ENABLE

SMARTCARD frame last data bit clock pulse output to SCLK pin

SMARTCARD Transfer Mode

SMARTCARD_MODE_RX

SMARTCARD RX mode

SMARTCARD_MODE_TX

SMARTCARD TX mode

SMARTCARD_MODE_TX_RX

SMARTCARD RX and TX mode

SMARTCARD advanced feature MSB first

SMARTCARD_ADVFEATURE_MSBFIRST_DISABLE

Most significant bit sent/received first disable

SMARTCARD_ADVFEATURE_MSBFIRST_ENABLE

Most significant bit sent/received first enable

SMARTCARD NACK Enable

SMARTCARD_NACK_DISABLE

SMARTCARD NACK transmission disabled

SMARTCARD_NACK_ENABLE

SMARTCARD NACK transmission enabled

SMARTCARD One Bit Sampling Method

SMARTCARD_ONE_BIT_SAMPLE_DISABLE

SMARTCARD frame one-bit sample disabled

SMARTCARD_ONE_BIT_SAMPLE_ENABLE

SMARTCARD frame one-bit sample enabled

SMARTCARD advanced feature Overrun Disable

SMARTCARD_ADVFEATURE_OVERRUN_ENABLE

RX overrun enable

SMARTCARD_ADVFEATURE_OVERRUN_DISABLE

RX overrun disable

SMARTCARD Parity

SMARTCARD_PARITY_EVEN

SMARTCARD frame even parity

SMARTCARD_PARITY_ODD

SMARTCARD frame odd parity

SMARTCARD Request Parameters

SMARTCARD_RXDATA_FLUSH_REQUEST

Receive data flush request

SMARTCARD_TXDATA_FLUSH_REQUEST

Transmit data flush request

SMARTCARD advanced feature RX pin active level inversion

SMARTCARD_ADVFEATURE_RXINV_DISABLE

RX pin active level inversion disable

SMARTCARD_ADVFEATURE_RXINV_ENABLE

RX pin active level inversion enable

SMARTCARD advanced feature RX TX pins swap

SMARTCARD_ADVFEATURE_SWAP_DISABLE

TX/RX pins swap disable

SMARTCARD_ADVFEATURE_SWAP_ENABLE

TX/RX pins swap enable

SMARTCARD State Code Definition

HAL_SMARTCARD_STATE_RESET

Peripheral is not initialized Value is allowed for gState and RxState

HAL_SMARTCARD_STATE_READY

Peripheral Initialized and ready for use Value is allowed for gState and RxState

HAL_SMARTCARD_STATE_BUSY

an internal process is ongoing Value is allowed for gState only

HAL_SMARTCARD_STATE_BUSY_TX

Data Transmission process is ongoing Value is allowed for gState only

HAL_SMARTCARD_STATE_BUSY_RX

Data Reception process is ongoing Value is allowed for RxState only

HAL_SMARTCARD_STATE_BUSY_TX_RX

Data Transmission and Reception process is ongoing Not to be used for neither gState nor RxState. Value is result of combination (Or) between gState and RxState values

HAL_SMARTCARD_STATE_TIMEOUT

Timeout state Value is allowed for gState only

HAL_SMARTCARD_STATE_ERROR

Error Value is allowed for gState only

SMARTCARD Number of Stop Bits

SMARTCARD_STOPBITS_0_5

SMARTCARD frame with 0.5 stop bit

SMARTCARD_STOPBITS_1_5

SMARTCARD frame with 1.5 stop bits

SMARTCARD Timeout Enable

SMARTCARD_TIMEOUT_DISABLE

SMARTCARD receiver timeout disabled

SMARTCARD_TIMEOUT_ENABLE

SMARTCARD receiver timeout enabled

SMARTCARD advanced feature TX pin active level inversion

SMARTCARD_ADVFEATURE_TXINV_DISABLE

TX pin active level inversion disable

SMARTCARD_ADVFEATURE_TXINV_ENABLE

TX pin active level inversion enable

SMARTCARD Word Length

SMARTCARD_WORDLENGTH_9B

SMARTCARD frame length

68 HAL SMARTCARD Extension Driver

68.1 SMARTCARDEx Firmware driver API description

The following section lists the various functions of the SMARTCARDEx library.

68.1.1 SMARTCARD peripheral extended features

The Extended SMARTCARD HAL driver can be used as follows:

1. After having configured the SMARTCARD basic features with HAL_SMARTCARD_Init(), then program SMARTCARD advanced features if required (TX/RX pins swap, TimeOut, auto-retry counter,...) in the hsmartcard AdvancedInit structure.
2. FIFO mode enabling/disabling and RX/TX FIFO threshold programming.

Note: When SMARTCARD operates in FIFO mode, FIFO mode must be enabled prior starting RX/TX transfers. Also RX/TX FIFO thresholds must be configured prior starting RX/TX transfers.

68.1.2 Peripheral Control functions

This subsection provides a set of functions allowing to control the SMARTCARD.

- HAL_SMARTCARDEx_EnableFifoMode() API enables the FIFO mode
- HAL_SMARTCARDEx_DisableFifoMode() API disables the FIFO mode
- HAL_SMARTCARDEx_SetTxFifoThreshold() API sets the TX FIFO threshold
- HAL_SMARTCARDEx_SetRxFifoThreshold() API sets the RX FIFO threshold

This section contains the following APIs:

- ***HAL_SMARTCARDEx_EnableFifoMode***
- ***HAL_SMARTCARDEx_DisableFifoMode***
- ***HAL_SMARTCARDEx_SetTxFifoThreshold***
- ***HAL_SMARTCARDEx_SetRxFifoThreshold***

68.1.3 IO operation functions

This subsection provides a set of FIFO mode related callback functions.

1. TX/RX Fifos Callbacks: (+) HAL_SMARTCARDEx_RxFifoFullCallback() (+) HAL_SMARTCARDEx_TxFifoEmptyCallback()

This subsection provides a set of FIFO mode related callback functions. (#) TX/RX Fifos Callbacks:

- HAL_SMARTCARDEx_RxFifoFullCallback()
- HAL_SMARTCARDEx_TxFifoEmptyCallback()

This section contains the following APIs:

- ***HAL_SMARTCARDEx_RxFifoFullCallback***
- ***HAL_SMARTCARDEx_TxFifoEmptyCallback***

68.1.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the SMARTCARD.

- HAL_SMARTCARDEx_EnableFifoMode() API enables the FIFO mode
- HAL_SMARTCARDEx_DisableFifoMode() API disables the FIFO mode
- HAL_SMARTCARDEx_SetTxFifoThreshold() API sets the TX FIFO threshold
- HAL_SMARTCARDEx_SetRxFifoThreshold() API sets the RX FIFO threshold

This section contains the following APIs:

- ***HAL_SMARTCARDEx_EnableFifoMode***
- ***HAL_SMARTCARDEx_DisableFifoMode***
- ***HAL_SMARTCARDEx_SetTxFifoThreshold***

- *HAL_SMARTCARDEx_SetRxFifoThreshold*

68.1.5 Detailed description of functions

`HAL_SMARTCARDEx_BlockLength_Config`

Function name

void HAL_SMARTCARDEx_BlockLength_Config (SMARTCARD_HandleTypeDef * hsmartcard, uint8_t BlockLength)

Function description

Update on the fly the SMARTCARD block length in RTOR register.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **BlockLength:** SMARTCARD block length (8-bit long at most)

Return values

- **None:**

`HAL_SMARTCARDEx_TimeOut_Config`

Function name

void HAL_SMARTCARDEx_TimeOut_Config (SMARTCARD_HandleTypeDef * hsmartcard, uint32_t TimeOutValue)

Function description

Update on the fly the receiver timeout value in RTOR register.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.
- **TimeOutValue:** receiver timeout value in number of baud blocks. The timeout value must be less or equal to 0x0FFFFFFFF.

Return values

- **None:**

`HAL_SMARTCARDEx_EnableReceiverTimeOut`

Function name

HAL_StatusTypeDef HAL_SMARTCARDEx_EnableReceiverTimeOut (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Enable the SMARTCARD receiver timeout feature.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

HAL_SMARTCARDEx_DisableReceiverTimeOut

Function name

HAL_StatusTypeDef HAL_SMARTCARDEx_DisableReceiverTimeOut (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Disable the SMARTCARD receiver timeout feature.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **HAL:** status

HAL_SMARTCARDEx_RxFifoFullCallback

Function name

void HAL_SMARTCARDEx_RxFifoFullCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

SMARTCARD RX Fifo full callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

HAL_SMARTCARDEx_TxFifoEmptyCallback

Function name

void HAL_SMARTCARDEx_TxFifoEmptyCallback (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

SMARTCARD TX Fifo empty callback.

Parameters

- **hsmartcard:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values

- **None:**

HAL_SMARTCARDEx_EnableFifoMode

Function name

HAL_StatusTypeDef HAL_SMARTCARDEx_EnableFifoMode (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Enable the FIFO mode.

Parameters

- **hsmartcard:** SMARTCARD handle.

Return values

- **HAL:** status

`HAL_SMARTCARDEx_DisableFifoMode`

Function name

HAL_StatusTypeDef HAL_SMARTCARDEx_DisableFifoMode (SMARTCARD_HandleTypeDef * hsmartcard)

Function description

Disable the FIFO mode.

Parameters

- **hsmartcard:** SMARTCARD handle.

Return values

- **HAL:** status

`HAL_SMARTCARDEx_SetTxFifoThreshold`

Function name

HAL_StatusTypeDef HAL_SMARTCARDEx_SetTxFifoThreshold (SMARTCARD_HandleTypeDef * hsmartcard, uint32_t Threshold)

Function description

Set the TXFIFO threshold.

Parameters

- **hsmartcard:** SMARTCARD handle.
- **Threshold:** TX FIFO threshold value This parameter can be one of the following values:
  - SMARTCARD_TXFIFO_THRESHOLD_1_8
  - SMARTCARD_TXFIFO_THRESHOLD_1_4
  - SMARTCARD_TXFIFO_THRESHOLD_1_2
  - SMARTCARD_TXFIFO_THRESHOLD_3_4
  - SMARTCARD_TXFIFO_THRESHOLD_7_8
  - SMARTCARD_TXFIFO_THRESHOLD_8_8

Return values

- **HAL:** status

`HAL_SMARTCARDEx_SetRxFifoThreshold`

Function name

HAL_StatusTypeDef HAL_SMARTCARDEx_SetRxFifoThreshold (SMARTCARD_HandleTypeDef * hsmartcard, uint32_t Threshold)

Function description

Set the RXFIFO threshold.

Parameters

- **hsmartcard:** SMARTCARD handle.
- **Threshold:** RX FIFO threshold value This parameter can be one of the following values:
  - SMARTCARD_RXFIFO_THRESHOLD_1_8
  - SMARTCARD_RXFIFO_THRESHOLD_1_4
  - SMARTCARD_RXFIFO_THRESHOLD_1_2
  - SMARTCARD_RXFIFO_THRESHOLD_3_4
  - SMARTCARD_RXFIFO_THRESHOLD_7_8
  - SMARTCARD_RXFIFO_THRESHOLD_8_8

Return values

- **HAL:** status

68.2 SMARTCARDEx Firmware driver defines

The following section lists the various define and macros of the module.

68.2.1 SMARTCARDEx

SMARTCARDEx

SMARTCARD advanced feature initialization type

SMARTCARD_ADVFEATURE_NO_INIT

No advanced feature initialization

SMARTCARD_ADVFEATURE_TXINVERT_INIT

TX pin active level inversion

SMARTCARD_ADVFEATURE_RXINVERT_INIT

RX pin active level inversion

SMARTCARD_ADVFEATURE_DATAINVERT_INIT

Binary data inversion

SMARTCARD_ADVFEATURE_SWAP_INIT

TX/RX pins swap

SMARTCARD_ADVFEATURE_RXOVERRUNDISABLE_INIT

RX overrun disable

SMARTCARD_ADVFEATURE_DMADISABLEONERROR_INIT

DMA disable on Reception Error

SMARTCARD_ADVFEATURE_MSBFIRST_INIT

Most significant bit sent/received first

SMARTCARD_ADVFEATURE_TXCOMPLETION

TX completion indication before of after guard time

SMARTCARDEx FIFO mode

SMARTCARD_FIFOMODE_DISABLE

FIFO mode disable

SMARTCARD_FIFOMODE_ENABLE

FIFO mode enable

SMARTCARD Flags

SMARTCARD_FLAG_TCBGT

SMARTCARD transmission complete before guard time completion

SMARTCARD_FLAG_REACK

SMARTCARD receive enable acknowledge flag

SMARTCARD_FLAG_TEACK

SMARTCARD transmit enable acknowledge flag

SMARTCARD_FLAG_BUSY

SMARTCARD busy flag

SMARTCARD_FLAG_EOBF

SMARTCARD end of block flag

SMARTCARD_FLAG_RTOF

SMARTCARD receiver timeout flag

SMARTCARD_FLAG_TXE

SMARTCARD transmit data register empty

SMARTCARD_FLAG_TXFNF

SMARTCARD TXFIFO not full

SMARTCARD_FLAG_TC

SMARTCARD transmission complete

SMARTCARD_FLAG_RXNE

SMARTCARD read data register not empty

SMARTCARD_FLAG_RXFNE

SMARTCARD RXFIFO not empty

SMARTCARD_FLAG_IDLE

SMARTCARD idle line detection

SMARTCARD_FLAG_ORE

SMARTCARD overrun error

SMARTCARD_FLAG_NE

SMARTCARD noise error

SMARTCARD_FLAG_FE

SMARTCARD frame error

SMARTCARD_FLAG_PE

SMARTCARD parity error

SMARTCARD_FLAG_TXFE

SMARTCARD TXFIFO Empty flag

SMARTCARD_FLAG_RXFF

SMARTCARD RXFIFO Full flag

SMARTCARD_FLAG_RXFT

SMARTCARD RXFIFO threshold flag

SMARTCARD_FLAG_TXFT

SMARTCARD TXFIFO threshold flag

SMARTCARD Interrupts Definition

SMARTCARD_IT_PE

SMARTCARD parity error interruption

SMARTCARD_IT_TXE

SMARTCARD transmit data register empty interruption

SMARTCARD_IT_TXFNF

SMARTCARD TX FIFO not full interruption

SMARTCARD_IT_TC

SMARTCARD transmission complete interruption

SMARTCARD_IT_RXNE

SMARTCARD read data register not empty interruption

SMARTCARD_IT_RXFNE

SMARTCARD RXFIFO not empty interruption

SMARTCARD_IT_IDLE

SMARTCARD idle line detection interruption

SMARTCARD_IT_ERR

SMARTCARD error interruption

SMARTCARD_IT_ORE

SMARTCARD overrun error interruption

SMARTCARD_IT_NE

SMARTCARD noise error interruption

SMARTCARD_IT_FE

SMARTCARD frame error interruption

SMARTCARD_IT_EOB

SMARTCARD end of block interruption

SMARTCARD_IT_RTO

SMARTCARD receiver timeout interruption

SMARTCARD_IT_TCBGT

SMARTCARD transmission complete before guard time completion interruption

SMARTCARD_IT_RXFF

SMARTCARD RXFIFO full interruption

SMARTCARD_IT_TXFE

SMARTCARD TXFIFO empty interruption

SMARTCARD_IT_RXFT

SMARTCARD RXFIFO threshold reached interruption

SMARTCARD_IT_TXFT

SMARTCARD TXFIFO threshold reached interruption

SMARTCARD Interruption Clear Flags

SMARTCARD_CLEAR_PEF

SMARTCARD parity error clear flag

SMARTCARD_CLEAR_FEF

SMARTCARD framing error clear flag

SMARTCARD_CLEAR_NEF

SMARTCARD noise error detected clear flag

SMARTCARD_CLEAR_OREF

SMARTCARD overrun error clear flag

SMARTCARD_CLEAR_IDLEF

SMARTCARD idle line detected clear flag

SMARTCARD_CLEAR_TXFECF

TXFIFO empty Clear Flag

SMARTCARD_CLEAR_TCF

SMARTCARD transmission complete clear flag

SMARTCARD_CLEAR_TCBGTF

SMARTCARD transmission complete before guard time completion clear flag

SMARTCARD_CLEAR_RTOF

SMARTCARD receiver time out clear flag

SMARTCARD_CLEAR_EOBF

SMARTCARD end of block clear flag

SMARTCARDEx RXFIFO threshold level

SMARTCARD_RXFIFO_THRESHOLD_1_8

RXFIFO FIFO reaches 1/8 of its depth

SMARTCARD_RXFIFO_THRESHOLD_1_4

RXFIFO FIFO reaches 1/4 of its depth

SMARTCARD_RXFIFO_THRESHOLD_1_2

RXFIFO FIFO reaches 1/2 of its depth

SMARTCARD_RXFIFO_THRESHOLD_3_4

RXFIFO FIFO reaches 3/4 of its depth

SMARTCARD_RXFIFO_THRESHOLD_7_8

RXFIFO FIFO reaches 7/8 of its depth

SMARTCARD_RXFIFO_THRESHOLD_8_8

RXFIFO FIFO becomes full

SMARTCARD Transmission Completion Indication

SMARTCARD_TCBGT

SMARTCARD transmission complete before guard time

SMARTCARD_TC

SMARTCARD transmission complete (flag raised when guard time has elapsed)

SMARTCARDEx TXFIFO threshold level

SMARTCARD_TXFIFO_THRESHOLD_1_8

TXFIFO reaches 1/8 of its depth

SMARTCARD_TXFIFO_THRESHOLD_1_4

TXFIFO reaches 1/4 of its depth

SMARTCARD_TXFIFO_THRESHOLD_1_2

TXFIFO reaches 1/2 of its depth

SMARTCARD_TXFIFO_THRESHOLD_3_4

TXFIFO reaches 3/4 of its depth

SMARTCARD_TXFIFO_THRESHOLD_7_8

TXFIFO reaches 7/8 of its depth

SMARTCARD_TXFIFO_THRESHOLD_8_8

TXFIFO becomes empty

69 HAL SMBUS Generic Driver

69.1 SMBUS Firmware driver registers structures

69.1.1 SMBUS_InitTypeDef

SMBUS_InitTypeDef is defined in the stm32l4xx_hal_smbus.h

Data Fields

- ***uint32_t Timing***
- ***uint32_t AnalogFilter***
- ***uint32_t OwnAddress1***
- ***uint32_t AddressingMode***
- ***uint32_t DualAddressMode***
- ***uint32_t OwnAddress2***
- ***uint32_t OwnAddress2Masks***
- ***uint32_t GeneralCallMode***
- ***uint32_t NoStretchMode***
- ***uint32_t PacketErrorCheckMode***
- ***uint32_t PeripheralMode***
- ***uint32_t SMBusTimeout***

Field Documentation

- ***uint32_t SMBUS_InitTypeDef::Timing***

  Specifies the SMBUS_TIMINGR_register value. This parameter calculated by referring to SMBUS initialization section in Reference manual
- ***uint32_t SMBUS_InitTypeDef::AnalogFilter***

  Specifies if Analog Filter is enable or not. This parameter can be a value of ***SMBUS_Analog_Filter***
- ***uint32_t SMBUS_InitTypeDef::OwnAddress1***

  Specifies the first device own address. This parameter can be a 7-bit or 10-bit address.
- ***uint32_t SMBUS_InitTypeDef::AddressingMode***

  Specifies if 7-bit or 10-bit addressing mode for master is selected. This parameter can be a value of ***SMBUS_addressing_mode***
- ***uint32_t SMBUS_InitTypeDef::DualAddressMode***

  Specifies if dual addressing mode is selected. This parameter can be a value of ***SMBUS_dual_addressing_mode***
- ***uint32_t SMBUS_InitTypeDef::OwnAddress2***

  Specifies the second device own address if dual addressing mode is selected This parameter can be a 7-bit address.
- ***uint32_t SMBUS_InitTypeDef::OwnAddress2Masks***

  Specifies the acknoledge mask address second device own address if dual addressing mode is selected This parameter can be a value of ***SMBUS_own_address2_masks***.
- ***uint32_t SMBUS_InitTypeDef::GeneralCallMode***

  Specifies if general call mode is selected. This parameter can be a value of ***SMBUS_general_call_addressing_mode***.
- ***uint32_t SMBUS_InitTypeDef::NoStretchMode***

  Specifies if nostretch mode is selected. This parameter can be a value of ***SMBUS_nostretch_mode***
- ***uint32_t SMBUS_InitTypeDef::PacketErrorCheckMode***

  Specifies if Packet Error Check mode is selected. This parameter can be a value of ***SMBUS_packet_error_check_mode***

- ***uint32_t SMBUS_InitTypeDef::PeripheralMode***
  Specifies which mode of Periphal is selected. This parameter can be a value of ***SMBUS_peripheral_mode***
- ***uint32_t SMBUS_InitTypeDef::SMBusTimeout***
  Specifies the content of the 32 Bits SMBUS_TIMEOUT_register value. (Enable bits and different timeout values) This parameter calculated by referring to SMBUS initialization section in Reference manual

69.1.2 __SMBUS_HandleTypeDef

__SMBUS_HandleTypeDef is defined in the stm32l4xx_hal_smbus.h

Data Fields

- ***I2C_TypeDef * Instance***
- ***SMBUS_InitTypeDef Init***
- ***uint8_t * pBuffPtr***
- ***uint16_t XferSize***
- ***__IO uint16_t XferCount***
- ***__IO uint32_t XferOptions***
- ***__IO uint32_t PreviousState***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***I2C_TypeDef* __SMBUS_HandleTypeDef::Instance***
  SMBUS registers base address
- ***SMBUS_InitTypeDef __SMBUS_HandleTypeDef::Init***
  SMBUS communication parameters
- ***uint8_t* __SMBUS_HandleTypeDef::pBuffPtr***
  Pointer to SMBUS transfer buffer
- ***uint16_t __SMBUS_HandleTypeDef::XferSize***
  SMBUS transfer size
- ***__IO uint16_t __SMBUS_HandleTypeDef::XferCount***
  SMBUS transfer counter
- ***__IO uint32_t __SMBUS_HandleTypeDef::XferOptions***
  SMBUS transfer options
- ***__IO uint32_t __SMBUS_HandleTypeDef::PreviousState***
  SMBUS communication Previous state
- ***HAL_LockTypeDef __SMBUS_HandleTypeDef::Lock***
  SMBUS locking object
- ***__IO uint32_t __SMBUS_HandleTypeDef::State***
  SMBUS communication state
- ***__IO uint32_t __SMBUS_HandleTypeDef::ErrorCode***
  SMBUS Error code

69.2 SMBUS Firmware driver API description

The following section lists the various functions of the SMBUS library.

69.2.1 How to use this driver

The SMBUS HAL driver can be used as follows:

1. Declare a SMBUS_HandleTypeDef handle structure, for example: SMBUS_HandleTypeDef hsmbus;

2. Initialize the SMBUS low level resources by implementing the @ref HAL_SMBUS_MspInit() API:
   a. Enable the SMBUSx interface clock
   b. SMBUS pins configuration
      - Enable the clock for the SMBUS GPIOs
      - Configure SMBUS pins as alternate function open-drain
   c. NVIC configuration if you need to use interrupt process
      - Configure the SMBUSx interrupt priority
      - Enable the NVIC SMBUS IRQ Channel
3. Configure the Communication Clock Timing, Bus Timeout, Own Address1, Master Addressing mode, Dual Addressing mode, Own Address2, Own Address2 Mask, General call, Nostretch mode, Peripheral mode and Packet Error Check mode in the hsmbus Init structure.
4. Initialize the SMBUS registers by calling the @ref HAL_SMBUS_Init() API:
   – These API's configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized @ref HAL_SMBUS_MspInit(&hsmbus) API.
5. To check if target device is ready for communication, use the function @ref HAL_SMBUS_IsDeviceReady()
6. For SMBUS IO operations, only one mode of operations is available within this driver

Interrupt mode IO operation

- Transmit in master/host SMBUS mode an amount of data in non-blocking mode using @ref HAL_SMBUS_Master_Transmit_IT()
  – At transmission end of transfer @ref HAL_SMBUS_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_MasterTxCpltCallback()
- Receive in master/host SMBUS mode an amount of data in non-blocking mode using @ref HAL_SMBUS_Master_Receive_IT()
  – At reception end of transfer @ref HAL_SMBUS_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_MasterRxCpltCallback()
- Abort a master/host SMBUS process communication with Interrupt using @ref HAL_SMBUS_Master_Abort_IT()
  – The associated previous transfer callback is called at the end of abort process
  – mean @ref HAL_SMBUS_MasterTxCpltCallback() in case of previous state was master transmit
  – mean @ref HAL_SMBUS_MasterRxCpltCallback() in case of previous state was master receive
- Enable/disable the Address listen mode in slave/device or host/slave SMBUS mode using @ref HAL_SMBUS_EnableListen_IT() @ref HAL_SMBUS_DisableListen_IT()
  – When address slave/device SMBUS match, @ref HAL_SMBUS_AddrCallback() is executed and user can add his own code to check the Address Match Code and the transmission direction request by master/host (Write/Read).
  – At Listen mode end @ref HAL_SMBUS_ListenCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_ListenCpltCallback()
- Transmit in slave/device SMBUS mode an amount of data in non-blocking mode using @ref HAL_SMBUS_Slave_Transmit_IT()
  – At transmission end of transfer @ref HAL_SMBUS_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_SlaveTxCpltCallback()
- Receive in slave/device SMBUS mode an amount of data in non-blocking mode using @ref HAL_SMBUS_Slave_Receive_IT()
  – At reception end of transfer @ref HAL_SMBUS_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_SlaveRxCpltCallback()
- Enable/Disable the SMBUS alert mode using @ref HAL_SMBUS_EnableAlert_IT() @ref HAL_SMBUS_DisableAlert_IT()
  – When SMBUS Alert is generated @ref HAL_SMBUS_ErrorCallback() is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_ErrorCallback() to check the Alert Error Code using function @ref HAL_SMBUS_GetError()
- Get HAL state machine or error values using @ref HAL_SMBUS_GetState() or @ref HAL_SMBUS_GetError()

- In case of transfer Error, @ref HAL_SMBUS_ErrorCallback() function is executed and user can add his own code by customization of function pointer @ref HAL_SMBUS_ErrorCallback() to check the Error Code using function @ref HAL_SMBUS_GetError()

SMBUS HAL driver macros list

Below the list of most used macros in SMBUS HAL driver.

- @ref __HAL_SMBUS_ENABLE: Enable the SMBUS peripheral
- @ref __HAL_SMBUS_DISABLE: Disable the SMBUS peripheral
- @ref __HAL_SMBUS_GET_FLAG: Check whether the specified SMBUS flag is set or not
- @ref __HAL_SMBUS_CLEAR_FLAG: Clear the specified SMBUS pending flag
- @ref __HAL_SMBUS_ENABLE_IT: Enable the specified SMBUS interrupt
- @ref __HAL_SMBUS_DISABLE_IT: Disable the specified SMBUS interrupt

Callback registration

The compilation flag USE_HAL_SMBUS_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_SMBUS_RegisterCallback() or @ref HAL_SMBUS_RegisterAddrCallback() to register an interrupt callback.

Function @ref HAL_SMBUS_RegisterCallback() allows to register following callbacks:

- MasterTxCpltCallback : callback for Master transmission end of transfer.
- MasterRxCpltCallback : callback for Master reception end of transfer.
- SlaveTxCpltCallback : callback for Slave transmission end of transfer.
- SlaveRxCpltCallback : callback for Slave reception end of transfer.
- ListenCpltCallback : callback for end of listen mode.
- ErrorCallback : callback for error detection.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

For specific callback AddrCallback use dedicated register callbacks : @ref HAL_SMBUS_RegisterAddrCallback.

Use function @ref HAL_SMBUS_UnRegisterCallback to reset a callback to the default weak function. @ref HAL_SMBUS_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- MasterTxCpltCallback : callback for Master transmission end of transfer.
- MasterRxCpltCallback : callback for Master reception end of transfer.
- SlaveTxCpltCallback : callback for Slave transmission end of transfer.
- SlaveRxCpltCallback : callback for Slave reception end of transfer.
- ListenCpltCallback : callback for end of listen mode.
- ErrorCallback : callback for error detection.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit.

For callback AddrCallback use dedicated register callbacks : @ref HAL_SMBUS_UnRegisterAddrCallback.

By default, after the @ref HAL_SMBUS_Init() and when the state is @ref HAL_I2C_STATE_RESET all callbacks are set to the corresponding weak functions: examples @ref HAL_SMBUS_MasterTxCpltCallback(), @ref HAL_SMBUS_MasterRxCpltCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the @ref HAL_SMBUS_Init()/ @ref HAL_SMBUS_DeInit() only when these callbacks are null (not registered beforehand). If MspInit or MspDeInit are not null, the @ref HAL_SMBUS_Init()/ @ref HAL_SMBUS_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state.

Callbacks can be registered/unregistered in @ref HAL_I2C_STATE_READY state only. Exception done MspInit/ MspDeInit functions that can be registered/unregistered in @ref HAL_I2C_STATE_READY or @ref HAL_I2C_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. Then, the user first registers the MspInit/MspDeInit user callbacks using @ref HAL_SMBUS_RegisterCallback() before calling @ref HAL_SMBUS_DeInit() or @ref HAL_SMBUS_Init() function.

When the compilation flag USE_HAL_SMBUS_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

Note: You can refer to the SMBUS HAL driver header file for more useful macros

69.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and deinitialize the SMBUSx peripheral:

- User must Implement HAL_SMBUS_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, IT and NVIC).
- Call the function HAL_SMBUS_Init() to configure the selected device with the selected configuration:
  - Clock Timing
  - Bus Timeout
  - Analog Filer mode
  - Own Address 1
  - Addressing mode (Master, Slave)
  - Dual Addressing mode
  - Own Address 2
  - Own Address 2 Mask
  - General call mode
  - Nostretch mode
  - Packet Error Check mode
  - Peripheral mode
- Call the function HAL_SMBUS_DeInit() to restore the default configuration of the selected SMBUSx peripheral.
- Enable/Disable Analog/Digital filters with HAL_SMBUS_ConfigAnalogFilter() and HAL_SMBUS_ConfigDigitalFilter().

This section contains the following APIs:

- ***HAL_SMBUS_Init***
- ***HAL_SMBUS_DeInit***
- ***HAL_SMBUS_MspInit***
- ***HAL_SMBUS_MspDeInit***
- ***HAL_SMBUS_ConfigAnalogFilter***
- ***HAL_SMBUS_ConfigDigitalFilter***

69.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SMBUS data transfers.

1. Blocking mode function to check if device is ready for usage is :
   - HAL_SMBUS_IsDeviceReady()
2. There is only one mode of transfer:
   - Non-Blocking mode : The communication is performed using Interrupts. These functions return the status of the transfer startup. The end of the data processing will be indicated through the dedicated SMBUS IRQ when using Interrupt mode.
3. Non-Blocking mode functions with Interrupt are :
   - HAL_SMBUS_Master_Transmit_IT()
   - HAL_SMBUS_Master_Receive_IT()
   - HAL_SMBUS_Slave_Transmit_IT()
   - HAL_SMBUS_Slave_Receive_IT()
   - HAL_SMBUS_EnableListen_IT() or alias HAL_SMBUS_EnableListen_IT()
   - HAL_SMBUS_DisableListen_IT()
   - HAL_SMBUS_EnableAlert_IT()
   - HAL_SMBUS_DisableAlert_IT()

4. A set of Transfer Complete Callbacks are provided in non-Blocking mode:
   - HAL_SMBUS_MasterTxCpltCallback()
   - HAL_SMBUS_MasterRxCpltCallback()
   - HAL_SMBUS_SlaveTxCpltCallback()
   - HAL_SMBUS_SlaveRxCpltCallback()
   - HAL_SMBUS_AddrCallback()
   - HAL_SMBUS_ListenCpltCallback()
   - HAL_SMBUS_ErrorCallback()

This section contains the following APIs:

- ***HAL_SMBUS_Master_Transmit_IT***
- ***HAL_SMBUS_Master_Receive_IT***
- ***HAL_SMBUS_Master_Abort_IT***
- ***HAL_SMBUS_Slave_Transmit_IT***
- ***HAL_SMBUS_Slave_Receive_IT***
- ***HAL_SMBUS_EnableListen_IT***
- ***HAL_SMBUS_DisableListen_IT***
- ***HAL_SMBUS_EnableAlert_IT***
- ***HAL_SMBUS_DisableAlert_IT***
- ***HAL_SMBUS_IsDeviceReady***

69.2.4 Peripheral State and Errors functions

This subsection permits to get in run-time the status of the peripheral and the data flow.

This section contains the following APIs:

- ***HAL_SMBUS_GetState***
- ***HAL_SMBUS_GetError***

69.2.5 Detailed description of functions

`HAL_SMBUS_Init`

Function name

HAL_StatusTypeDef HAL_SMBUS_Init (SMBUS_HandleTypeDef * hsmbus)

Function description

Initialize the SMBUS according to the specified parameters in the SMBUS_InitTypeDef and initialize the associated handle.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **HAL:** status

`HAL_SMBUS_DeInit`

Function name

HAL_StatusTypeDef HAL_SMBUS_DeInit (SMBUS_HandleTypeDef * hsmbus)

Function description

DeInitialize the SMBUS peripheral.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **HAL:** status

`HAL_SMBUS_MspInit`

Function name

void HAL_SMBUS_MspInit (SMBUS_HandleTypeDef * hsmbus)

Function description

Initialize the SMBUS MSP.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_MspDeInit`

Function name

void HAL_SMBUS_MspDeInit (SMBUS_HandleTypeDef * hsmbus)

Function description

DeInitialize the SMBUS MSP.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_ConfigAnalogFilter`

Function name

HAL_StatusTypeDef HAL_SMBUS_ConfigAnalogFilter (SMBUS_HandleTypeDef * hsmbus, uint32_t AnalogFilter)

Function description

Configure Analog noise filter.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **AnalogFilter:** This parameter can be one of the following values:
  - SMBUS_ANALOGFILTER_ENABLE
  - SMBUS_ANALOGFILTER_DISABLE

Return values

- **HAL:** status

HAL_SMBUS_ConfigDigitalFilter

Function name

HAL_StatusTypeDef HAL_SMBUS_ConfigDigitalFilter (SMBUS_HandleTypeDef * hsmbus, uint32_t DigitalFilter)

Function description

Configure Digital noise filter.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **DigitalFilter:** Coefficient of digital noise filter between Min_Data=0x00 and Max_Data=0x0F.

Return values

- **HAL:** status

HAL_SMBUS_IsDeviceReady

Function name

HAL_StatusTypeDef HAL_SMBUS_IsDeviceReady (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress, uint32_t Trials, uint32_t Timeout)

Function description

Check if target device is ready for communication.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **Trials:** Number of trials
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SMBUS_Master_Transmit_IT

Function name

HAL_StatusTypeDef HAL_SMBUS_Master_Transmit_IT (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Transmit in master/host SMBUS mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

HAL_SMBUS_Master_Receive_IT

Function name

HAL_StatusTypeDef HAL_SMBUS_Master_Receive_IT (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Receive in master/host SMBUS mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

HAL_SMBUS_Master_Abort_IT

Function name

HAL_StatusTypeDef HAL_SMBUS_Master_Abort_IT (SMBUS_HandleTypeDef * hsmbus, uint16_t DevAddress)

Function description

Abort a master/host SMBUS process communication with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **DevAddress:** Target device address: The device 7 bits address value in datasheet must be shifted to the left before calling the interface

Return values

- **HAL:** status

Notes

- This abort can be called only if state is ready

HAL_SMBUS_Slave_Transmit_IT

Function name

HAL_StatusTypeDef HAL_SMBUS_Slave_Transmit_IT (SMBUS_HandleTypeDef * hsmbus, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Transmit in slave/device SMBUS mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

`HAL_SMBUS_Slave_Receive_IT`

Function name

HAL_StatusTypeDef HAL_SMBUS_Slave_Receive_IT (SMBUS_HandleTypeDef * hsmbus, uint8_t * pData, uint16_t Size, uint32_t XferOptions)

Function description

Receive in slave/device SMBUS mode an amount of data in non-blocking mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of SMBUS XferOptions definition

Return values

- **HAL:** status

`HAL_SMBUS_EnableAlert_IT`

Function name

HAL_StatusTypeDef HAL_SMBUS_EnableAlert_IT (SMBUS_HandleTypeDef * hsmbus)

Function description

Enable the SMBUS alert mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUSx peripheral.

Return values

- **HAL:** status

`HAL_SMBUS_DisableAlert_IT`

Function name

HAL_StatusTypeDef HAL_SMBUS_DisableAlert_IT (SMBUS_HandleTypeDef * hsmbus)

Function description

Disable the SMBUS alert mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUSx peripheral.

Return values

- **HAL:** status

`HAL_SMBUS_EnableListen_IT`

Function name

HAL_StatusTypeDef HAL_SMBUS_EnableListen_IT (SMBUS_HandleTypeDef * hsmbus)

Function description

Enable the Address listen mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **HAL:** status

`HAL_SMBUS_DisableListen_IT`

Function name

HAL_StatusTypeDef HAL_SMBUS_DisableListen_IT (SMBUS_HandleTypeDef * hsmbus)

Function description

Disable the Address listen mode with Interrupt.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **HAL:** status

`HAL_SMBUS_EV_IRQHandler`

Function name

void HAL_SMBUS_EV_IRQHandler (SMBUS_HandleTypeDef * hsmbus)

Function description

Handle SMBUS event interrupt request.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_ER_IRQHandler`

Function name

void HAL_SMBUS_ER_IRQHandler (SMBUS_HandleTypeDef * hsmbus)

Function description

Handle SMBUS error interrupt request.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_MasterTxCpltCallback`

Function name

void HAL_SMBUS_MasterTxCpltCallback (SMBUS_HandleTypeDef * hsmbus)

Function description

Master Tx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_MasterRxCpltCallback`

Function name

void HAL_SMBUS_MasterRxCpltCallback (SMBUS_HandleTypeDef * hsmbus)

Function description

Master Rx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_SlaveTxCpltCallback`

Function name

void HAL_SMBUS_SlaveTxCpltCallback (SMBUS_HandleTypeDef * hsmbus)

Function description

Slave Tx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_SlaveRxCpltCallback`

Function name

void HAL_SMBUS_SlaveRxCpltCallback (SMBUS_HandleTypeDef * hsmbus)

Function description

Slave Rx Transfer completed callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

HAL_SMBUS_AddrCallback

Function name

void HAL_SMBUS_AddrCallback (SMBUS_HandleTypeDef * hsmbus, uint8_t TransferDirection, uint16_t AddrMatchCode)

Function description

Slave Address Match callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.
- **TransferDirection:** Master request Transfer Direction (Write/Read)
- **AddrMatchCode:** Address Match Code

Return values

- **None:**

HAL_SMBUS_ListenCpltCallback

Function name

void HAL_SMBUS_ListenCpltCallback (SMBUS_HandleTypeDef * hsmbus)

Function description

Listen Complete callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

HAL_SMBUS_ErrorCallback

Function name

void HAL_SMBUS_ErrorCallback (SMBUS_HandleTypeDef * hsmbus)

Function description

SMBUS error callback.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **None:**

`HAL_SMBUS_GetState`

Function name

uint32_t HAL_SMBUS_GetState (SMBUS_HandleTypeDef * hsmbus)

Function description

Return the SMBUS handle state.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **HAL:** state

`HAL_SMBUS_GetError`

Function name

uint32_t HAL_SMBUS_GetError (SMBUS_HandleTypeDef * hsmbus)

Function description

Return the SMBUS error code.

Parameters

- **hsmbus:** Pointer to a SMBUS_HandleTypeDef structure that contains the configuration information for the specified SMBUS.

Return values

- **SMBUS:** Error Code

69.3 SMBUS Firmware driver defines

The following section lists the various define and macros of the module.

69.3.1 SMBUS

SMBUS

SMBUS addressing mode

SMBUS_ADDRESSINGMODE_7BIT

SMBUS_ADDRESSINGMODE_10BIT

SMBUS Analog Filter

SMBUS_ANALOGFILTER_ENABLE

SMBUS_ANALOGFILTER_DISABLE

SMBUS dual addressing mode

SMBUS_DUALADDRESS_DISABLE

SMBUS_DUALADDRESS_ENABLE

SMBUS Error Code definition

HAL_SMBUS_ERROR_NONE

No error

HAL_SMBUS_ERROR_BERR

BERR error

HAL_SMBUS_ERROR_ARLO

ARLO error

HAL_SMBUS_ERROR_ACKF

ACKF error

HAL_SMBUS_ERROR_OVR

OVR error

HAL_SMBUS_ERROR_HALTIMEOUT

Timeout error

HAL_SMBUS_ERROR_BUSTIMEOUT

Bus Timeout error

HAL_SMBUS_ERROR_ALERT

Alert error

HAL_SMBUS_ERROR_PECERR

PEC error

HAL_SMBUS_ERROR_INVALID_PARAM

Invalid Parameters error

SMBUS Exported Macros

__HAL_SMBUS_RESET_HANDLE_STATE

Description:

- Reset SMBUS handle state.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.

Return value:

- None

__HAL_SMBUS_ENABLE_IT

Description:

- Enable the specified SMBUS interrupts.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.
- __INTERRUPT__: specifies the interrupt source to enable. This parameter can be one of the following values:
  - SMBUS_IT_ERRI Errors interrupt enable
  - SMBUS_IT_TCI Transfer complete interrupt enable
  - SMBUS_IT_STOPI STOP detection interrupt enable
  - SMBUS_IT_NACKI NACK received interrupt enable
  - SMBUS_IT_ADDRI Address match interrupt enable
  - SMBUS_IT_RXI RX interrupt enable
  - SMBUS_IT_TXI TX interrupt enable

Return value:

- None

__HAL_SMBUS_DISABLE_IT

Description:

- Disable the specified SMBUS interrupts.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.
- __INTERRUPT__: specifies the interrupt source to disable. This parameter can be one of the following values:
  - SMBUS_IT_ERRI Errors interrupt enable
  - SMBUS_IT_TCI Transfer complete interrupt enable
  - SMBUS_IT_STOPI STOP detection interrupt enable
  - SMBUS_IT_NACKI NACK received interrupt enable
  - SMBUS_IT_ADDRI Address match interrupt enable
  - SMBUS_IT_RXI RX interrupt enable
  - SMBUS_IT_TXI TX interrupt enable

Return value:

- None

__HAL_SMBUS_GET_IT_SOURCE

Description:

- Check whether the specified SMBUS interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.
- __INTERRUPT__: specifies the SMBUS interrupt source to check. This parameter can be one of the following values:
  - SMBUS_IT_ERRI Errors interrupt enable
  - SMBUS_IT_TCI Transfer complete interrupt enable
  - SMBUS_IT_STOPI STOP detection interrupt enable
  - SMBUS_IT_NACKI NACK received interrupt enable
  - SMBUS_IT_ADDRI Address match interrupt enable
  - SMBUS_IT_RXI RX interrupt enable
  - SMBUS_IT_TXI TX interrupt enable

Return value:

- The: new state of __IT__ (SET or RESET).

SMBUS_FLAG_MASK

Description:

- Check whether the specified SMBUS flag is set or not.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SMBUS_FLAG_TXE Transmit data register empty
  - SMBUS_FLAG_TXIS Transmit interrupt status
  - SMBUS_FLAG_RXNE Receive data register not empty
  - SMBUS_FLAG_ADDR Address matched (slave mode)
  - SMBUS_FLAG_AF NACK received flag
  - SMBUS_FLAG_STOPF STOP detection flag
  - SMBUS_FLAG_TC Transfer complete (master mode)
  - SMBUS_FLAG_TCR Transfer complete reload
  - SMBUS_FLAG_BERR Bus error
  - SMBUS_FLAG_ARLO Arbitration lost
  - SMBUS_FLAG_OVR Overrun/Underrun
  - SMBUS_FLAG_PECERR PEC error in reception
  - SMBUS_FLAG_TIMEOUT Timeout or Tlow detection flag
  - SMBUS_FLAG_ALERT SMBus alert
  - SMBUS_FLAG_BUSY Bus busy
  - SMBUS_FLAG_DIR Transfer direction (slave mode)

Return value:

- The: new state of __FLAG__ (SET or RESET).

__HAL_SMBUS_GET_FLAG

__HAL_SMBUS_CLEAR_FLAG

Description:

- Clear the SMBUS pending flags which are cleared by writing 1 in a specific bit.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.
- __FLAG__: specifies the flag to clear. This parameter can be any combination of the following values:
  - SMBUS_FLAG_ADDR Address matched (slave mode)
  - SMBUS_FLAG_AF NACK received flag
  - SMBUS_FLAG_STOPF STOP detection flag
  - SMBUS_FLAG_BERR Bus error
  - SMBUS_FLAG_ARLO Arbitration lost
  - SMBUS_FLAG_OVR Overrun/Underrun
  - SMBUS_FLAG_PECERR PEC error in reception
  - SMBUS_FLAG_TIMEOUT Timeout or Tlow detection flag
  - SMBUS_FLAG_ALERT SMBus alert

Return value:

- None

__HAL_SMBUS_ENABLE

Description:

- Enable the specified SMBUS peripheral.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.

Return value:

- None

__HAL_SMBUS_DISABLE

Description:

- Disable the specified SMBUS peripheral.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.

Return value:

- None

__HAL_SMBUS_GENERATE_NACK

Description:

- Generate a Non-Acknowledge SMBUS peripheral in Slave mode.

Parameters:

- __HANDLE__: specifies the SMBUS Handle.

Return value:

- None

SMBUS Flag definition

SMBUS_FLAG_TXE

SMBUS_FLAG_TXIS

SMBUS_FLAG_RXNE

SMBUS_FLAG_ADDR

SMBUS_FLAG_AF

SMBUS_FLAG_STOPF

SMBUS_FLAG_TC

SMBUS_FLAG_TCR

SMBUS_FLAG_BERR

SMBUS_FLAG_ARLO

SMBUS_FLAG_OVR

SMBUS_FLAG_PECERR

SMBUS_FLAG_TIMEOUT

SMBUS_FLAG_ALERT

SMBUS_FLAG_BUSY

SMBUS_FLAG_DIR

SMBUS general call addressing mode

SMBUS_GENERALCALL_DISABLE

SMBUS_GENERALCALL_ENABLE

SMBUS Interrupt configuration definition

SMBUS_IT_ERRI

SMBUS_IT_TCI

SMBUS_IT_STOPI

SMBUS_IT_NACKI

SMBUS_IT_ADDRI

SMBUS_IT_RXI

SMBUS_IT_TXI

SMBUS_IT_TX

SMBUS_IT_RX

SMBUS_IT_ALERT

SMBUS_IT_ADDR

SMBUS nostretch mode

SMBUS_NOSTRETCH_DISABLE

SMBUS_NOSTRETCH_ENABLE

SMBUS ownaddress2 masks

SMBUS_OA2_NOMASK

SMBUS_OA2_MASK01

SMBUS_OA2_MASK02

SMBUS_OA2_MASK03

SMBUS_OA2_MASK04

SMBUS_OA2_MASK05

SMBUS_OA2_MASK06

SMBUS_OA2_MASK07

SMBUS packet error check mode

SMBUS_PEC_DISABLE

SMBUS_PEC_ENABLE

SMBUS peripheral mode

SMBUS_PERIPHERAL_MODE_SMBUS_HOST

SMBUS_PERIPHERAL_MODE_SMBUS_SLAVE

SMBUS_PERIPHERAL_MODE_SMBUS_SLAVE_ARP

SMBUS ReloadEndMode definition

SMBUS_SOFTEND_MODE

SMBUS_RELOAD_MODE

SMBUS_AUTOEND_MODE

SMBUS_SENDPEC_MODE

SMBUS StartStopMode definition

SMBUS_NO_STARTSTOP

SMBUS_GENERATE_STOP

SMBUS_GENERATE_START_READ

SMBUS_GENERATE_START_WRITE

SMBUS XferOptions definition

SMBUS_FIRST_FRAME

SMBUS_NEXT_FRAME

SMBUS_FIRST_AND_LAST_FRAME_NO_PEC

SMBUS_LAST_FRAME_NO_PEC

SMBUS_FIRST_AND_LAST_FRAME_WITH_PEC

SMBUS_LAST_FRAME_WITH_PEC

SMBUS_OTHER_FRAME_NO_PEC

SMBUS_OTHER_FRAME_WITH_PEC

SMBUS_OTHER_AND_LAST_FRAME_NO_PEC

SMBUS_OTHER_AND_LAST_FRAME_WITH_PEC

70 HAL SPI Generic Driver

70.1 SPI Firmware driver registers structures

70.1.1 SPI_InitTypeDef

SPI_InitTypeDef is defined in the stm32l4xx_hal_spi.h

Data Fields

- ***uint32_t Mode***
- ***uint32_t Direction***
- ***uint32_t DataSize***
- ***uint32_t CLKPolarity***
- ***uint32_t CLKPhase***
- ***uint32_t NSS***
- ***uint32_t BaudRatePrescaler***
- ***uint32_t FirstBit***
- ***uint32_t TIMode***
- ***uint32_t CRCCalculation***
- ***uint32_t CRCPolynomial***
- ***uint32_t CRCLength***
- ***uint32_t NSSPMode***

Field Documentation

- ***uint32_t SPI_InitTypeDef::Mode***
  Specifies the SPI operating mode. This parameter can be a value of ***SPI_Mode***
- ***uint32_t SPI_InitTypeDef::Direction***
  Specifies the SPI bidirectional mode state. This parameter can be a value of ***SPI_Direction***
- ***uint32_t SPI_InitTypeDef::DataSize***
  Specifies the SPI data size. This parameter can be a value of ***SPI_Data_Size***
- ***uint32_t SPI_InitTypeDef::CLKPolarity***
  Specifies the serial clock steady state. This parameter can be a value of ***SPI_Clock_Polarity***
- ***uint32_t SPI_InitTypeDef::CLKPhase***
  Specifies the clock active edge for the bit capture. This parameter can be a value of ***SPI_Clock_Phase***
- ***uint32_t SPI_InitTypeDef::NSS***
  Specifies whether the NSS signal is managed by hardware (NSS pin) or by software using the SSI bit. This parameter can be a value of ***SPI_Slave_Select_management***
- ***uint32_t SPI_InitTypeDef::BaudRatePrescaler***
  Specifies the Baud Rate prescaler value which will be used to configure the transmit and receive SCK clock. This parameter can be a value of ***SPI_BaudRate_Prescaler***
  Note:
  – The communication clock is derived from the master clock. The slave clock does not need to be set.
- ***uint32_t SPI_InitTypeDef::FirstBit***
  Specifies whether data transfers start from MSB or LSB bit. This parameter can be a value of ***SPI_MSB_LSB_transmission***
- ***uint32_t SPI_InitTypeDef::TIMode***
  Specifies if the TI mode is enabled or not. This parameter can be a value of ***SPI_TI_mode***
- ***uint32_t SPI_InitTypeDef::CRCCalculation***
  Specifies if the CRC calculation is enabled or not. This parameter can be a value of ***SPI_CRC_Calculation***

- ***uint32_t SPI_InitTypeDef::CRCPolynomial***
  Specifies the polynomial used for the CRC calculation. This parameter must be an odd number between Min_Data = 1 and Max_Data = 65535
- ***uint32_t SPI_InitTypeDef::CRCLength***
  Specifies the CRC Length used for the CRC calculation. CRC Length is only used with Data8 and Data16, not other data size This parameter can be a value of ***SPI_CRC_length***
- ***uint32_t SPI_InitTypeDef::NSSPMode***
  Specifies whether the NSSP signal is enabled or not . This parameter can be a value of ***SPI_NSSP_Mode*** This mode is activated by the NSSP bit in the SPIx_CR2 register and it takes effect only if the SPI interface is configured as Motorola SPI master (FRF=0) with capture on the first edge (SPIx_CR1 CPHA = 0, CPOL setting is ignored)..

70.1.2 __SPI_HandleTypeDef

__SPI_HandleTypeDef is defined in the stm32l4xx_hal_spi.h

Data Fields

- ***SPI_TypeDef * Instance***
- ***SPI_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint32_t CRCSize***
- ***void(* RxISR***
- ***void(* TxISR***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SPI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***SPI_TypeDef* __SPI_HandleTypeDef::Instance***
  SPI registers base address
- ***SPI_InitTypeDef __SPI_HandleTypeDef::Init***
  SPI communication parameters
- ***uint8_t* __SPI_HandleTypeDef::pTxBuffPtr***
  Pointer to SPI Tx transfer Buffer
- ***uint16_t __SPI_HandleTypeDef::TxXferSize***
  SPI Tx Transfer size
- ***__IO uint16_t __SPI_HandleTypeDef::TxXferCount***
  SPI Tx Transfer Counter
- ***uint8_t* __SPI_HandleTypeDef::pRxBuffPtr***
  Pointer to SPI Rx transfer Buffer
- ***uint16_t __SPI_HandleTypeDef::RxXferSize***
  SPI Rx Transfer size
- ***__IO uint16_t __SPI_HandleTypeDef::RxXferCount***
  SPI Rx Transfer Counter
- ***uint32_t __SPI_HandleTypeDef::CRCSize***
  SPI CRC size used for the transfer

- ***void(* __SPI_HandleTypeDef::RxISR)(struct __SPI_HandleTypeDef *hspi)***
  function pointer on Rx ISR
- ***void(* __SPI_HandleTypeDef::TxISR)(struct __SPI_HandleTypeDef *hspi)***
  function pointer on Tx ISR
- ***DMA_HandleTypeDef* __SPI_HandleTypeDef::hdmatx***
  SPI Tx DMA Handle parameters
- ***DMA_HandleTypeDef* __SPI_HandleTypeDef::hdmarx***
  SPI Rx DMA Handle parameters
- ***HAL_LockTypeDef __SPI_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_SPI_StateTypeDef __SPI_HandleTypeDef::State***
  SPI communication state
- ***__IO uint32_t __SPI_HandleTypeDef::ErrorCode***
  SPI Error code

70.2 SPI Firmware driver API description

The following section lists the various functions of the SPI library.

70.2.1 How to use this driver

The SPI HAL driver can be used as follows:

1. Declare a SPI_HandleTypeDef handle structure, for example: SPI_HandleTypeDef hspi;
2. Initialize the SPI low level resources by implementing the HAL_SPI_MspInit() API:
   a. Enable the SPIx interface clock
   b. SPI pins configuration
      - Enable the clock for the SPI GPIOs
      - Configure these SPI pins as alternate function push-pull
   c. NVIC configuration if you need to use interrupt process
      - Configure the SPIx interrupt priority
      - Enable the NVIC SPI IRQ handle
   d. DMA Configuration if you need to use DMA process
      - Declare a DMA_HandleTypeDef handle structure for the transmit or receive Stream/Channel
      - Enable the DMAx clock
      - Configure the DMA handle parameters
      - Configure the DMA Tx or Rx Stream/Channel
      - Associate the initialized hdma_tx(or _rx) handle to the hspi DMA Tx or Rx handle
      - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx or Rx Stream/Channel
3. Program the Mode, BidirectionalMode , Data size, Baudrate Prescaler, NSS management, Clock polarity and phase, FirstBit and CRC configuration in the hspi Init structure.
4. Initialize the SPI registers by calling the HAL_SPI_Init() API:
   – This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_SPI_MspInit() API.

Circular mode restriction:

1. The DMA circular mode cannot be used when the SPI is configured in these modes:
   a. Master 2Lines RxOnly
   b. Master 1Line Rx
2. The CRC feature is not managed when the DMA circular mode is enabled
3. When the SPI DMA Pause/Stop features are used, we must use the following APIs the HAL_SPI_DMAPause()/ HAL_SPI_DMAStop() only under the SPI callbacks

Master Receive mode restriction:

1. In Master unidirectional receive-only mode (MSTR =1, BIDIMODE=0, RXONLY=1) or bidirectional receive mode (MSTR=1, BIDIMODE=1, BIDIOE=0), to ensure that the SPI does not initiate a new transfer the following procedure has to be respected:
   a. HAL_SPI_DeInit()
   b. HAL_SPI_Init()

Callback registration:

1. The compilation flag USE_HAL_SPI_REGISTER_CALLBACKS when set to 1U allows the user to configure dynamically the driver callbacks. Use Functions HAL_SPI_RegisterCallback() to register an interrupt callback. Function HAL_SPI_RegisterCallback() allows to register following callbacks: (+) TxCpltCallback : SPI Tx Completed callback (+) RxCpltCallback : SPI Rx Completed callback (+) TxRxCpltCallback : SPI TxRx Completed callback (+) TxHalfCpltCallback : SPI Tx Half Completed callback (+) RxHalfCpltCallback : SPI Rx Half Completed callback (+) TxRxHalfCpltCallback : SPI TxRx Half Completed callback (+) ErrorCallback : SPI Error callback (+) AbortCpltCallback : SPI Abort callback (+) MspInitCallback : SPI Msp Init callback (+) MspDeInitCallback : SPI Msp DeInit callback This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.
2. Use function HAL_SPI_UnRegisterCallback to reset a callback to the default weak function. HAL_SPI_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks: (+) TxCpltCallback : SPI Tx Completed callback (+) RxCpltCallback : SPI Rx Completed callback (+) TxRxCpltCallback : SPI TxRx Completed callback (+) TxHalfCpltCallback : SPI Tx Half Completed callback (+) RxHalfCpltCallback : SPI Rx Half Completed callback (+) TxRxHalfCpltCallback : SPI TxRx Half Completed callback (+) ErrorCallback : SPI Error callback (+) AbortCpltCallback : SPI Abort callback (+) MspInitCallback : SPI Msp Init callback (+) MspDeInitCallback : SPI Msp DeInit callback By default, after the HAL_SPI_Init() and when the state is HAL_SPI_STATE_RESET all callbacks are set to the corresponding weak functions: examples HAL_SPI_MasterTxCpltCallback(), HAL_SPI_MasterRxCpltCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the HAL_SPI_Init()/ HAL_SPI_DeInit() only when these callbacks are null (not registered beforehand). If MspInit or MspDeInit are not null, the HAL_SPI_Init()/ HAL_SPI_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state. Callbacks can be registered/unregistered in HAL_SPI_STATE_READY state only. Exception done MspInit/MspDeInit functions that can be registered/unregistered in HAL_SPI_STATE_READY or HAL_SPI_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. Then, the user first registers the MspInit/MspDeInit user callbacks using HAL_SPI_RegisterCallback() before calling HAL_SPI_DeInit() or HAL_SPI_Init() function. When The compilation define USE_HAL_PPP_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

Callback registration: (#) The compilation flag USE_HAL_SPI_REGISTER_CALLBACKS when set to 1U allows the user to configure dynamically the driver callbacks. Use Functions HAL_SPI_RegisterCallback() to register an interrupt callback. Function HAL_SPI_RegisterCallback() allows to register following callbacks:

- TxCpltCallback : SPI Tx Completed callback
- RxCpltCallback : SPI Rx Completed callback
- TxRxCpltCallback : SPI TxRx Completed callback
- TxHalfCpltCallback : SPI Tx Half Completed callback
- RxHalfCpltCallback : SPI Rx Half Completed callback
- TxRxHalfCpltCallback : SPI TxRx Half Completed callback
- ErrorCallback : SPI Error callback
- AbortCpltCallback : SPI Abort callback
- MspInitCallback : SPI Msp Init callback
- MspDeInitCallback : SPI Msp DeInit callback This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function. (#) Use function HAL_SPI_UnRegisterCallback to reset a callback to the default weak function. HAL_SPI_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:
- TxCpltCallback : SPI Tx Completed callback
- RxCpltCallback : SPI Rx Completed callback
- TxRxCpltCallback : SPI TxRx Completed callback
- TxHalfCpltCallback : SPI Tx Half Completed callback
- RxHalfCpltCallback : SPI Rx Half Completed callback

- TxRxHalfCpltCallback : SPI TxRx Half Completed callback
- ErrorCallback : SPI Error callback
- AbortCpltCallback : SPI Abort callback
- MspInitCallback : SPI Msp Init callback
- MspDeInitCallback : SPI Msp DeInit callback By default, after the HAL_SPI_Init() and when the state is HAL_SPI_STATE_RESET all callbacks are set to the corresponding weak functions: examples HAL_SPI_MasterTxCpltCallback(), HAL_SPI_MasterRxCpltCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the HAL_SPI_Init()/ HAL_SPI_DeInit() only when these callbacks are null (not registered beforehand). If MspInit or MspDeInit are not null, the HAL_SPI_Init()/ HAL_SPI_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state. Callbacks can be registered/unregistered in HAL_SPI_STATE_READY state only. Exception done MspInit/MspDeInit functions that can be registered/unregistered in HAL_SPI_STATE_READY or HAL_SPI_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. Then, the user first registers the MspInit/MspDeInit user callbacks using HAL_SPI_RegisterCallback() before calling HAL_SPI_DeInit() or HAL_SPI_Init() function. When The compilation define USE_HAL_PPP_REGISTER_CALLBACKS is set to 0 or not defined, the callback registering feature is not available and weak (surcharged) callbacks are used.

Using the HAL it is not possible to reach all supported SPI frequency with the different SPI Modes, the following table resume the max SPI frequency reached with data size 8bits/16bits, according to frequency of the APBx Peripheral Clock (fPCLK) used by the SPI instance.

70.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialize the SPIx peripheral:

- User must implement HAL_SPI_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_SPI_Init() to configure the selected device with the selected configuration:
  - Mode
  - Direction
  - Data Size
  - Clock Polarity and Phase
  - NSS Management
  - BaudRate Prescaler
  - FirstBit
  - TIMode
  - CRC Calculation
  - CRC Polynomial if CRC enabled
  - CRC Length, used only with Data8 and Data16
  - FIFO reception threshold
- Call the function HAL_SPI_DeInit() to restore the default configuration of the selected SPIx peripheral.

This section contains the following APIs:

- ***HAL_SPI_Init***
- ***HAL_SPI_DeInit***
- ***HAL_SPI_MspInit***
- ***HAL_SPI_MspDeInit***

70.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SPI data transfers.

The SPI supports master and slave mode :

1. There are two modes of transfer:
   - Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
   - No-Blocking mode: The communication is performed using Interrupts or DMA, These APIs return the HAL status. The end of the data processing will be indicated through the dedicated SPI IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_SPI_TxCpltCallback(), HAL_SPI_RxCpltCallback() and HAL_SPI_TxRxCpltCallback() user callbacks will be executed respectively at the end of the transmit or Receive process The HAL_SPI_ErrorCallback()user callback will be executed when a communication error is detected
2. APIs provided for these 2 transfer modes (Blocking mode or Non blocking mode using either Interrupt or DMA) exist for 1Line (simplex) and 2Lines (full duplex) modes.

This section contains the following APIs:

- ***HAL_SPI_Transmit***
- ***HAL_SPI_Receive***
- ***HAL_SPI_TransmitReceive***
- ***HAL_SPI_Transmit_IT***
- ***HAL_SPI_Receive_IT***
- ***HAL_SPI_TransmitReceive_IT***
- ***HAL_SPI_Transmit_DMA***
- ***HAL_SPI_Receive_DMA***
- ***HAL_SPI_TransmitReceive_DMA***
- ***HAL_SPI_Abort***
- ***HAL_SPI_Abort_IT***
- ***HAL_SPI_DMAPause***
- ***HAL_SPI_DMAResume***
- ***HAL_SPI_DMAStop***
- ***HAL_SPI_IRQHandler***
- ***HAL_SPI_TxCpltCallback***
- ***HAL_SPI_RxCpltCallback***
- ***HAL_SPI_TxRxCpltCallback***
- ***HAL_SPI_TxHalfCpltCallback***
- ***HAL_SPI_RxHalfCpltCallback***
- ***HAL_SPI_TxRxHalfCpltCallback***
- ***HAL_SPI_ErrorCallback***
- ***HAL_SPI_AbortCpltCallback***

70.2.4 Peripheral State and Errors functions

This subsection provides a set of functions allowing to control the SPI.

- HAL_SPI_GetState() API can be helpful to check in run-time the state of the SPI peripheral
- HAL_SPI_GetError() check in run-time Errors occurring during communication

This section contains the following APIs:

- ***HAL_SPI_GetState***
- ***HAL_SPI_GetError***

70.2.5 Detailed description of functions

`HAL_SPI_Init`

Function name

HAL_StatusTypeDef HAL_SPI_Init (SPI_HandleTypeDef * hspi)

Function description

Initialize the SPI according to the specified parameters in the SPI_InitTypeDef and initialize the associated handle.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **HAL:** status

HAL_SPI_DeInit

Function name

HAL_StatusTypeDef HAL_SPI_DeInit (SPI_HandleTypeDef * hspi)

Function description

De-Initialize the SPI peripheral.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **HAL:** status

HAL_SPI_MspInit

Function name

void HAL_SPI_MspInit (SPI_HandleTypeDef * hspi)

Function description

Initialize the SPI MSP.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

HAL_SPI_MspDeInit

Function name

void HAL_SPI_MspDeInit (SPI_HandleTypeDef * hspi)

Function description

De-Initialize the SPI MSP.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

HAL_SPI_Transmit

Function name

HAL_StatusTypeDef HAL_SPI_Transmit (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Transmit an amount of data in blocking mode.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be sent
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SPI_Receive

Function name

HAL_StatusTypeDef HAL_SPI_Receive (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be received
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SPI_TransmitReceive

Function name

HAL_StatusTypeDef HAL_SPI_TransmitReceive (SPI_HandleTypeDef * hspi, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)

Function description

Transmit and Receive an amount of data in blocking mode.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pTxData:** pointer to transmission data buffer
- **pRxData:** pointer to reception data buffer
- **Size:** amount of data to be sent and received
- **Timeout:** Timeout duration

Return values

- **HAL:** status

HAL_SPI_Transmit_IT

Function name

HAL_StatusTypeDef HAL_SPI_Transmit_IT (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)

Function description

Transmit an amount of data in non-blocking mode with Interrupt.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be sent

Return values

- **HAL:** status

`HAL_SPI_Receive_IT`

Function name

HAL_StatusTypeDef HAL_SPI_Receive_IT (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in non-blocking mode with Interrupt.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be sent

Return values

- **HAL:** status

`HAL_SPI_TransmitReceive_IT`

Function name

HAL_StatusTypeDef HAL_SPI_TransmitReceive_IT (SPI_HandleTypeDef * hspi, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)

Function description

Transmit and Receive an amount of data in non-blocking mode with Interrupt.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pTxData:** pointer to transmission data buffer
- **pRxData:** pointer to reception data buffer
- **Size:** amount of data to be sent and received

Return values

- **HAL:** status

`HAL_SPI_Transmit_DMA`

Function name

HAL_StatusTypeDef HAL_SPI_Transmit_DMA (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)

Function description

Transmit an amount of data in non-blocking mode with DMA.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be sent

Return values

- **HAL:** status

HAL_SPI_Receive_DMA

Function name

HAL_StatusTypeDef HAL_SPI_Receive_DMA (SPI_HandleTypeDef * hspi, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in non-blocking mode with DMA.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pData:** pointer to data buffer
- **Size:** amount of data to be sent

Return values

- **HAL:** status

Notes

- In case of MASTER mode and SPI_DIRECTION_2LINES direction, hdmatx shall be defined.
- When the CRC feature is enabled the pData Length must be Size + 1.

HAL_SPI_TransmitReceive_DMA

Function name

HAL_StatusTypeDef HAL_SPI_TransmitReceive_DMA (SPI_HandleTypeDef * hspi, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)

Function description

Transmit and Receive an amount of data in non-blocking mode with DMA.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.
- **pTxData:** pointer to transmission data buffer
- **pRxData:** pointer to reception data buffer
- **Size:** amount of data to be sent

Return values

- **HAL:** status

Notes

- When the CRC feature is enabled the pRxData Length must be Size + 1

HAL_SPI_DMAPause

Function name

HAL_StatusTypeDef HAL_SPI_DMAPause (SPI_HandleTypeDef * hspi)

Function description

Pause the DMA Transfer.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.

Return values

- **HAL:** status

`HAL_SPI_DMAResume`

Function name

HAL_StatusTypeDef HAL_SPI_DMAResume (SPI_HandleTypeDef * hspi)

Function description

Resume the DMA Transfer.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.

Return values

- **HAL:** status

`HAL_SPI_DMAStop`

Function name

HAL_StatusTypeDef HAL_SPI_DMAStop (SPI_HandleTypeDef * hspi)

Function description

Stop the DMA Transfer.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.

Return values

- **HAL:** status

`HAL_SPI_Abort`

Function name

HAL_StatusTypeDef HAL_SPI_Abort (SPI_HandleTypeDef * hspi)

Function description

Abort ongoing transfer (blocking mode).

Parameters

- **hspi:** SPI handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer (Tx and Rx), started in Interrupt or DMA mode. This procedure performs following operations : Disable SPI Interrupts (depending of transfer direction)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

HAL_SPI_Abort_IT

Function name

HAL_StatusTypeDef HAL_SPI_Abort_IT (SPI_HandleTypeDef * hspi)

Function description

Abort ongoing transfer (Interrupt mode).

Parameters

- **hspi:** SPI handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer (Tx and Rx), started in Interrupt or DMA mode. This procedure performs following operations : Disable SPI Interrupts (depending of transfer direction)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

HAL_SPI_IRQHandler

Function name

void HAL_SPI_IRQHandler (SPI_HandleTypeDef * hspi)

Function description

Handle SPI interrupt request.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.

Return values

- **None:**

HAL_SPI_TxCpltCallback

Function name

void HAL_SPI_TxCpltCallback (SPI_HandleTypeDef * hspi)

Function description

Tx Transfer completed callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

HAL_SPI_RxCpltCallback

Function name

void HAL_SPI_RxCpltCallback (SPI_HandleTypeDef * hspi)

Function description

Rx Transfer completed callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

`HAL_SPI_TxRxCpltCallback`

Function name

void HAL_SPI_TxRxCpltCallback (SPI_HandleTypeDef * hspi)

Function description

Tx and Rx Transfer completed callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

`HAL_SPI_TxHalfCpltCallback`

Function name

void HAL_SPI_TxHalfCpltCallback (SPI_HandleTypeDef * hspi)

Function description

Tx Half Transfer completed callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

`HAL_SPI_RxHalfCpltCallback`

Function name

void HAL_SPI_RxHalfCpltCallback (SPI_HandleTypeDef * hspi)

Function description

Rx Half Transfer completed callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

`HAL_SPI_TxRxHalfCpltCallback`

Function name

void HAL_SPI_TxRxHalfCpltCallback (SPI_HandleTypeDef * hspi)

Function description

Tx and Rx Half Transfer callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

`HAL_SPI_ErrorCallback`

Function name

void HAL_SPI_ErrorCallback (SPI_HandleTypeDef * hspi)

Function description

SPI error callback.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **None:**

`HAL_SPI_AbortCpltCallback`

Function name

void HAL_SPI_AbortCpltCallback (SPI_HandleTypeDef * hspi)

Function description

SPI Abort Complete callback.

Parameters

- **hspi:** SPI handle.

Return values

- **None:**

`HAL_SPI_GetState`

Function name

HAL_SPI_StateTypeDef HAL_SPI_GetState (SPI_HandleTypeDef * hspi)

Function description

Return the SPI handle state.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **SPI:** state

`HAL_SPI_GetError`

Function name

uint32_t HAL_SPI_GetError (SPI_HandleTypeDef * hspi)

Function description

Return the SPI error code.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values

- **SPI:** error code in bitmap format

70.3 SPI Firmware driver defines

The following section lists the various define and macros of the module.

70.3.1 SPI

SPI

SPI BaudRate Prescaler

SPI_BAUDRATEPRESCALER_2

SPI_BAUDRATEPRESCALER_4

SPI_BAUDRATEPRESCALER_8

SPI_BAUDRATEPRESCALER_16

SPI_BAUDRATEPRESCALER_32

SPI_BAUDRATEPRESCALER_64

SPI_BAUDRATEPRESCALER_128

SPI_BAUDRATEPRESCALER_256

SPI Clock Phase

SPI_PHASE_1EDGE

SPI_PHASE_2EDGE

SPI Clock Polarity

SPI_POLARITY_LOW

SPI_POLARITY_HIGH

SPI CRC Calculation

SPI_CRCCALCULATION_DISABLE

SPI_CRCCALCULATION_ENABLE

SPI CRC Length

SPI_CRC_LENGTH_DATASIZE

SPI_CRC_LENGTH_8BIT

SPI_CRC_LENGTH_16BIT

SPI Data Size

SPI_DATASIZE_4BIT

SPI_DATASIZE_5BIT

SPI_DATASIZE_6BIT

SPI_DATASIZE_7BIT

SPI_DATASIZE_8BIT

SPI_DATASIZE_9BIT

SPI_DATASIZE_10BIT

SPI_DATASIZE_11BIT

SPI_DATASIZE_12BIT

SPI_DATASIZE_13BIT

SPI_DATASIZE_14BIT

SPI_DATASIZE_15BIT

SPI_DATASIZE_16BIT

SPI Direction Mode

SPI_DIRECTION_2LINES

SPI_DIRECTION_2LINES_RXONLY

SPI_DIRECTION_1LINE

SPI Error Code

HAL_SPI_ERROR_NONE

No error

HAL_SPI_ERROR_MODF

MODF error

HAL_SPI_ERROR_CRC

CRC error

HAL_SPI_ERROR_OVR

OVR error

HAL_SPI_ERROR_FRE

FRE error

HAL_SPI_ERROR_DMA

DMA transfer error

HAL_SPI_ERROR_FLAG

Error on RXNE/TXE/BSY/FTLVL/FRLVL Flag

HAL_SPI_ERROR_ABORT

Error during SPI Abort procedure

SPI Exported Macros

__HAL_SPI_RESET_HANDLE_STATE

Description:

- Reset SPI handle state.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

__HAL_SPI_ENABLE_IT

Description:

- Enable the specified SPI interrupts.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.
- __INTERRUPT__: specifies the interrupt source to enable. This parameter can be one of the following values:
  - SPI_IT_TXE: Tx buffer empty interrupt enable
  - SPI_IT_RXNE: RX buffer not empty interrupt enable
  - SPI_IT_ERR: Error interrupt enable

Return value:

- None

__HAL_SPI_DISABLE_IT

Description:

- Disable the specified SPI interrupts.

Parameters:

- __HANDLE__: specifies the SPI handle. This parameter can be SPIx where x: 1, 2, or 3 to select the SPI peripheral.
- __INTERRUPT__: specifies the interrupt source to disable. This parameter can be one of the following values:
  - SPI_IT_TXE: Tx buffer empty interrupt enable
  - SPI_IT_RXNE: RX buffer not empty interrupt enable
  - SPI_IT_ERR: Error interrupt enable

Return value:

- None

__HAL_SPI_GET_IT_SOURCE

Description:

- Check whether the specified SPI interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.
- __INTERRUPT__: specifies the SPI interrupt source to check. This parameter can be one of the following values:
  - SPI_IT_TXE: Tx buffer empty interrupt enable
  - SPI_IT_RXNE: RX buffer not empty interrupt enable
  - SPI_IT_ERR: Error interrupt enable

Return value:

- The: new state of __IT__ (TRUE or FALSE).

__HAL_SPI_GET_FLAG

Description:

- Check whether the specified SPI flag is set or not.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - SPI_FLAG_RXNE: Receive buffer not empty flag
  - SPI_FLAG_TXE: Transmit buffer empty flag
  - SPI_FLAG_CRCERR: CRC error flag
  - SPI_FLAG_MODF: Mode fault flag
  - SPI_FLAG_OVR: Overrun flag
  - SPI_FLAG_BSY: Busy flag
  - SPI_FLAG_FRE: Frame format error flag
  - SPI_FLAG_FTLVL: SPI fifo transmission level
  - SPI_FLAG_FRLVL: SPI fifo reception level

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_SPI_CLEAR_CRCERRFLAG

Description:

- Clear the SPI CRCERR pending flag.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

__HAL_SPI_CLEAR_MODFFLAG

Description:

- Clear the SPI MODF pending flag.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

__HAL_SPI_CLEAR_OVRFLAG

Description:

- Clear the SPI OVR pending flag.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

__HAL_SPI_CLEAR_FREFLAG

Description:

- Clear the SPI FRE pending flag.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

__HAL_SPI_ENABLE

Description:

- Enable the SPI peripheral.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

__HAL_SPI_DISABLE

Description:

- Disable the SPI peripheral.

Parameters:

- __HANDLE__: specifies the SPI Handle. This parameter can be SPI where x: 1, 2, or 3 to select the SPI peripheral.

Return value:

- None

SPI FIFO Reception Threshold

SPI_RXFIFO_THRESHOLD

SPI_RXFIFO_THRESHOLD_QF

SPI_RXFIFO_THRESHOLD_HF

SPI Flags Definition

SPI_FLAG_RXNE

SPI_FLAG_TXE

SPI_FLAG_BSY

SPI_FLAG_CRCERR

SPI_FLAG_MODF

SPI_FLAG_OVR

SPI_FLAG_FRE

SPI_FLAG_FTLVL

SPI_FLAG_FRLVL

SPI_FLAG_MASK

SPI Interrupt Definition

SPI_IT_TXE

SPI_IT_RXNE

SPI_IT_ERR

SPI Mode

SPI_MODE_SLAVE

SPI_MODE_MASTER

SPI MSB LSB Transmission

SPI_FIRSTBIT_MSB

SPI_FIRSTBIT_LSB

SPI NSS Pulse Mode

SPI_NSS_PULSE_ENABLE

SPI_NSS_PULSE_DISABLE

SPI Reception FIFO Status Level

SPI_FRLVL_EMPTY

SPI_FRLVL_QUARTER_FULL

SPI_FRLVL_HALF_FULL

SPI_FRLVL_FULL

SPI Slave Select Management

SPI_NSS_SOFT

SPI_NSS_HARD_INPUT

SPI_NSS_HARD_OUTPUT

SPI TI Mode

SPI_TIMODE_DISABLE

SPI_TIMODE_ENABLE

SPI Transmission FIFO Status Level

SPI_FTLVL_EMPTY

SPI_FTLVL_QUARTER_FULL

SPI_FTLVL_HALF_FULL

SPI_FTLVL_FULL

71 HAL SPI Extension Driver

71.1 SPIEx Firmware driver API description

The following section lists the various functions of the SPIEx library.

71.1.1 IO operation functions

This subsection provides a set of extended functions to manage the SPI data transfers.

1. Rx data flush function:
   – HAL_SPIEx_FlushRxFifo()

This section contains the following APIs:

- ***HAL_SPIEx_FlushRxFifo***

71.1.2 Detailed description of functions

`HAL_SPIEx_FlushRxFifo`

Function name

HAL_StatusTypeDef HAL_SPIEx_FlushRxFifo (SPI_HandleTypeDef * hspi)

Function description

Flush the RX fifo.

Parameters

- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified SPI module.

Return values

- **HAL:** status

72 HAL TIM Generic Driver

72.1 TIM Firmware driver registers structures

72.1.1 TIM_Base_InitTypeDef

TIM_Base_InitTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t CounterMode***
- ***uint32_t Period***
- ***uint32_t ClockDivision***
- ***uint32_t RepetitionCounter***
- ***uint32_t AutoReloadPreload***

Field Documentation

- ***uint32_t TIM_Base_InitTypeDef::Prescaler***

  Specifies the prescaler value used to divide the TIM clock. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t TIM_Base_InitTypeDef::CounterMode***

  Specifies the counter mode. This parameter can be a value of ***TIM_Counter_Mode***
- ***uint32_t TIM_Base_InitTypeDef::Period***

  Specifies the period value to be loaded into the active Auto-Reload Register at the next update event. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- ***uint32_t TIM_Base_InitTypeDef::ClockDivision***

  Specifies the clock division. This parameter can be a value of ***TIM_ClockDivision***
- ***uint32_t TIM_Base_InitTypeDef::RepetitionCounter***

  Specifies the repetition counter value. Each time the RCR downcounter reaches zero, an update event is generated and counting restarts from the RCR value (N). This means in PWM mode that (N+1) corresponds to:
  - the number of PWM periods in edge-aligned mode
  - the number of half PWM period in center-aligned mode GP timers: this parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF. Advanced timers: this parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.
- ***uint32_t TIM_Base_InitTypeDef::AutoReloadPreload***

  Specifies the auto-reload preload. This parameter can be a value of ***TIM_AutoReloadPreload***

72.1.2 TIM_OC_InitTypeDef

TIM_OC_InitTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t OCMode***
- ***uint32_t Pulse***
- ***uint32_t OCPolarity***
- ***uint32_t OCNPolarity***
- ***uint32_t OCFastMode***
- ***uint32_t OCIdleState***
- ***uint32_t OCNIdleState***

Field Documentation

- ***uint32_t TIM_OC_InitTypeDef::OCMode***

  Specifies the TIM mode. This parameter can be a value of ***TIM_Output_Compare_and_PWM_modes***

- ***uint32_t TIM_OC_InitTypeDef::Pulse***
  Specifies the pulse value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t TIM_OC_InitTypeDef::OCPolarity***
  Specifies the output polarity. This parameter can be a value of *TIM_Output_Compare_Polarity*
- ***uint32_t TIM_OC_InitTypeDef::OCNPolarity***
  Specifies the complementary output polarity. This parameter can be a value of *TIM_Output_Compare_N_Polarity*
  Note:
  – This parameter is valid only for timer instances supporting break feature.
- ***uint32_t TIM_OC_InitTypeDef::OCFastMode***
  Specifies the Fast mode state. This parameter can be a value of *TIM_Output_Fast_State*
  Note:
  – This parameter is valid only in PWM1 and PWM2 mode.
- ***uint32_t TIM_OC_InitTypeDef::OCIdleState***
  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of *TIM_Output_Compare_Idle_State*
  Note:
  – This parameter is valid only for timer instances supporting break feature.
- ***uint32_t TIM_OC_InitTypeDef::OCNIdleState***
  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of *TIM_Output_Compare_N_Idle_State*
  Note:
  – This parameter is valid only for timer instances supporting break feature.

72.1.3 TIM_OnePulse_InitTypeDef

TIM_OnePulse_InitTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t OCMode***
- ***uint32_t Pulse***
- ***uint32_t OCPolarity***
- ***uint32_t OCNPolarity***
- ***uint32_t OCIdleState***
- ***uint32_t OCNIdleState***
- ***uint32_t ICPolarity***
- ***uint32_t ICSelection***
- ***uint32_t ICFilter***

Field Documentation

- ***uint32_t TIM_OnePulse_InitTypeDef::OCMode***
  Specifies the TIM mode. This parameter can be a value of *TIM_Output_Compare_and_PWM_modes*
- ***uint32_t TIM_OnePulse_InitTypeDef::Pulse***
  Specifies the pulse value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF
- ***uint32_t TIM_OnePulse_InitTypeDef::OCPolarity***
  Specifies the output polarity. This parameter can be a value of *TIM_Output_Compare_Polarity*
- ***uint32_t TIM_OnePulse_InitTypeDef::OCNPolarity***
  Specifies the complementary output polarity. This parameter can be a value of *TIM_Output_Compare_N_Polarity*
  Note:
  – This parameter is valid only for timer instances supporting break feature.

- ***uint32_t TIM_OnePulse_InitTypeDef::OCIdleState***
  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of *TIM_Output_Compare_Idle_State*
  Note:
  – This parameter is valid only for timer instances supporting break feature.
- ***uint32_t TIM_OnePulse_InitTypeDef::OCNIdleState***
  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of *TIM_Output_Compare_N_Idle_State*
  Note:
  – This parameter is valid only for timer instances supporting break feature.
- ***uint32_t TIM_OnePulse_InitTypeDef::ICPolarity***
  Specifies the active edge of the input signal. This parameter can be a value of *TIM_Input_Capture_Polarity*
- ***uint32_t TIM_OnePulse_InitTypeDef::ICSelection***
  Specifies the input. This parameter can be a value of *TIM_Input_Capture_Selection*
- ***uint32_t TIM_OnePulse_InitTypeDef::ICFilter***
  Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

72.1.4 TIM_IC_InitTypeDef

TIM_IC_InitTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t ICPolarity***
- ***uint32_t ICSelection***
- ***uint32_t ICPrescaler***
- ***uint32_t ICFilter***

Field Documentation

- ***uint32_t TIM_IC_InitTypeDef::ICPolarity***
  Specifies the active edge of the input signal. This parameter can be a value of *TIM_Input_Capture_Polarity*
- ***uint32_t TIM_IC_InitTypeDef::ICSelection***
  Specifies the input. This parameter can be a value of *TIM_Input_Capture_Selection*
- ***uint32_t TIM_IC_InitTypeDef::ICPrescaler***
  Specifies the Input Capture Prescaler. This parameter can be a value of *TIM_Input_Capture_Prescaler*
- ***uint32_t TIM_IC_InitTypeDef::ICFilter***
  Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

72.1.5 TIM_Encoder_InitTypeDef

TIM_Encoder_InitTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t EncoderMode***
- ***uint32_t IC1Polarity***
- ***uint32_t IC1Selection***
- ***uint32_t IC1Prescaler***
- ***uint32_t IC1Filter***
- ***uint32_t IC2Polarity***
- ***uint32_t IC2Selection***
- ***uint32_t IC2Prescaler***
- ***uint32_t IC2Filter***

Field Documentation

- ***uint32_t TIM_Encoder_InitTypeDef::EncoderMode***
  Specifies the active edge of the input signal. This parameter can be a value of *TIM_Encoder_Mode*
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Polarity***
  Specifies the active edge of the input signal. This parameter can be a value of *TIM_Input_Capture_Polarity*
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Selection***
  Specifies the input. This parameter can be a value of *TIM_Input_Capture_Selection*
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Prescaler***
  Specifies the Input Capture Prescaler. This parameter can be a value of *TIM_Input_Capture_Prescaler*
- ***uint32_t TIM_Encoder_InitTypeDef::IC1Filter***
  Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Polarity***
  Specifies the active edge of the input signal. This parameter can be a value of *TIM_Input_Capture_Polarity*
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Selection***
  Specifies the input. This parameter can be a value of *TIM_Input_Capture_Selection*
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Prescaler***
  Specifies the Input Capture Prescaler. This parameter can be a value of *TIM_Input_Capture_Prescaler*
- ***uint32_t TIM_Encoder_InitTypeDef::IC2Filter***
  Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

72.1.6 TIM_ClockConfigTypeDef

TIM_ClockConfigTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t ClockSource***
- ***uint32_t ClockPolarity***
- ***uint32_t ClockPrescaler***
- ***uint32_t ClockFilter***

Field Documentation

- ***uint32_t TIM_ClockConfigTypeDef::ClockSource***
  TIM clock sources This parameter can be a value of *TIM_Clock_Source*
- ***uint32_t TIM_ClockConfigTypeDef::ClockPolarity***
  TIM clock polarity This parameter can be a value of *TIM_Clock_Polarity*
- ***uint32_t TIM_ClockConfigTypeDef::ClockPrescaler***
  TIM clock prescaler This parameter can be a value of *TIM_Clock_Prescaler*
- ***uint32_t TIM_ClockConfigTypeDef::ClockFilter***
  TIM clock filter This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

72.1.7 TIM_ClearInputConfigTypeDef

TIM_ClearInputConfigTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t ClearInputState***
- ***uint32_t ClearInputSource***
- ***uint32_t ClearInputPolarity***
- ***uint32_t ClearInputPrescaler***
- ***uint32_t ClearInputFilter***

Field Documentation

- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputState***
  TIM clear Input state This parameter can be ENABLE or DISABLE

- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputSource***
  TIM clear Input sources This parameter can be a value of ***TIM_ClearInput_Source***
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputPolarity***
  TIM Clear Input polarity This parameter can be a value of ***TIM_ClearInput_Polarity***
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputPrescaler***
  TIM Clear Input prescaler This parameter must be 0: When OCRef clear feature is used with ETR source, ETR prescaler must be off
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputFilter***
  TIM Clear Input filter This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

72.1.8 TIM_MasterConfigTypeDef

TIM_MasterConfigTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t MasterOutputTrigger***
- ***uint32_t MasterOutputTrigger2***
- ***uint32_t MasterSlaveMode***

Field Documentation

- ***uint32_t TIM_MasterConfigTypeDef::MasterOutputTrigger***
  Trigger output (TRGO) selection This parameter can be a value of ***TIM_Master_Mode_Selection***
- ***uint32_t TIM_MasterConfigTypeDef::MasterOutputTrigger2***
  Trigger output2 (TRGO2) selection This parameter can be a value of ***TIM_Master_Mode_Selection_2***
- ***uint32_t TIM_MasterConfigTypeDef::MasterSlaveMode***
  Master/slave mode selection This parameter can be a value of ***TIM_Master_Slave_Mode***

72.1.9 TIM_SlaveConfigTypeDef

TIM_SlaveConfigTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t SlaveMode***
- ***uint32_t InputTrigger***
- ***uint32_t TriggerPolarity***
- ***uint32_t TriggerPrescaler***
- ***uint32_t TriggerFilter***

Field Documentation

- ***uint32_t TIM_SlaveConfigTypeDef::SlaveMode***
  Slave mode selection This parameter can be a value of ***TIM_Slave_Mode***
- ***uint32_t TIM_SlaveConfigTypeDef::InputTrigger***
  Input Trigger source This parameter can be a value of ***TIM_Trigger_Selection***
- ***uint32_t TIM_SlaveConfigTypeDef::TriggerPolarity***
  Input Trigger polarity This parameter can be a value of ***TIM_Trigger_Polarity***
- ***uint32_t TIM_SlaveConfigTypeDef::TriggerPrescaler***
  Input trigger prescaler This parameter can be a value of ***TIM_Trigger_Prescaler***
- ***uint32_t TIM_SlaveConfigTypeDef::TriggerFilter***
  Input trigger filter This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

72.1.10 TIM_BreakDeadTimeConfigTypeDef

TIM_BreakDeadTimeConfigTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***uint32_t OffStateRunMode***
- ***uint32_t OffStateIDLEMode***
- ***uint32_t LockLevel***

- ***uint32_t DeadTime***
- ***uint32_t BreakState***
- ***uint32_t BreakPolarity***
- ***uint32_t BreakFilter***
- ***uint32_t Break2State***
- ***uint32_t Break2Polarity***
- ***uint32_t Break2Filter***
- ***uint32_t AutomaticOutput***

Field Documentation

- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::OffStateRunMode***
  TIM off state in run mode This parameter can be a value of *TIM_OSSR_Off_State_Selection_for_Run_mode_state*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::OffStateIDLEMode***
  TIM off state in IDLE mode This parameter can be a value of *TIM_OSSI_Off_State_Selection_for_Idle_mode_state*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::LockLevel***
  TIM Lock level This parameter can be a value of *TIM_Lock_level*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::DeadTime***
  TIM dead Time This parameter can be a number between Min_Data = 0x00 and Max_Data = 0xFF
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::BreakState***
  TIM Break State This parameter can be a value of *TIM_Break_Input_enable_disable*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::BreakPolarity***
  TIM Break input polarity This parameter can be a value of *TIM_Break_Polarity*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::BreakFilter***
  Specifies the break input filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::Break2State***
  TIM Break2 State This parameter can be a value of *TIM_Break2_Input_enable_disable*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::Break2Polarity***
  TIM Break2 input polarity This parameter can be a value of *TIM_Break2_Polarity*
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::Break2Filter***
  TIM break2 input filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- ***uint32_t TIM_BreakDeadTimeConfigTypeDef::AutomaticOutput***
  TIM Automatic Output Enable state This parameter can be a value of *TIM_AOE_Bit_Set_Reset*

72.1.11 TIM_HandleTypeDef

TIM_HandleTypeDef is defined in the stm32l4xx_hal_tim.h

Data Fields

- ***TIM_TypeDef * Instance***
- ***TIM_Base_InitTypeDef Init***
- ***HAL_TIM_ActiveChannel Channel***
- ***DMA_HandleTypeDef * hdma***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_TIM_StateTypeDef State***

Field Documentation

- ***TIM_TypeDef* TIM_HandleTypeDef::Instance***
  Register base address
- ***TIM_Base_InitTypeDef TIM_HandleTypeDef::Init***
  TIM Time Base required parameters

- ***HAL_TIM_ActiveChannel TIM_HandleTypeDef::Channel***
  Active channel
- ***DMA_HandleTypeDef* TIM_HandleTypeDef::hdma[7]***
  DMA Handlers array This array is accessed by a ***DMA_Handle_index***
- ***HAL_LockTypeDef TIM_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_TIM_StateTypeDef TIM_HandleTypeDef::State***
  TIM operation state

72.2 TIM Firmware driver API description

The following section lists the various functions of the TIM library.

72.2.1 TIMER Generic features

The Timer features include:

1. 16-bit up, down, up/down auto-reload counter.
2. 16-bit programmable prescaler allowing dividing (also on the fly) the counter clock frequency either by any factor between 1 and 65536.
3. Up to 4 independent channels for:
   – Input Capture
   – Output Compare
   – PWM generation (Edge and Center-aligned Mode)
   – One-pulse mode output
4. Synchronization circuit to control the timer with external signals and to interconnect several timers together.
5. Supports incremental encoder for positioning purposes

72.2.2 How to use this driver

1. Initialize the TIM low level resources by implementing the following functions depending on the selected feature:
   – Time Base : HAL_TIM_Base_MspInit()
   – Input Capture : HAL_TIM_IC_MspInit()
   – Output Compare : HAL_TIM_OC_MspInit()
   – PWM generation : HAL_TIM_PWM_MspInit()
   – One-pulse mode output : HAL_TIM_OnePulse_MspInit()
   – Encoder mode output : HAL_TIM_Encoder_MspInit()
2. Initialize the TIM low level resources :
   a. Enable the TIM interface clock using __HAL_RCC_TIMx_CLK_ENABLE();
   b. TIM pins configuration
      ◦ Enable the clock for the TIM GPIOs using the following function: __HAL_RCC_GPIOx_CLK_ENABLE();
      ◦ Configure these TIM pins in Alternate function mode using HAL_GPIO_Init();
3. The external Clock can be configured, if needed (the default clock is the internal clock from the APBx), using the following function: HAL_TIM_ConfigClockSource, the clock configuration should be done before any start function.

4. Configure the TIM in the desired functioning mode using one of the Initialization function of this driver:
   - HAL_TIM_Base_Init: to use the Timer to generate a simple time base
   - HAL_TIM_OC_Init and HAL_TIM_OC_ConfigChannel: to use the Timer to generate an Output Compare signal.
   - HAL_TIM_PWM_Init and HAL_TIM_PWM_ConfigChannel: to use the Timer to generate a PWM signal.
   - HAL_TIM_IC_Init and HAL_TIM_IC_ConfigChannel: to use the Timer to measure an external signal.
   - HAL_TIM_OnePulse_Init and HAL_TIM_OnePulse_ConfigChannel: to use the Timer in One Pulse Mode.
   - HAL_TIM_Encoder_Init: to use the Timer Encoder Interface.
5. Activate the TIM peripheral using one of the start functions depending from the feature used:
   - Time Base : HAL_TIM_Base_Start(), HAL_TIM_Base_Start_DMA(), HAL_TIM_Base_Start_IT()
   - Input Capture : HAL_TIM_IC_Start(), HAL_TIM_IC_Start_DMA(), HAL_TIM_IC_Start_IT()
   - Output Compare : HAL_TIM_OC_Start(), HAL_TIM_OC_Start_DMA(), HAL_TIM_OC_Start_IT()
   - PWM generation : HAL_TIM_PWM_Start(), HAL_TIM_PWM_Start_DMA(), HAL_TIM_PWM_Start_IT()
   - One-pulse mode output : HAL_TIM_OnePulse_Start(), HAL_TIM_OnePulse_Start_IT()
   - Encoder mode output : HAL_TIM_Encoder_Start(), HAL_TIM_Encoder_Start_DMA(), HAL_TIM_Encoder_Start_IT().
6. The DMA Burst is managed with the two following functions: HAL_TIM_DMABurst_WriteStart() HAL_TIM_DMABurst_ReadStart()

Callback registration

The compilation define USE_HAL_TIM_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_TIM_RegisterCallback() to register a callback. @ref HAL_TIM_RegisterCallback() takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_TIM_UnRegisterCallback() to reset a callback to the default weak function. @ref HAL_TIM_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID.

These functions allow to register/unregister following callbacks:

- Base_MspInitCallback : TIM Base Msp Init Callback.
- Base_MspDeInitCallback : TIM Base Msp DeInit Callback.
- IC_MspInitCallback : TIM IC Msp Init Callback.
- IC_MspDeInitCallback : TIM IC Msp DeInit Callback.
- OC_MspInitCallback : TIM OC Msp Init Callback.
- OC_MspDeInitCallback : TIM OC Msp DeInit Callback.
- PWM_MspInitCallback : TIM PWM Msp Init Callback.
- PWM_MspDeInitCallback : TIM PWM Msp DeInit Callback.
- OnePulse_MspInitCallback : TIM One Pulse Msp Init Callback.
- OnePulse_MspDeInitCallback : TIM One Pulse Msp DeInit Callback.
- Encoder_MspInitCallback : TIM Encoder Msp Init Callback.
- Encoder_MspDeInitCallback : TIM Encoder Msp DeInit Callback.
- HallSensor_MspInitCallback : TIM Hall Sensor Msp Init Callback.
- HallSensor_MspDeInitCallback : TIM Hall Sensor Msp DeInit Callback.
- PeriodElapsedCallback : TIM Period Elapsed Callback.
- PeriodElapsedHalfCpltCallback : TIM Period Elapsed half complete Callback.
- TriggerCallback : TIM Trigger Callback.
- TriggerHalfCpltCallback : TIM Trigger half complete Callback.
- IC_CaptureCallback : TIM Input Capture Callback.
- IC_CaptureHalfCpltCallback : TIM Input Capture half complete Callback.
- OC_DelayElapsedCallback : TIM Output Compare Delay Elapsed Callback.
- PWM_PulseFinishedCallback : TIM PWM Pulse Finished Callback.

- PWM_PulseFinishedHalfCpltCallback : TIM PWM Pulse Finished half complete Callback.
- ErrorCallback : TIM Error Callback.
- CommutationCallback : TIM Commutation Callback.
- CommutationHalfCpltCallback : TIM Commutation half complete Callback.
- BreakCallback : TIM Break Callback.
- Break2Callback : TIM Break2 Callback.

By default, after the Init and when the state is HAL_TIM_STATE_RESET all interrupt callbacks are set to the corresponding weak functions: examples @ref HAL_TIM_TriggerCallback(), @ref HAL_TIM_ErrorCallback().

Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functionalities in the Init / DeInit only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the Init / DeInit keep and use the user MspInit / MspDeInit callbacks(registered beforehand)

Callbacks can be registered / unregistered in HAL_TIM_STATE_READY state only. Exception done MspInit / MspDeInit that can be registered / unregistered in HAL_TIM_STATE_READY or HAL_TIM_STATE_RESET state, thus registered(user) MspInit / DeInit callbacks can be used during the Init / DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_TIM_RegisterCallback() before calling DeInit or Init function.

When The compilation define USE_HAL_TIM_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

72.2.3 Time Base functions

This section provides functions allowing to:

- Initialize and configure the TIM base.
- De-initialize the TIM base.
- Start the Time Base.
- Stop the Time Base.
- Start the Time Base and enable interrupt.
- Stop the Time Base and disable interrupt.
- Start the Time Base and enable DMA transfer.
- Stop the Time Base and disable DMA transfer.

This section contains the following APIs:

- ***HAL_TIM_Base_Init***
- ***HAL_TIM_Base_DeInit***
- ***HAL_TIM_Base_MspInit***
- ***HAL_TIM_Base_MspDeInit***
- ***HAL_TIM_Base_Start***
- ***HAL_TIM_Base_Stop***
- ***HAL_TIM_Base_Start_IT***
- ***HAL_TIM_Base_Stop_IT***
- ***HAL_TIM_Base_Start_DMA***
- ***HAL_TIM_Base_Stop_DMA***

72.2.4 TIM Output Compare functions

This section provides functions allowing to:

- Initialize and configure the TIM Output Compare.
- De-initialize the TIM Output Compare.
- Start the TIM Output Compare.
- Stop the TIM Output Compare.
- Start the TIM Output Compare and enable interrupt.
- Stop the TIM Output Compare and disable interrupt.
- Start the TIM Output Compare and enable DMA transfer.
- Stop the TIM Output Compare and disable DMA transfer.

This section contains the following APIs:

- ***HAL_TIM_OC_Init***
- ***HAL_TIM_OC_DeInit***
- ***HAL_TIM_OC_MspInit***
- ***HAL_TIM_OC_MspDeInit***
- ***HAL_TIM_OC_Start***
- ***HAL_TIM_OC_Stop***
- ***HAL_TIM_OC_Start_IT***
- ***HAL_TIM_OC_Stop_IT***
- ***HAL_TIM_OC_Start_DMA***
- ***HAL_TIM_OC_Stop_DMA***

72.2.5 TIM PWM functions

This section provides functions allowing to:

- Initialize and configure the TIM PWM.
- De-initialize the TIM PWM.
- Start the TIM PWM.
- Stop the TIM PWM.
- Start the TIM PWM and enable interrupt.
- Stop the TIM PWM and disable interrupt.
- Start the TIM PWM and enable DMA transfer.
- Stop the TIM PWM and disable DMA transfer.

This section contains the following APIs:

- ***HAL_TIM_PWM_Init***
- ***HAL_TIM_PWM_DeInit***
- ***HAL_TIM_PWM_MspInit***
- ***HAL_TIM_PWM_MspDeInit***
- ***HAL_TIM_PWM_Start***
- ***HAL_TIM_PWM_Stop***
- ***HAL_TIM_PWM_Start_IT***
- ***HAL_TIM_PWM_Stop_IT***
- ***HAL_TIM_PWM_Start_DMA***
- ***HAL_TIM_PWM_Stop_DMA***

72.2.6 TIM Input Capture functions

This section provides functions allowing to:

- Initialize and configure the TIM Input Capture.
- De-initialize the TIM Input Capture.
- Start the TIM Input Capture.
- Stop the TIM Input Capture.
- Start the TIM Input Capture and enable interrupt.
- Stop the TIM Input Capture and disable interrupt.
- Start the TIM Input Capture and enable DMA transfer.
- Stop the TIM Input Capture and disable DMA transfer.

This section contains the following APIs:

- ***HAL_TIM_IC_Init***
- ***HAL_TIM_IC_DeInit***
- ***HAL_TIM_IC_MspInit***

- *HAL_TIM_IC_MspDeInit*
- *HAL_TIM_IC_Start*
- *HAL_TIM_IC_Stop*
- *HAL_TIM_IC_Start_IT*
- *HAL_TIM_IC_Stop_IT*
- *HAL_TIM_IC_Start_DMA*
- *HAL_TIM_IC_Stop_DMA*

72.2.7 TIM One Pulse functions

This section provides functions allowing to:

- Initialize and configure the TIM One Pulse.
- De-initialize the TIM One Pulse.
- Start the TIM One Pulse.
- Stop the TIM One Pulse.
- Start the TIM One Pulse and enable interrupt.
- Stop the TIM One Pulse and disable interrupt.
- Start the TIM One Pulse and enable DMA transfer.
- Stop the TIM One Pulse and disable DMA transfer.

This section contains the following APIs:

- *HAL_TIM_OnePulse_Init*
- *HAL_TIM_OnePulse_DeInit*
- *HAL_TIM_OnePulse_MspInit*
- *HAL_TIM_OnePulse_MspDeInit*
- *HAL_TIM_OnePulse_Start*
- *HAL_TIM_OnePulse_Stop*
- *HAL_TIM_OnePulse_Start_IT*
- *HAL_TIM_OnePulse_Stop_IT*

72.2.8 TIM Encoder functions

This section provides functions allowing to:

- Initialize and configure the TIM Encoder.
- De-initialize the TIM Encoder.
- Start the TIM Encoder.
- Stop the TIM Encoder.
- Start the TIM Encoder and enable interrupt.
- Stop the TIM Encoder and disable interrupt.
- Start the TIM Encoder and enable DMA transfer.
- Stop the TIM Encoder and disable DMA transfer.

This section contains the following APIs:

- *HAL_TIM_Encoder_Init*
- *HAL_TIM_Encoder_DeInit*
- *HAL_TIM_Encoder_MspInit*
- *HAL_TIM_Encoder_MspDeInit*
- *HAL_TIM_Encoder_Start*
- *HAL_TIM_Encoder_Stop*
- *HAL_TIM_Encoder_Start_IT*
- *HAL_TIM_Encoder_Stop_IT*
- *HAL_TIM_Encoder_Start_DMA*

- *HAL_TIM_Encoder_Stop_DMA*

72.2.9 TIM Callbacks functions

This section provides TIM callback functions:

- TIM Period elapsed callback
- TIM Output Compare callback
- TIM Input capture callback
- TIM Trigger callback
- TIM Error callback

This section contains the following APIs:

- *HAL_TIM_PeriodElapsedCallback*
- *HAL_TIM_PeriodElapsedHalfCpltCallback*
- *HAL_TIM_OC_DelayElapsedCallback*
- *HAL_TIM_IC_CaptureCallback*
- *HAL_TIM_IC_CaptureHalfCpltCallback*
- *HAL_TIM_PWM_PulseFinishedCallback*
- *HAL_TIM_PWM_PulseFinishedHalfCpltCallback*
- *HAL_TIM_TriggerCallback*
- *HAL_TIM_TriggerHalfCpltCallback*
- *HAL_TIM_ErrorCallback*

72.2.10 Detailed description of functions

`HAL_TIM_Base_Init`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Init (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Time base Unit according to the specified parameters in the TIM_HandleTypeDef and initialize the associated handle.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

Notes

- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode. Ex: call HAL_TIM_Base_DeInit() before HAL_TIM_Base_Init()

`HAL_TIM_Base_DeInit`

Function name

HAL_StatusTypeDef HAL_TIM_Base_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM Base peripheral.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

`HAL_TIM_Base_MspInit`

Function name

void HAL_TIM_Base_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Base MSP.

Parameters

- **htim:** TIM Base handle

Return values

- **None:**

`HAL_TIM_Base_MspDeInit`

Function name

void HAL_TIM_Base_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM Base MSP.

Parameters

- **htim:** TIM Base handle

Return values

- **None:**

`HAL_TIM_Base_Start`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Start (TIM_HandleTypeDef * htim)

Function description

Starts the TIM Base generation.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

`HAL_TIM_Base_Stop`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Stop (TIM_HandleTypeDef * htim)

Function description

Stops the TIM Base generation.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

`HAL_TIM_Base_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Start_IT (TIM_HandleTypeDef * htim)

Function description

Starts the TIM Base generation in interrupt mode.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

`HAL_TIM_Base_Stop_IT`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Stop_IT (TIM_HandleTypeDef * htim)

Function description

Stops the TIM Base generation in interrupt mode.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

`HAL_TIM_Base_Start_DMA`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Start_DMA (TIM_HandleTypeDef * htim, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM Base generation in DMA mode.

Parameters

- **htim:** TIM Base handle
- **pData:** The source Buffer address.
- **Length:** The length of data to be transferred from memory to peripheral.

Return values

- **HAL:** status

`HAL_TIM_Base_Stop_DMA`

Function name

HAL_StatusTypeDef HAL_TIM_Base_Stop_DMA (TIM_HandleTypeDef * htim)

Function description

Stops the TIM Base generation in DMA mode.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** status

`HAL_TIM_OC_Init`

Function name

HAL_StatusTypeDef HAL_TIM_OC_Init (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Output Compare according to the specified parameters in the TIM_HandleTypeDef and initializes the associated handle.

Parameters

- **htim:** TIM Output Compare handle

Return values

- **HAL:** status

Notes

- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode. Ex: call HAL_TIM_OC_DeInit() before HAL_TIM_OC_Init()

`HAL_TIM_OC_DeInit`

Function name

HAL_StatusTypeDef HAL_TIM_OC_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM peripheral.

Parameters

- **htim:** TIM Output Compare handle

Return values

- **HAL:** status

`HAL_TIM_OC_MspInit`

Function name

void HAL_TIM_OC_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Output Compare MSP.

Parameters

- **htim:** TIM Output Compare handle

Return values

- **None:**

HAL_TIM_OC_MspDeInit

Function name

void HAL_TIM_OC_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM Output Compare MSP.

Parameters

- **htim:** TIM Output Compare handle

Return values

- **None:**

HAL_TIM_OC_Start

Function name

HAL_StatusTypeDef HAL_TIM_OC_Start (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Output Compare signal generation.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return values

- **HAL:** status

HAL_TIM_OC_Stop

Function name

HAL_StatusTypeDef HAL_TIM_OC_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Output Compare signal generation.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return values

- **HAL:** status

`HAL_TIM_OC_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIM_OC_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Output Compare signal generation in interrupt mode.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

`HAL_TIM_OC_Stop_IT`

Function name

HAL_StatusTypeDef HAL_TIM_OC_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Output Compare signal generation in interrupt mode.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

`HAL_TIM_OC_Start_DMA`

Function name

HAL_StatusTypeDef HAL_TIM_OC_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM Output Compare signal generation in DMA mode.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
- **pData:** The source Buffer address.
- **Length:** The length of data to be transferred from memory to TIM peripheral

Return values

- **HAL:** status

HAL_TIM_OC_Stop_DMA

Function name

HAL_StatusTypeDef HAL_TIM_OC_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Output Compare signal generation in DMA mode.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Init

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Init (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM PWM Time Base according to the specified parameters in the TIM_HandleTypeDef and initializes the associated handle.

Parameters

- **htim:** TIM PWM handle

Return values

- **HAL:** status

Notes

- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode. Ex: call HAL_TIM_PWM_DeInit() before HAL_TIM_PWM_Init()

HAL_TIM_PWM_DeInit

Function name

HAL_StatusTypeDef HAL_TIM_PWM_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM peripheral.

Parameters

- **htim:** TIM PWM handle

Return values

- **HAL:** status

HAL_TIM_PWM_MspInit

Function name

void HAL_TIM_PWM_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM PWM MSP.

Parameters

- **htim:** TIM PWM handle

Return values

- **None:**

HAL_TIM_PWM_MspDeInit

Function name

void HAL_TIM_PWM_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM PWM MSP.

Parameters

- **htim:** TIM PWM handle

Return values

- **None:**

HAL_TIM_PWM_Start

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Start (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the PWM signal generation.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return values

- **HAL:** status

`HAL_TIM_PWM_Stop`

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the PWM signal generation.

Parameters

- **htim:** TIM PWM handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return values

- **HAL:** status

`HAL_TIM_PWM_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the PWM signal generation in interrupt mode.

Parameters

- **htim:** TIM PWM handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Stop_IT

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the PWM signal generation in interrupt mode.

Parameters

- **htim:** TIM PWM handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_PWM_Start_DMA

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM PWM signal generation in DMA mode.

Parameters

- **htim:** TIM PWM handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
- **pData:** The source Buffer address.
- **Length:** The length of data to be transferred from memory to TIM peripheral

Return values

- **HAL:** status

HAL_TIM_PWM_Stop_DMA

Function name

HAL_StatusTypeDef HAL_TIM_PWM_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM PWM signal generation in DMA mode.

Parameters

- **htim:** TIM PWM handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

`HAL_TIM_IC_Init`

Function name

HAL_StatusTypeDef HAL_TIM_IC_Init (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Input Capture Time base according to the specified parameters in the TIM_HandleTypeDef and initializes the associated handle.

Parameters

- **htim:** TIM Input Capture handle

Return values

- **HAL:** status

Notes

- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode. Ex: call HAL_TIM_IC_DeInit() before HAL_TIM_IC_Init()

`HAL_TIM_IC_DeInit`

Function name

HAL_StatusTypeDef HAL_TIM_IC_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM peripheral.

Parameters

- **htim:** TIM Input Capture handle

Return values

- **HAL:** status

`HAL_TIM_IC_MspInit`

Function name

void HAL_TIM_IC_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Input Capture MSP.

Parameters

- **htim:** TIM Input Capture handle

Return values

- **None:**

`HAL_TIM_IC_MspDeInit`

Function name

void HAL_TIM_IC_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM Input Capture MSP.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIM_IC_Start`

Function name

HAL_StatusTypeDef HAL_TIM_IC_Start (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Input Capture measurement.

Parameters

- **htim:** TIM Input Capture handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

`HAL_TIM_IC_Stop`

Function name

HAL_StatusTypeDef HAL_TIM_IC_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Input Capture measurement.

Parameters

- **htim:** TIM Input Capture handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_Start_IT

Function name

HAL_StatusTypeDef HAL_TIM_IC_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Input Capture measurement in interrupt mode.

Parameters

- **htim:** TIM Input Capture handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_Stop_IT

Function name

HAL_StatusTypeDef HAL_TIM_IC_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Input Capture measurement in interrupt mode.

Parameters

- **htim:** TIM Input Capture handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

HAL_TIM_IC_Start_DMA

Function name

HAL_StatusTypeDef HAL_TIM_IC_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM Input Capture measurement in DMA mode.

Parameters

- **htim:** TIM Input Capture handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
- **pData:** The destination Buffer address.
- **Length:** The length of data to be transferred from TIM peripheral to memory.

Return values

- **HAL:** status

`HAL_TIM_IC_Stop_DMA`

Function name

HAL_StatusTypeDef HAL_TIM_IC_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Input Capture measurement in DMA mode.

Parameters

- **htim:** TIM Input Capture handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

`HAL_TIM_OnePulse_Init`

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_Init (TIM_HandleTypeDef * htim, uint32_t OnePulseMode)

Function description

Initializes the TIM One Pulse Time Base according to the specified parameters in the TIM_HandleTypeDef and initializes the associated handle.

Parameters

- **htim:** TIM One Pulse handle
- **OnePulseMode:** Select the One pulse mode. This parameter can be one of the following values:
  - TIM_OPMODE_SINGLE: Only one pulse will be generated.
  - TIM_OPMODE_REPETITIVE: Repetitive pulses will be generated.

Return values

- **HAL:** status

Notes

- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode. Ex: call HAL_TIM_OnePulse_DeInit() before HAL_TIM_OnePulse_Init()

HAL_TIM_OnePulse_DeInit

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM One Pulse.

Parameters

- **htim:** TIM One Pulse handle

Return values

- **HAL:** status

HAL_TIM_OnePulse_MspInit

Function name

void HAL_TIM_OnePulse_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM One Pulse MSP.

Parameters

- **htim:** TIM One Pulse handle

Return values

- **None:**

HAL_TIM_OnePulse_MspDeInit

Function name

void HAL_TIM_OnePulse_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM One Pulse MSP.

Parameters

- **htim:** TIM One Pulse handle

Return values

- **None:**

HAL_TIM_OnePulse_Start

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_Start (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Starts the TIM One Pulse signal generation.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIM_OnePulse_Stop`

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_Stop (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Stops the TIM One Pulse signal generation.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channels to be disable This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIM_OnePulse_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_Start_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Starts the TIM One Pulse signal generation in interrupt mode.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIM_OnePulse_Stop_IT`

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_Stop_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Stops the TIM One Pulse signal generation in interrupt mode.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

HAL_TIM_Encoder_Init

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Init (TIM_HandleTypeDef * htim, TIM_Encoder_InitTypeDef * sConfig)

Function description

Initializes the TIM Encoder Interface and initialize the associated handle.

Parameters

- **htim:** TIM Encoder Interface handle
- **sConfig:** TIM Encoder Interface configuration structure

Return values

- **HAL:** status

Notes

- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode. Ex: call HAL_TIM_Encoder_DeInit() before HAL_TIM_Encoder_Init()
- Encoder mode and External clock mode 2 are not compatible and must not be selected together Ex: A call for HAL_TIM_Encoder_Init will erase the settings of HAL_TIM_ConfigClockSource using TIM_CLOCKSOURCE_ETRMODE2 and vice versa

HAL_TIM_Encoder_DeInit

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM Encoder interface.

Parameters

- **htim:** TIM Encoder Interface handle

Return values

- **HAL:** status

HAL_TIM_Encoder_MspInit

Function name

void HAL_TIM_Encoder_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Encoder Interface MSP.

Parameters

- **htim:** TIM Encoder Interface handle

Return values

- **None:**

HAL_TIM_Encoder_MspDeInit

Function name

void HAL_TIM_Encoder_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM Encoder Interface MSP.

Parameters

- **htim:** TIM Encoder Interface handle

Return values

- **None:**

`HAL_TIM_Encoder_Start`

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Start (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Encoder Interface.

Parameters

- **htim:** TIM Encoder Interface handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values

- **HAL:** status

`HAL_TIM_Encoder_Stop`

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Encoder Interface.

Parameters

- **htim:** TIM Encoder Interface handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values

- **HAL:** status

`HAL_TIM_Encoder_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Encoder Interface in interrupt mode.

Parameters

- **htim:** TIM Encoder Interface handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values

- **HAL:** status

HAL_TIM_Encoder_Stop_IT

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Encoder Interface in interrupt mode.

Parameters

- **htim:** TIM Encoder Interface handle
- **Channel:** TIM Channels to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values

- **HAL:** status

HAL_TIM_Encoder_Start_DMA

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData1, uint32_t * pData2, uint16_t Length)

Function description

Starts the TIM Encoder Interface in DMA mode.

Parameters

- **htim:** TIM Encoder Interface handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected
- **pData1:** The destination Buffer address for IC1.
- **pData2:** The destination Buffer address for IC2.
- **Length:** The length of data to be transferred from TIM peripheral to memory.

Return values

- **HAL:** status

HAL_TIM_Encoder_Stop_DMA

Function name

HAL_StatusTypeDef HAL_TIM_Encoder_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Encoder Interface in DMA mode.

Parameters

- **htim:** TIM Encoder Interface handle
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_ALL: TIM Channel 1 and TIM Channel 2 are selected

Return values

- **HAL:** status

`HAL_TIM_IRQHandler`

Function name

void HAL_TIM_IRQHandler (TIM_HandleTypeDef * htim)

Function description

This function handles TIM interrupts requests.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIM_OC_ConfigChannel`

Function name

HAL_StatusTypeDef HAL_TIM_OC_ConfigChannel (TIM_HandleTypeDef * htim, TIM_OC_InitTypeDef * sConfig, uint32_t Channel)

Function description

Initializes the TIM Output Compare Channels according to the specified parameters in the TIM_OC_InitTypeDef.

Parameters

- **htim:** TIM Output Compare handle
- **sConfig:** TIM Output Compare configuration structure
- **Channel:** TIM Channels to configure This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return values

- **HAL:** status

`HAL_TIM_PWM_ConfigChannel`

Function name

HAL_StatusTypeDef HAL_TIM_PWM_ConfigChannel (TIM_HandleTypeDef * htim, TIM_OC_InitTypeDef * sConfig, uint32_t Channel)

Function description

Initializes the TIM PWM channels according to the specified parameters in the TIM_OC_InitTypeDef.

Parameters

- **htim:** TIM PWM handle
- **sConfig:** TIM PWM configuration structure
- **Channel:** TIM Channels to be configured This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return values

- **HAL:** status

`HAL_TIM_IC_ConfigChannel`

Function name

HAL_StatusTypeDef HAL_TIM_IC_ConfigChannel (TIM_HandleTypeDef * htim, TIM_IC_InitTypeDef * sConfig, uint32_t Channel)

Function description

Initializes the TIM Input Capture Channels according to the specified parameters in the TIM_IC_InitTypeDef.

Parameters

- **htim:** TIM IC handle
- **sConfig:** TIM Input Capture configuration structure
- **Channel:** TIM Channel to configure This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **HAL:** status

`HAL_TIM_OnePulse_ConfigChannel`

Function name

HAL_StatusTypeDef HAL_TIM_OnePulse_ConfigChannel (TIM_HandleTypeDef * htim, TIM_OnePulse_InitTypeDef * sConfig, uint32_t OutputChannel, uint32_t InputChannel)

Function description

Initializes the TIM One Pulse Channels according to the specified parameters in the TIM_OnePulse_InitTypeDef.

Parameters

- **htim:** TIM One Pulse handle
- **sConfig:** TIM One Pulse configuration structure
- **OutputChannel:** TIM output channel to configure This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
- **InputChannel:** TIM input Channel to configure This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIM_ConfigOCrefClear`

Function name

HAL_StatusTypeDef HAL_TIM_ConfigOCrefClear (TIM_HandleTypeDef * htim, TIM_ClearInputConfigTypeDef * sClearInputConfig, uint32_t Channel)

Function description

Configures the OCRef clear feature.

Parameters

- **htim:** TIM handle
- **sClearInputConfig:** pointer to a TIM_ClearInputConfigTypeDef structure that contains the OCREF clear feature and parameters for the TIM peripheral.
- **Channel:** specifies the TIM Channel This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1
  - TIM_CHANNEL_2: TIM Channel 2
  - TIM_CHANNEL_3: TIM Channel 3
  - TIM_CHANNEL_4: TIM Channel 4
  - TIM_CHANNEL_5: TIM Channel 5
  - TIM_CHANNEL_6: TIM Channel 6

Return values

- **HAL:** status

`HAL_TIM_ConfigClockSource`

Function name

HAL_StatusTypeDef HAL_TIM_ConfigClockSource (TIM_HandleTypeDef * htim, TIM_ClockConfigTypeDef * sClockSourceConfig)

Function description

Configures the clock source to be used.

Parameters

- **htim:** TIM handle
- **sClockSourceConfig:** pointer to a TIM_ClockConfigTypeDef structure that contains the clock source information for the TIM peripheral.

Return values

- **HAL:** status

`HAL_TIM_ConfigTI1Input`

Function name

HAL_StatusTypeDef HAL_TIM_ConfigTI1Input (TIM_HandleTypeDef * htim, uint32_t TI1_Selection)

Function description

Selects the signal connected to the TI1 input: direct from CH1_input or a XOR combination between CH1_input, CH2_input & CH3_input.

Parameters

- **htim:** TIM handle.
- **TI1_Selection:** Indicate whether or not channel 1 is connected to the output of a XOR gate. This parameter can be one of the following values:
  - TIM_TI1SELECTION_CH1: The TIMx_CH1 pin is connected to TI1 input
  - TIM_TI1SELECTION_XORCOMBINATION: The TIMx_CH1, CH2 and CH3 pins are connected to the TI1 input (XOR combination)

Return values

- **HAL:** status

`HAL_TIM_SlaveConfigSynchro`

Function name

HAL_StatusTypeDef HAL_TIM_SlaveConfigSynchro (TIM_HandleTypeDef * htim, TIM_SlaveConfigTypeDef * sSlaveConfig)

Function description

Configures the TIM in Slave mode.

Parameters

- **htim:** TIM handle.
- **sSlaveConfig:** pointer to a TIM_SlaveConfigTypeDef structure that contains the selected trigger (internal trigger input, filtered timer input or external trigger input) and the Slave mode (Disable, Reset, Gated, Trigger, External clock mode 1).

Return values

- **HAL:** status

`HAL_TIM_SlaveConfigSynchro_IT`

Function name

HAL_StatusTypeDef HAL_TIM_SlaveConfigSynchro_IT (TIM_HandleTypeDef * htim, TIM_SlaveConfigTypeDef * sSlaveConfig)

Function description

Configures the TIM in Slave mode in interrupt mode.

Parameters

- **htim:** TIM handle.
- **sSlaveConfig:** pointer to a TIM_SlaveConfigTypeDef structure that contains the selected trigger (internal trigger input, filtered timer input or external trigger input) and the Slave mode (Disable, Reset, Gated, Trigger, External clock mode 1).

Return values

- **HAL:** status

`HAL_TIM_DMABurst_WriteStart`

Function name

HAL_StatusTypeDef HAL_TIM_DMABurst_WriteStart (TIM_HandleTypeDef * htim, uint32_t BurstBaseAddress, uint32_t BurstRequestSrc, uint32_t * BurstBuffer, uint32_t BurstLength)

Function description

Configure the DMA Burst to transfer Data from the memory to the TIM peripheral.

Parameters

- **htim:** TIM handle
- **BurstBaseAddress:** TIM Base address from where the DMA will start the Data write This parameter can be one of the following values:
  - TIM_DMABASE_CR1
  - TIM_DMABASE_CR2
  - TIM_DMABASE_SMCR
  - TIM_DMABASE_DIER
  - TIM_DMABASE_SR
  - TIM_DMABASE_EGR
  - TIM_DMABASE_CCMR1
  - TIM_DMABASE_CCMR2
  - TIM_DMABASE_CCER
  - TIM_DMABASE_CNT
  - TIM_DMABASE_PSC
  - TIM_DMABASE_ARR
  - TIM_DMABASE_RCR
  - TIM_DMABASE_CCR1
  - TIM_DMABASE_CCR2
  - TIM_DMABASE_CCR3
  - TIM_DMABASE_CCR4
  - TIM_DMABASE_BDTR
  - TIM_DMABASE_OR1
  - TIM_DMABASE_CCMR3
  - TIM_DMABASE_CCR5
  - TIM_DMABASE_CCR6
  - TIM_DMABASE_OR2
  - TIM_DMABASE_OR3
- **BurstRequestSrc:** TIM DMA Request sources This parameter can be one of the following values:
  - TIM_DMA_UPDATE: TIM update Interrupt source
  - TIM_DMA_CC1: TIM Capture Compare 1 DMA source
  - TIM_DMA_CC2: TIM Capture Compare 2 DMA source
  - TIM_DMA_CC3: TIM Capture Compare 3 DMA source
  - TIM_DMA_CC4: TIM Capture Compare 4 DMA source
  - TIM_DMA_COM: TIM Commutation DMA source
  - TIM_DMA_TRIGGER: TIM Trigger DMA source
- **BurstBuffer:** The Buffer address.
- **BurstLength:** DMA Burst length. This parameter can be one value between: TIM_DMABURSTLENGTH_1TRANSFER and TIM_DMABURSTLENGTH_18TRANSFERS.

Return values

- **HAL:** status

Notes

- This function should be used only when BurstLength is equal to DMA data transfer length.

HAL_TIM_DMABurst_WriteStop

Function name

HAL_StatusTypeDef HAL_TIM_DMABurst_WriteStop (TIM_HandleTypeDef * htim, uint32_t BurstRequestSrc)

Function description

Stops the TIM DMA Burst mode.

Parameters

- **htim:** TIM handle
- **BurstRequestSrc:** TIM DMA Request sources to disable

Return values

- **HAL:** status

HAL_TIM_DMABurst_ReadStart

Function name

HAL_StatusTypeDef HAL_TIM_DMABurst_ReadStart (TIM_HandleTypeDef * htim, uint32_t BurstBaseAddress, uint32_t BurstRequestSrc, uint32_t * BurstBuffer, uint32_t BurstLength)

Function description

Configure the DMA Burst to transfer Data from the TIM peripheral to the memory.

Parameters

- **htim:** TIM handle
- **BurstBaseAddress:** TIM Base address from where the DMA will start the Data read This parameter can be one of the following values:
  - TIM_DMABASE_CR1
  - TIM_DMABASE_CR2
  - TIM_DMABASE_SMCR
  - TIM_DMABASE_DIER
  - TIM_DMABASE_SR
  - TIM_DMABASE_EGR
  - TIM_DMABASE_CCMR1
  - TIM_DMABASE_CCMR2
  - TIM_DMABASE_CCER
  - TIM_DMABASE_CNT
  - TIM_DMABASE_PSC
  - TIM_DMABASE_ARR
  - TIM_DMABASE_RCR
  - TIM_DMABASE_CCR1
  - TIM_DMABASE_CCR2
  - TIM_DMABASE_CCR3
  - TIM_DMABASE_CCR4
  - TIM_DMABASE_BDTR
  - TIM_DMABASE_OR1
  - TIM_DMABASE_CCMR3
  - TIM_DMABASE_CCR5
  - TIM_DMABASE_CCR6
  - TIM_DMABASE_OR2
  - TIM_DMABASE_OR3
- **BurstRequestSrc:** TIM DMA Request sources This parameter can be one of the following values:
  - TIM_DMA_UPDATE: TIM update Interrupt source
  - TIM_DMA_CC1: TIM Capture Compare 1 DMA source
  - TIM_DMA_CC2: TIM Capture Compare 2 DMA source
  - TIM_DMA_CC3: TIM Capture Compare 3 DMA source
  - TIM_DMA_CC4: TIM Capture Compare 4 DMA source
  - TIM_DMA_COM: TIM Commutation DMA source
  - TIM_DMA_TRIGGER: TIM Trigger DMA source
- **BurstBuffer:** The Buffer address.
- **BurstLength:** DMA Burst length. This parameter can be one value between: TIM_DMABURSTLENGTH_1TRANSFER and TIM_DMABURSTLENGTH_18TRANSFERS.

Return values

- **HAL:** status

Notes

- This function should be used only when BurstLength is equal to DMA data transfer length.

`HAL_TIM_DMABurst_ReadStop`

Function name

HAL_StatusTypeDef HAL_TIM_DMABurst_ReadStop (TIM_HandleTypeDef * htim, uint32_t BurstRequestSrc)

Function description

Stop the DMA burst reading.

Parameters

- **htim:** TIM handle
- **BurstRequestSrc:** TIM DMA Request sources to disable.

Return values

- **HAL:** status

HAL_TIM_GenerateEvent

Function name

HAL_StatusTypeDef HAL_TIM_GenerateEvent (TIM_HandleTypeDef * htim, uint32_t EventSource)

Function description

Generate a software event.

Parameters

- **htim:** TIM handle
- **EventSource:** specifies the event source. This parameter can be one of the following values:
  - TIM_EVENTSOURCE_UPDATE: Timer update Event source
  - TIM_EVENTSOURCE_CC1: Timer Capture Compare 1 Event source
  - TIM_EVENTSOURCE_CC2: Timer Capture Compare 2 Event source
  - TIM_EVENTSOURCE_CC3: Timer Capture Compare 3 Event source
  - TIM_EVENTSOURCE_CC4: Timer Capture Compare 4 Event source
  - TIM_EVENTSOURCE_COM: Timer COM event source
  - TIM_EVENTSOURCE_TRIGGER: Timer Trigger Event source
  - TIM_EVENTSOURCE_BREAK: Timer Break event source
  - TIM_EVENTSOURCE_BREAK2: Timer Break2 event source

Return values

- **HAL:** status

Notes

- Basic timers can only generate an update event.
- TIM_EVENTSOURCE_COM is relevant only with advanced timer instances.
- TIM_EVENTSOURCE_BREAK and TIM_EVENTSOURCE_BREAK2 are relevant only for timer instances supporting break input(s).

HAL_TIM_ReadCapturedValue

Function name

uint32_t HAL_TIM_ReadCapturedValue (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Read the captured value from Capture Compare unit.

Parameters

- **htim:** TIM handle.
- **Channel:** TIM Channels to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected

Return values

- **Captured:** value

`HAL_TIM_PeriodElapsedCallback`

Function name

void HAL_TIM_PeriodElapsedCallback (TIM_HandleTypeDef * htim)

Function description

Period elapsed callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIM_PeriodElapsedHalfCpltCallback`

Function name

void HAL_TIM_PeriodElapsedHalfCpltCallback (TIM_HandleTypeDef * htim)

Function description

Period elapsed half complete callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIM_OC_DelayElapsedCallback`

Function name

void HAL_TIM_OC_DelayElapsedCallback (TIM_HandleTypeDef * htim)

Function description

Output Compare callback in non-blocking mode.

Parameters

- **htim:** TIM OC handle

Return values

- **None:**

HAL_TIM_IC_CaptureCallback

Function name

void HAL_TIM_IC_CaptureCallback (TIM_HandleTypeDef * htim)

Function description

Input Capture callback in non-blocking mode.

Parameters

- **htim:** TIM IC handle

Return values

- **None:**

HAL_TIM_IC_CaptureHalfCpltCallback

Function name

void HAL_TIM_IC_CaptureHalfCpltCallback (TIM_HandleTypeDef * htim)

Function description

Input Capture half complete callback in non-blocking mode.

Parameters

- **htim:** TIM IC handle

Return values

- **None:**

HAL_TIM_PWM_PulseFinishedCallback

Function name

void HAL_TIM_PWM_PulseFinishedCallback (TIM_HandleTypeDef * htim)

Function description

PWM Pulse finished callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

HAL_TIM_PWM_PulseFinishedHalfCpltCallback

Function name

void HAL_TIM_PWM_PulseFinishedHalfCpltCallback (TIM_HandleTypeDef * htim)

Function description

PWM Pulse finished half complete callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

HAL_TIM_TriggerCallback

Function name

void HAL_TIM_TriggerCallback (TIM_HandleTypeDef * htim)

Function description

Hall Trigger detection callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

HAL_TIM_TriggerHalfCpltCallback

Function name

void HAL_TIM_TriggerHalfCpltCallback (TIM_HandleTypeDef * htim)

Function description

Hall Trigger detection half complete callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

HAL_TIM_ErrorCallback

Function name

void HAL_TIM_ErrorCallback (TIM_HandleTypeDef * htim)

Function description

Timer error callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

HAL_TIM_Base_GetState

Function name

HAL_TIM_StateTypeDef HAL_TIM_Base_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM Base handle state.

Parameters

- **htim:** TIM Base handle

Return values

- **HAL:** state

HAL_TIM_OC_GetState

Function name

HAL_TIM_StateTypeDef HAL_TIM_OC_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM OC handle state.

Parameters

- **htim:** TIM Output Compare handle

Return values

- **HAL:** state

HAL_TIM_PWM_GetState

Function name

HAL_TIM_StateTypeDef HAL_TIM_PWM_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM PWM handle state.

Parameters

- **htim:** TIM handle

Return values

- **HAL:** state

HAL_TIM_IC_GetState

Function name

HAL_TIM_StateTypeDef HAL_TIM_IC_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM Input Capture handle state.

Parameters

- **htim:** TIM IC handle

Return values

- **HAL:** state

HAL_TIM_OnePulse_GetState

Function name

HAL_TIM_StateTypeDef HAL_TIM_OnePulse_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM One Pulse Mode handle state.

Parameters

- **htim:** TIM OPM handle

Return values

- **HAL:** state

HAL_TIM_Encoder_GetState

Function name

HAL_TIM_StateTypeDef HAL_TIM_Encoder_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM Encoder Mode handle state.

Parameters

- **htim:** TIM Encoder Interface handle

Return values

- **HAL:** state

TIM_Base_SetConfig

Function name

void TIM_Base_SetConfig (TIM_TypeDef * TIMx, TIM_Base_InitTypeDef * Structure)

Function description

Time Base configuration.

Parameters

- **TIMx:** TIM peripheral
- **Structure:** TIM Base configuration structure

Return values

- **None:**

TIM_TI1_SetConfig

Function name

void TIM_TI1_SetConfig (TIM_TypeDef * TIMx, uint32_t TIM_ICPolarity, uint32_t TIM_ICSelection, uint32_t TIM_ICFilter)

Function description

Configure the TI1 as Input.

Parameters

- **TIMx:** to select the TIM peripheral.
- **TIM_ICPolarity:** The Input Polarity. This parameter can be one of the following values:
  - TIM_ICPOLARITY_RISING
  - TIM_ICPOLARITY_FALLING
  - TIM_ICPOLARITY_BOTHEDGE
- **TIM_ICSelection:** specifies the input to be used. This parameter can be one of the following values:
  - TIM_ICSELECTION_DIRECTTI: TIM Input 1 is selected to be connected to IC1.
  - TIM_ICSELECTION_INDIRECTTI: TIM Input 1 is selected to be connected to IC2.
  - TIM_ICSELECTION_TRC: TIM Input 1 is selected to be connected to TRC.
- **TIM_ICFilter:** Specifies the Input Capture Filter. This parameter must be a value between 0x00 and 0x0F.

Return values

- **None:**

Notes

- TIM_ICFilter and TIM_ICPolarity are not used in INDIRECT mode as TI2FP1 (on channel2 path) is used as the input signal. Therefore CCMR1 must be protected against un-initialized filter and polarity values.

`TIM_OC2_SetConfig`

Function name

void TIM_OC2_SetConfig (TIM_TypeDef * TIMx, TIM_OC_InitTypeDef * OC_Config)

Function description

Timer Output Compare 2 configuration.

Parameters

- **TIMx:** to select the TIM peripheral
- **OC_Config:** The ouput configuration structure

Return values

- **None:**

`TIM_ETR_SetConfig`

Function name

void TIM_ETR_SetConfig (TIM_TypeDef * TIMx, uint32_t TIM_ExtTRGPrescaler, uint32_t TIM_ExtTRGPolarity, uint32_t ExtTRGFilter)

Function description

Configures the TIMx External Trigger (ETR).

Parameters

- **TIMx:** to select the TIM peripheral
- **TIM_ExtTRGPrescaler:** The external Trigger Prescaler. This parameter can be one of the following values:
  - TIM_ETRPRESCALER_DIV1: ETRP Prescaler OFF.
  - TIM_ETRPRESCALER_DIV2: ETRP frequency divided by 2.
  - TIM_ETRPRESCALER_DIV4: ETRP frequency divided by 4.
  - TIM_ETRPRESCALER_DIV8: ETRP frequency divided by 8.
- **TIM_ExtTRGPolarity:** The external Trigger Polarity. This parameter can be one of the following values:
  - TIM_ETRPOLARITY_INVERTED: active low or falling edge active.
  - TIM_ETRPOLARITY_NONINVERTED: active high or rising edge active.
- **ExtTRGFilter:** External Trigger Filter. This parameter must be a value between 0x00 and 0x0F

Return values

- **None:**

`TIM_DMADelayPulseCplt`

Function name

void TIM_DMADelayPulseCplt (DMA_HandleTypeDef * hdma)

Function description

TIM DMA Delay Pulse complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`TIM_DMADelayPulseHalfCplt`

Function name

void TIM_DMADelayPulseHalfCplt (DMA_HandleTypeDef * hdma)

Function description

TIM DMA Delay Pulse half complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`TIM_DMAError`

Function name

void TIM_DMAError (DMA_HandleTypeDef * hdma)

Function description

TIM DMA error callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`TIM_DMACaptureCplt`

Function name

void TIM_DMACaptureCplt (DMA_HandleTypeDef * hdma)

Function description

TIM DMA Capture complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`TIM_DMACaptureHalfCplt`

Function name

void TIM_DMACaptureHalfCplt (DMA_HandleTypeDef * hdma)

Function description

TIM DMA Capture half complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`TIM_CCxChannelCmd`

Function name

void TIM_CCxChannelCmd (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ChannelState)

Function description

Enables or disables the TIM Capture Compare Channel x.

Parameters

- **TIMx:** to select the TIM peripheral
- **Channel:** specifies the TIM Channel This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1
  - TIM_CHANNEL_2: TIM Channel 2
  - TIM_CHANNEL_3: TIM Channel 3
  - TIM_CHANNEL_4: TIM Channel 4
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected
- **ChannelState:** specifies the TIM Channel CCxE bit new state. This parameter can be: TIM_CCx_ENABLE or TIM_CCx_DISABLE.

Return values

- **None:**

72.3 TIM Firmware driver defines

The following section lists the various define and macros of the module.

72.3.1 TIM

TIM

TIM Automatic Output Enable

TIM_AUTOMATICOUTPUT_DISABLE

MOE can be set only by software

TIM_AUTOMATICOUTPUT_ENABLE

MOE can be set by software or automatically at the next update event (if none of the break inputs BRK and BRK2 is active)

TIM Auto-Reload Preload

TIM_AUTORELOAD_PRELOAD_DISABLE

TIMx_ARR register is not buffered

TIM_AUTORELOAD_PRELOAD_ENABLE

TIMx_ARR register is buffered

TIM Break input 2 Enable

TIM_BREAK2_DISABLE

Break input BRK2 is disabled

TIM_BREAK2_ENABLE

Break input BRK2 is enabled

TIM Break Input 2 Polarity

TIM_BREAK2POLARITY_LOW

Break input BRK2 is active low

TIM_BREAK2POLARITY_HIGH

Break input BRK2 is active high

TIM Break Input Enable

TIM_BREAK_ENABLE

Break input BRK is enabled

TIM_BREAK_DISABLE

Break input BRK is disabled

TIM Break Input Polarity

TIM_BREAKPOLARITY_LOW

Break input BRK is active low

TIM_BREAKPOLARITY_HIGH

Break input BRK is active high

TIM Break System

TIM_BREAK_SYSTEM_ECC

Enables and locks the ECC error signal with Break Input of TIM1/8/15/16/17

TIM_BREAK_SYSTEM_PVD

Enables and locks the PVD connection with TIM1/8/15/16/17 Break Input and also the PVDE and PLS bits of the Power Control Interface

TIM_BREAK_SYSTEM_SRAM2_PARITY_ERROR

Enables and locks the SRAM2_PARITY error signal with Break Input of TIM1/8/15/16/17

TIM_BREAK_SYSTEM_LOCKUP

Enables and locks the LOCKUP output of CortexM4 with Break Input of TIM1/8/15/16/17

TIM Channel

TIM_CHANNEL_1

Capture/compare channel 1 identifier

TIM_CHANNEL_2

Capture/compare channel 2 identifier

TIM_CHANNEL_3

Capture/compare channel 3 identifier

TIM_CHANNEL_4

Capture/compare channel 4 identifier

TIM_CHANNEL_5

Compare channel 5 identifier

TIM_CHANNEL_6

Compare channel 6 identifier

TIM_CHANNEL_ALL

Global Capture/compare channel identifier

TIM Clear Input Polarity

TIM_CLEARINPUTPOLARITY_INVERTED

Polarity for ETRx pin

TIM_CLEARINPUTPOLARITY_NONINVERTED

Polarity for ETRx pin

TIM Clear Input Prescaler

TIM_CLEARINPUTPRESCALER_DIV1

No prescaler is used

TIM_CLEARINPUTPRESCALER_DIV2

Prescaler for External ETR pin: Capture performed once every 2 events.

TIM_CLEARINPUTPRESCALER_DIV4

Prescaler for External ETR pin: Capture performed once every 4 events.

TIM_CLEARINPUTPRESCALER_DIV8

Prescaler for External ETR pin: Capture performed once every 8 events.

TIM Clear Input Source

TIM_CLEARINPUTSOURCE_NONE

OCREF_CLR is disabled

TIM_CLEARINPUTSOURCE_ETR

OCREF_CLR is connected to ETRF input

TIM_CLEARINPUTSOURCE_OCREFCLR

OCREF_CLR is connected to OCREF_CLR_INT

TIM Clock Division

TIM_CLOCKDIVISION_DIV1

Clock division: tDTS=tCK_INT

TIM_CLOCKDIVISION_DIV2

Clock division: tDTS=2*tCK_INT

TIM_CLOCKDIVISION_DIV4

Clock division: tDTS=4*tCK_INT

TIM Clock Polarity

TIM_CLOCKPOLARITY_INVERTED

Polarity for ETRx clock sources

TIM_CLOCKPOLARITY_NONINVERTED

Polarity for ETRx clock sources

TIM_CLOCKPOLARITY_RISING

Polarity for TIx clock sources

TIM_CLOCKPOLARITY_FALLING

Polarity for TIx clock sources

TIM_CLOCKPOLARITY_BOTHEDGE

Polarity for TIx clock sources

TIM Clock Prescaler

TIM_CLOCKPRESCALER_DIV1

No prescaler is used

TIM_CLOCKPRESCALER_DIV2

Prescaler for External ETR Clock: Capture performed once every 2 events.

TIM_CLOCKPRESCALER_DIV4

Prescaler for External ETR Clock: Capture performed once every 4 events.

TIM_CLOCKPRESCALER_DIV8

Prescaler for External ETR Clock: Capture performed once every 8 events.

TIM Clock Source

TIM_CLOCKSOURCE_ETRMODE2

External clock source mode 2

TIM_CLOCKSOURCE_INTERNAL

Internal clock source

TIM_CLOCKSOURCE_ITR0

External clock source mode 1 (ITR0)

TIM_CLOCKSOURCE_ITR1

External clock source mode 1 (ITR1)

TIM_CLOCKSOURCE_ITR2

External clock source mode 1 (ITR2)

TIM_CLOCKSOURCE_ITR3

External clock source mode 1 (ITR3)

TIM_CLOCKSOURCE_TI1ED

External clock source mode 1 (TTI1FP1 + edge detect.)

TIM_CLOCKSOURCE_TI1

External clock source mode 1 (TTI1FP1)

TIM_CLOCKSOURCE_TI2

External clock source mode 1 (TTI2FP2)

TIM_CLOCKSOURCE_ETRMODE1

External clock source mode 1 (ETRF)

TIM Commutation Source

TIM_COMMUTATION_TRGI

When Capture/compare control bits are preloaded, they are updated by setting the COMG bit or when an rising edge occurs on trigger input

TIM_COMMUTATION_SOFTWARE

When Capture/compare control bits are preloaded, they are updated by setting the COMG bit

TIM Counter Mode

TIM_COUNTERMODE_UP

Counter used as up-counter

TIM_COUNTERMODE_DOWN

Counter used as down-counter

TIM_COUNTERMODE_CENTERALIGNED1

Center-aligned mode 1

TIM_COUNTERMODE_CENTERALIGNED2

Center-aligned mode 2

TIM_COUNTERMODE_CENTERALIGNED3

Center-aligned mode 3

TIM DMA Base Address

TIM_DMABASE_CR1

TIM_DMABASE_CR2

TIM_DMABASE_SMCR

TIM_DMABASE_DIER

TIM_DMABASE_SR

TIM_DMABASE_EGR

TIM_DMABASE_CCMR1

TIM_DMABASE_CCMR2

TIM_DMABASE_CCER

TIM_DMABASE_CNT

TIM_DMABASE_PSC

TIM_DMABASE_ARR

TIM_DMABASE_RCR

TIM_DMABASE_CCR1

TIM_DMABASE_CCR2

TIM_DMABASE_CCR3

TIM_DMABASE_CCR4

TIM_DMABASE_BDTR

TIM_DMABASE_DCR

TIM_DMABASE_DMAR

TIM_DMABASE_OR1

TIM_DMABASE_CCMR3

TIM_DMABASE_CCR5

TIM_DMABASE_CCR6

TIM_DMABASE_OR2

TIM_DMABASE_OR3

TIM DMA Burst Length

TIM_DMABURSTLENGTH_1TRANSFER

The transfer is done to 1 register starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_2TRANSFERS

The transfer is done to 2 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_3TRANSFERS

The transfer is done to 3 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_4TRANSFERS

The transfer is done to 4 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_5TRANSFERS

The transfer is done to 5 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_6TRANSFERS

The transfer is done to 6 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_7TRANSFERS

The transfer is done to 7 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_8TRANSFERS

The transfer is done to 8 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_9TRANSFERS

The transfer is done to 9 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_10TRANSFERS

The transfer is done to 10 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_11TRANSFERS

The transfer is done to 11 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_12TRANSFERS

The transfer is done to 12 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_13TRANSFERS

The transfer is done to 13 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_14TRANSFERS

The transfer is done to 14 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_15TRANSFERS

The transfer is done to 15 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_16TRANSFERS

The transfer is done to 16 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_17TRANSFERS

The transfer is done to 17 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM_DMABURSTLENGTH_18TRANSFERS

The transfer is done to 18 registers starting from TIMx_CR1 + TIMx_DCR.DBA

TIM DMA Sources

TIM_DMA_UPDATE

DMA request is triggered by the update event

TIM_DMA_CC1

DMA request is triggered by the capture/compare macth 1 event

TIM_DMA_CC2

DMA request is triggered by the capture/compare macth 2 event event

TIM_DMA_CC3

DMA request is triggered by the capture/compare macth 3 event event

TIM_DMA_CC4

DMA request is triggered by the capture/compare macth 4 event event

TIM_DMA_COM

DMA request is triggered by the commutation event

TIM_DMA_TRIGGER

DMA request is triggered by the trigger event

TIM Encoder Mode

TIM_ENCODERMODE_TI1

Quadrature encoder mode 1, x2 mode, counts up/down on TI1FP1 edge depending on TI2FP2 level

TIM_ENCODERMODE_TI2

Quadrature encoder mode 2, x2 mode, counts up/down on TI2FP2 edge depending on TI1FP1 level.

TIM_ENCODERMODE_TI12

Quadrature encoder mode 3, x4 mode, counts up/down on both TI1FP1 and TI2FP2 edges depending on the level of the other input.

TIM ETR Polarity

TIM_ETRPOLARITY_INVERTED

Polarity for ETR source

TIM_ETRPOLARITY_NONINVERTED

Polarity for ETR source

TIM ETR Prescaler

TIM_ETRPRESCALER_DIV1

No prescaler is used

TIM_ETRPRESCALER_DIV2

ETR input source is divided by 2

TIM_ETRPRESCALER_DIV4

ETR input source is divided by 4

TIM_ETRPRESCALER_DIV8

ETR input source is divided by 8

TIM Event Source

TIM_EVENTSOURCE_UPDATE

Reinitialize the counter and generates an update of the registers

TIM_EVENTSOURCE_CC1

A capture/compare event is generated on channel 1

TIM_EVENTSOURCE_CC2

A capture/compare event is generated on channel 2

TIM_EVENTSOURCE_CC3

A capture/compare event is generated on channel 3

TIM_EVENTSOURCE_CC4

A capture/compare event is generated on channel 4

TIM_EVENTSOURCE_COM

A commutation event is generated

TIM_EVENTSOURCE_TRIGGER

A trigger event is generated

TIM_EVENTSOURCE_BREAK

A break event is generated

TIM_EVENTSOURCE_BREAK2

A break 2 event is generated

TIM Exported Macros

__HAL_TIM_RESET_HANDLE_STATE

Description:

- Reset TIM handle state.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

__HAL_TIM_ENABLE

Description:

- Enable the TIM peripheral.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

__HAL_TIM_MOE_ENABLE

Description:

- Enable the TIM main Output.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

__HAL_TIM_DISABLE

Description:

- Disable the TIM peripheral.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

__HAL_TIM_MOE_DISABLE

Description:

- Disable the TIM main Output.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

Notes:

- The Main Output Enable of a timer instance is disabled only if all the CCx and CCxN channels have been disabled

__HAL_TIM_MOE_DISABLE_UNCONDITIONALLY

Description:

- Disable the TIM main Output.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

Notes:

- The Main Output Enable of a timer instance is disabled unconditionally

__HAL_TIM_ENABLE_IT

Description:

- Enable the specified TIM interrupt.

Parameters:

- __HANDLE__: specifies the TIM Handle.
- __INTERRUPT__: specifies the TIM interrupt source to enable. This parameter can be one of the following values:
  - TIM_IT_UPDATE: Update interrupt
  - TIM_IT_CC1: Capture/Compare 1 interrupt
  - TIM_IT_CC2: Capture/Compare 2 interrupt
  - TIM_IT_CC3: Capture/Compare 3 interrupt
  - TIM_IT_CC4: Capture/Compare 4 interrupt
  - TIM_IT_COM: Commutation interrupt
  - TIM_IT_TRIGGER: Trigger interrupt
  - TIM_IT_BREAK: Break interrupt

Return value:

- None

__HAL_TIM_DISABLE_IT

Description:

- Disable the specified TIM interrupt.

Parameters:

- __HANDLE__: specifies the TIM Handle.
- __INTERRUPT__: specifies the TIM interrupt source to disable. This parameter can be one of the following values:
  - TIM_IT_UPDATE: Update interrupt
  - TIM_IT_CC1: Capture/Compare 1 interrupt
  - TIM_IT_CC2: Capture/Compare 2 interrupt
  - TIM_IT_CC3: Capture/Compare 3 interrupt
  - TIM_IT_CC4: Capture/Compare 4 interrupt
  - TIM_IT_COM: Commutation interrupt
  - TIM_IT_TRIGGER: Trigger interrupt
  - TIM_IT_BREAK: Break interrupt

Return value:

- None

__HAL_TIM_ENABLE_DMA

Description:

- Enable the specified DMA request.

Parameters:

- __HANDLE__: specifies the TIM Handle.
- __DMA__: specifies the TIM DMA request to enable. This parameter can be one of the following values:
  - TIM_DMA_UPDATE: Update DMA request
  - TIM_DMA_CC1: Capture/Compare 1 DMA request
  - TIM_DMA_CC2: Capture/Compare 2 DMA request
  - TIM_DMA_CC3: Capture/Compare 3 DMA request
  - TIM_DMA_CC4: Capture/Compare 4 DMA request
  - TIM_DMA_COM: Commutation DMA request
  - TIM_DMA_TRIGGER: Trigger DMA request

Return value:

- None

__HAL_TIM_DISABLE_DMA

Description:

- Disable the specified DMA request.

Parameters:

- __HANDLE__: specifies the TIM Handle.
- __DMA__: specifies the TIM DMA request to disable. This parameter can be one of the following values:
  - TIM_DMA_UPDATE: Update DMA request
  - TIM_DMA_CC1: Capture/Compare 1 DMA request
  - TIM_DMA_CC2: Capture/Compare 2 DMA request
  - TIM_DMA_CC3: Capture/Compare 3 DMA request
  - TIM_DMA_CC4: Capture/Compare 4 DMA request
  - TIM_DMA_COM: Commutation DMA request
  - TIM_DMA_TRIGGER: Trigger DMA request

Return value:

- None

__HAL_TIM_GET_FLAG

Description:

- Check whether the specified TIM interrupt flag is set or not.

Parameters:

- __HANDLE__: specifies the TIM Handle.
- __FLAG__: specifies the TIM interrupt flag to check. This parameter can be one of the following values:
  - TIM_FLAG_UPDATE: Update interrupt flag
  - TIM_FLAG_CC1: Capture/Compare 1 interrupt flag
  - TIM_FLAG_CC2: Capture/Compare 2 interrupt flag
  - TIM_FLAG_CC3: Capture/Compare 3 interrupt flag
  - TIM_FLAG_CC4: Capture/Compare 4 interrupt flag
  - TIM_FLAG_CC5: Compare 5 interrupt flag
  - TIM_FLAG_CC6: Compare 6 interrupt flag
  - TIM_FLAG_COM: Commutation interrupt flag
  - TIM_FLAG_TRIGGER: Trigger interrupt flag
  - TIM_FLAG_BREAK: Break interrupt flag
  - TIM_FLAG_BREAK2: Break 2 interrupt flag
  - TIM_FLAG_SYSTEM_BREAK: System Break interrupt flag
  - TIM_FLAG_CC1OF: Capture/Compare 1 overcapture flag
  - TIM_FLAG_CC2OF: Capture/Compare 2 overcapture flag
  - TIM_FLAG_CC3OF: Capture/Compare 3 overcapture flag
  - TIM_FLAG_CC4OF: Capture/Compare 4 overcapture flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_TIM_CLEAR_FLAG

Description:

- Clear the specified TIM interrupt flag.

Parameters:

- __HANDLE__: specifies the TIM Handle.
- __FLAG__: specifies the TIM interrupt flag to clear. This parameter can be one of the following values:
  - TIM_FLAG_UPDATE: Update interrupt flag
  - TIM_FLAG_CC1: Capture/Compare 1 interrupt flag
  - TIM_FLAG_CC2: Capture/Compare 2 interrupt flag
  - TIM_FLAG_CC3: Capture/Compare 3 interrupt flag
  - TIM_FLAG_CC4: Capture/Compare 4 interrupt flag
  - TIM_FLAG_CC5: Compare 5 interrupt flag
  - TIM_FLAG_CC6: Compare 6 interrupt flag
  - TIM_FLAG_COM: Commutation interrupt flag
  - TIM_FLAG_TRIGGER: Trigger interrupt flag
  - TIM_FLAG_BREAK: Break interrupt flag
  - TIM_FLAG_BREAK2: Break 2 interrupt flag
  - TIM_FLAG_SYSTEM_BREAK: System Break interrupt flag
  - TIM_FLAG_CC1OF: Capture/Compare 1 overcapture flag
  - TIM_FLAG_CC2OF: Capture/Compare 2 overcapture flag
  - TIM_FLAG_CC3OF: Capture/Compare 3 overcapture flag
  - TIM_FLAG_CC4OF: Capture/Compare 4 overcapture flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_TIM_GET_IT_SOURCE

Description:

- Check whether the specified TIM interrupt source is enabled or not.

Parameters:

- __HANDLE__: TIM handle
- __INTERRUPT__: specifies the TIM interrupt source to check. This parameter can be one of the following values:
  - TIM_IT_UPDATE: Update interrupt
  - TIM_IT_CC1: Capture/Compare 1 interrupt
  - TIM_IT_CC2: Capture/Compare 2 interrupt
  - TIM_IT_CC3: Capture/Compare 3 interrupt
  - TIM_IT_CC4: Capture/Compare 4 interrupt
  - TIM_IT_COM: Commutation interrupt
  - TIM_IT_TRIGGER: Trigger interrupt
  - TIM_IT_BREAK: Break interrupt

Return value:

- The: state of TIM_IT (SET or RESET).

__HAL_TIM_CLEAR_IT

Description:

- Clear the TIM interrupt pending bits.

Parameters:

- __HANDLE__: TIM handle
- __INTERRUPT__: specifies the interrupt pending bit to clear. This parameter can be one of the following values:
  - TIM_IT_UPDATE: Update interrupt
  - TIM_IT_CC1: Capture/Compare 1 interrupt
  - TIM_IT_CC2: Capture/Compare 2 interrupt
  - TIM_IT_CC3: Capture/Compare 3 interrupt
  - TIM_IT_CC4: Capture/Compare 4 interrupt
  - TIM_IT_COM: Commutation interrupt
  - TIM_IT_TRIGGER: Trigger interrupt
  - TIM_IT_BREAK: Break interrupt

Return value:

- None

__HAL_TIM_IS_TIM_COUNTING_DOWN

Description:

- Indicates whether or not the TIM Counter is used as downcounter.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- False: (Counter used as upcounter) or True (Counter used as downcounter)

Notes:

- This macro is particularly useful to get the counting mode when the timer operates in Center-aligned mode or Encoder mode.

__HAL_TIM_SET_PRESCALER

Description:

- Set the TIM Prescaler on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __PRESC__: specifies the Prescaler new value.

Return value:

- None

__HAL_TIM_SET_COUNTER

Description:

- Set the TIM Counter Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __COUNTER__: specifies the Counter register new value.

Return value:

- None

__HAL_TIM_GET_COUNTER

Description:

- Get the TIM Counter Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- 16-bit: or 32-bit value of the timer counter register (TIMx_CNT)

__HAL_TIM_SET_AUTORELOAD

Description:

- Set the TIM Autoreload Register value on runtime without calling another time any Init function.

Parameters:

- __HANDLE__: TIM handle.
- __AUTORELOAD__: specifies the Counter register new value.

Return value:

- None

__HAL_TIM_GET_AUTORELOAD

Description:

- Get the TIM Autoreload Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- 16-bit: or 32-bit value of the timer auto-reload register(TIMx_ARR)

__HAL_TIM_SET_CLOCKDIVISION

Description:

- Set the TIM Clock Division value on runtime without calling another time any Init function.

Parameters:

- __HANDLE__: TIM handle.
- __CKD__: specifies the clock division value. This parameter can be one of the following value:
  - TIM_CLOCKDIVISION_DIV1: tDTS=tCK_INT
  - TIM_CLOCKDIVISION_DIV2: tDTS=2*tCK_INT
  - TIM_CLOCKDIVISION_DIV4: tDTS=4*tCK_INT

Return value:

- None

__HAL_TIM_GET_CLOCKDIVISION

Description:

- Get the TIM Clock Division value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- The: clock division can be one of the following values:
  - TIM_CLOCKDIVISION_DIV1: tDTS=tCK_INT
  - TIM_CLOCKDIVISION_DIV2: tDTS=2*tCK_INT
  - TIM_CLOCKDIVISION_DIV4: tDTS=4*tCK_INT

__HAL_TIM_SET_ICPRESCALER

Description:

- Set the TIM Input Capture prescaler on runtime without calling another time

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channels to be configured. This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
- __ICPSC__: specifies the Input Capture4 prescaler new value. This parameter can be one of the following values:
  - TIM_ICPSC_DIV1: no prescaler
  - TIM_ICPSC_DIV2: capture is done once every 2 events
  - TIM_ICPSC_DIV4: capture is done once every 4 events
  - TIM_ICPSC_DIV8: capture is done once every 8 events

Return value:

- None

__HAL_TIM_GET_ICPRESCALER

Description:

- Get the TIM Input Capture prescaler on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channels to be configured. This parameter can be one of the following values:
  - TIM_CHANNEL_1: get input capture 1 prescaler value
  - TIM_CHANNEL_2: get input capture 2 prescaler value
  - TIM_CHANNEL_3: get input capture 3 prescaler value
  - TIM_CHANNEL_4: get input capture 4 prescaler value

Return value:

- The: input capture prescaler can be one of the following values:
  - TIM_ICPSC_DIV1: no prescaler
  - TIM_ICPSC_DIV2: capture is done once every 2 events
  - TIM_ICPSC_DIV4: capture is done once every 4 events
  - TIM_ICPSC_DIV8: capture is done once every 8 events

__HAL_TIM_SET_COMPARE

Description:

- Set the TIM Capture Compare Register value on runtime without calling another time ConfigChannel function.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channels to be configured. This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected
- __COMPARE__: specifies the Capture Compare register new value.

Return value:

- None

__HAL_TIM_GET_COMPARE

Description:

- Get the TIM Capture Compare Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channel associated with the capture compare register This parameter can be one of the following values:
  - TIM_CHANNEL_1: get capture/compare 1 register value
  - TIM_CHANNEL_2: get capture/compare 2 register value
  - TIM_CHANNEL_3: get capture/compare 3 register value
  - TIM_CHANNEL_4: get capture/compare 4 register value
  - TIM_CHANNEL_5: get capture/compare 5 register value
  - TIM_CHANNEL_6: get capture/compare 6 register value

Return value:

- 16-bit: or 32-bit value of the capture/compare register (TIMx_CCRy)

__HAL_TIM_ENABLE_OCxPRELOAD

Description:

- Set the TIM Output compare preload.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channels to be configured. This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return value:

- None

__HAL_TIM_DISABLE_OCxPRELOAD

Description:

- Reset the TIM Output compare preload.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channels to be configured. This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
  - TIM_CHANNEL_5: TIM Channel 5 selected
  - TIM_CHANNEL_6: TIM Channel 6 selected

Return value:

- None

__HAL_TIM_URS_ENABLE

Description:

- Set the Update Request Source (URS) bit of the TIMx_CR1 register.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

Notes:

- When the URS bit of the TIMx_CR1 register is set, only counter overflow/underflow generates an update interrupt or DMA request (if enabled)

__HAL_TIM_URS_DISABLE

Description:

- Reset the Update Request Source (URS) bit of the TIMx_CR1 register.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

Notes:

- When the URS bit of the TIMx_CR1 register is reset, any of the following events generate an update interrupt or DMA request (if enabled): _ Counter overflow underflow _ Setting the UG bit _ Update generation through the slave mode controller

__HAL_TIM_SET_CAPTUREPOLARITY

Description:

- Set the TIM Capture x input polarity on runtime.

Parameters:

- __HANDLE__: TIM handle.
- __CHANNEL__: TIM Channels to be configured. This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
  - TIM_CHANNEL_4: TIM Channel 4 selected
- __POLARITY__: Polarity for TIx source
  - TIM_INPUTCHANNELPOLARITY_RISING: Rising Edge
  - TIM_INPUTCHANNELPOLARITY_FALLING: Falling Edge
  - TIM_INPUTCHANNELPOLARITY_BOTHEDGE: Rising and Falling Edge

Return value:

- None

TIM Flag Definition

TIM_FLAG_UPDATE

Update interrupt flag

TIM_FLAG_CC1

Capture/Compare 1 interrupt flag

TIM_FLAG_CC2

Capture/Compare 2 interrupt flag

TIM_FLAG_CC3

Capture/Compare 3 interrupt flag

TIM_FLAG_CC4

Capture/Compare 4 interrupt flag

TIM_FLAG_CC5

Capture/Compare 5 interrupt flag

TIM_FLAG_CC6

Capture/Compare 6 interrupt flag

TIM_FLAG_COM

Commutation interrupt flag

TIM_FLAG_TRIGGER

Trigger interrupt flag

TIM_FLAG_BREAK

Break interrupt flag

TIM_FLAG_BREAK2

Break 2 interrupt flag

TIM_FLAG_SYSTEM_BREAK

System Break interrupt flag

TIM_FLAG_CC1OF

Capture 1 overcapture flag

TIM_FLAG_CC2OF

Capture 2 overcapture flag

TIM_FLAG_CC3OF

Capture 3 overcapture flag

TIM_FLAG_CC4OF

Capture 4 overcapture flag

Group Channel 5 and Channel 1, 2 or 3

TIM_GROUPCH5_NONE

TIM_GROUPCH5_OC1REFC

TIM_GROUPCH5_OC2REFC

TIM_GROUPCH5_OC3REFC

TIM Input Capture Polarity

TIM_ICPOLARITY_RISING

Capture triggered by rising edge on timer input

TIM_ICPOLARITY_FALLING

Capture triggered by falling edge on timer input

TIM_ICPOLARITY_BOTHEDGE

Capture triggered by both rising and falling edges on timer input

TIM Input Capture Prescaler

TIM_ICPSC_DIV1

Capture performed each time an edge is detected on the capture input

TIM_ICPSC_DIV2

Capture performed once every 2 events

TIM_ICPSC_DIV4

Capture performed once every 4 events

TIM_ICPSC_DIV8

Capture performed once every 8 events

TIM Input Capture Selection

TIM_ICSELECTION_DIRECTTI

TIM Input 1, 2, 3 or 4 is selected to be connected to IC1, IC2, IC3 or IC4, respectively

TIM_ICSELECTION_INDIRECTTI

TIM Input 1, 2, 3 or 4 is selected to be connected to IC2, IC1, IC4 or IC3, respectively

TIM_ICSELECTION_TRC

TIM Input 1, 2, 3 or 4 is selected to be connected to TRC

TIM Input Channel polarity

TIM_INPUTCHANNELPOLARITY_RISING

Polarity for TIx source

TIM_INPUTCHANNELPOLARITY_FALLING

Polarity for TIx source

TIM_INPUTCHANNELPOLARITY_BOTHEDGE

Polarity for TIx source

TIM interrupt Definition

TIM_IT_UPDATE

Update interrupt

TIM_IT_CC1

Capture/Compare 1 interrupt

TIM_IT_CC2

Capture/Compare 2 interrupt

TIM_IT_CC3

Capture/Compare 3 interrupt

TIM_IT_CC4

Capture/Compare 4 interrupt

TIM_IT_COM

Commutation interrupt

TIM_IT_TRIGGER

Trigger interrupt

TIM_IT_BREAK

Break interrupt

TIM Lock level

TIM_LOCKLEVEL_OFF

LOCK OFF

TIM_LOCKLEVEL_1

LOCK Level 1

TIM_LOCKLEVEL_2

LOCK Level 2

TIM_LOCKLEVEL_3

LOCK Level 3

TIM Master Mode Selection

TIM_TRGO_RESET

TIMx_EGR.UG bit is used as trigger output (TRGO)

TIM_TRGO_ENABLE

TIMx_CR1.CEN bit is used as trigger output (TRGO)

TIM_TRGO_UPDATE

Update event is used as trigger output (TRGO)

TIM_TRGO_OC1

Capture or a compare match 1 is used as trigger output (TRGO)

TIM_TRGO_OC1REF

OC1REF signal is used as trigger output (TRGO)

TIM_TRGO_OC2REF

OC2REF signal is used as trigger output(TRGO)

TIM_TRGO_OC3REF

OC3REF signal is used as trigger output(TRGO)

TIM_TRGO_OC4REF

OC4REF signal is used as trigger output(TRGO)

TIM Master Mode Selection 2 (TRGO2)

TIM_TRGO2_RESET

TIMx_EGR.UG bit is used as trigger output (TRGO2)

TIM_TRGO2_ENABLE

TIMx_CR1.CEN bit is used as trigger output (TRGO2)

TIM_TRGO2_UPDATE

Update event is used as trigger output (TRGO2)

TIM_TRGO2_OC1

Capture or a compare match 1 is used as trigger output (TRGO2)

TIM_TRGO2_OC1REF

OC1REF signal is used as trigger output (TRGO2)

TIM_TRGO2_OC2REF

OC2REF signal is used as trigger output (TRGO2)

TIM_TRGO2_OC3REF

OC3REF signal is used as trigger output (TRGO2)

TIM_TRGO2_OC4REF

OC4REF signal is used as trigger output (TRGO2)

TIM_TRGO2_OC5REF

OC5REF signal is used as trigger output (TRGO2)

TIM_TRGO2_OC6REF

OC6REF signal is used as trigger output (TRGO2)

TIM_TRGO2_OC4REF_RISINGFALLING

OC4REF rising or falling edges generate pulses on TRGO2

TIM_TRGO2_OC6REF_RISINGFALLING

OC6REF rising or falling edges generate pulses on TRGO2

TIM_TRGO2_OC4REF_RISING_OC6REF_RISING

OC4REF or OC6REF rising edges generate pulses on TRGO2

TIM_TRGO2_OC4REF_RISING_OC6REF_FALLING

OC4REF rising or OC6REF falling edges generate pulses on TRGO2

TIM_TRGO2_OC5REF_RISING_OC6REF_RISING

OC5REF or OC6REF rising edges generate pulses on TRGO2

TIM_TRGO2_OC5REF_RISING_OC6REF_FALLING

OC5REF or OC6REF rising edges generate pulses on TRGO2

TIM Master/Slave Mode

TIM_MASTERSLAVEMODE_ENABLE

No action

TIM_MASTERSLAVEMODE_DISABLE

Master/slave mode is selected

TIM One Pulse Mode

TIM_OPMODE_SINGLE

Counter stops counting at the next update event

TIM_OPMODE_REPETITIVE

Counter is not stopped at update event

TIM OSSI OffState Selection for Idle mode state

TIM_OSSI_ENABLE

When inactive, OC/OCN outputs are enabled (still controlled by the timer)

TIM_OSSI_DISABLE

When inactive, OC/OCN outputs are disabled (not controlled any longer by the timer)

TIM OSSR OffState Selection for Run mode state

TIM_OSSR_ENABLE

When inactive, OC/OCN outputs are enabled (still controlled by the timer)

TIM_OSSR_DISABLE

When inactive, OC/OCN outputs are disabled (not controlled any longer by the timer)

TIM Output Compare and PWM Modes

TIM_OCMODE_TIMING

Frozen

TIM_OCMODE_ACTIVE

Set channel to active level on match

TIM_OCMODE_INACTIVE

Set channel to inactive level on match

TIM_OCMODE_TOGGLE

Toggle

TIM_OCMODE_PWM1

PWM mode 1

TIM_OCMODE_PWM2

PWM mode 2

TIM_OCMODE_FORCED_ACTIVE

Force active level

TIM_OCMODE_FORCED_INACTIVE

Force inactive level

TIM_OCMODE_RETRIGERRABLE_OPM1

Retrigerrable OPM mode 1

TIM_OCMODE_RETRIGERRABLE_OPM2

Retrigerrable OPM mode 2

TIM_OCMODE_COMBINED_PWM1

Combined PWM mode 1

TIM_OCMODE_COMBINED_PWM2

Combined PWM mode 2

TIM_OCMODE_ASSYMETRIC_PWM1

Asymmetric PWM mode 1

TIM_OCMODE_ASSYMETRIC_PWM2

Asymmetric PWM mode 2

TIM Output Compare Idle State

TIM_OCIDLESTATE_SET

Output Idle state: OCx=1 when MOE=0

TIM_OCIDLESTATE_RESET

Output Idle state: OCx=0 when MOE=0

TIM Complementary Output Compare Idle State

TIM_OCNIDLESTATE_SET

Complementary output Idle state: OCxN=1 when MOE=0

TIM_OCNIDLESTATE_RESET

Complementary output Idle state: OCxN=0 when MOE=0

TIM Complementary Output Compare Polarity

TIM_OCNPOLARITY_HIGH

Capture/Compare complementary output polarity

TIM_OCNPOLARITY_LOW

Capture/Compare complementary output polarity

TIM Complementary Output Compare State

TIM_OUTPUTNSTATE_DISABLE

OCxN is disabled

TIM_OUTPUTNSTATE_ENABLE

OCxN is enabled

TIM Output Compare Polarity

TIM_OCPOLARITY_HIGH

Capture/Compare output polarity

TIM_OCPOLARITY_LOW

Capture/Compare output polarity

TIM Output Compare State

TIM_OUTPUTSTATE_DISABLE

Capture/Compare 1 output disabled

TIM_OUTPUTSTATE_ENABLE

Capture/Compare 1 output enabled

TIM Output Fast State

TIM_OCFAST_DISABLE

Output Compare fast disable

TIM_OCFAST_ENABLE

Output Compare fast enable

TIM Slave mode

TIM_SLAVEMODE_DISABLE

Slave mode disabled

TIM_SLAVEMODE_RESET

Reset Mode

TIM_SLAVEMODE_GATED

Gated Mode

TIM_SLAVEMODE_TRIGGER

Trigger Mode

TIM_SLAVEMODE_EXTERNAL1

External Clock Mode 1

TIM_SLAVEMODE_COMBINED_RESETTRIGGER

Combined reset + trigger mode

TIM TI1 Input Selection

TIM_TI1SELECTION_CH1

The TIMx_CH1 pin is connected to TI1 input

TIM_TI1SELECTION_XORCOMBINATION

The TIMx_CH1, CH2 and CH3 pins are connected to the TI1 input (XOR combination)

TIM Trigger Polarity

TIM_TRIGGERPOLARITY_INVERTED

Polarity for ETRx trigger sources

TIM_TRIGGERPOLARITY_NONINVERTED

Polarity for ETRx trigger sources

TIM_TRIGGERPOLARITY_RISING

Polarity for TIxFPx or TI1_ED trigger sources

TIM_TRIGGERPOLARITY_FALLING

Polarity for TIxFPx or TI1_ED trigger sources

TIM_TRIGGERPOLARITY_BOTHEDGE

Polarity for TIxFPx or TI1_ED trigger sources

TIM Trigger Prescaler

TIM_TRIGGERPRESCALER_DIV1

No prescaler is used

TIM_TRIGGERPRESCALER_DIV2

Prescaler for External ETR Trigger: Capture performed once every 2 events.

TIM_TRIGGERPRESCALER_DIV4

Prescaler for External ETR Trigger: Capture performed once every 4 events.

TIM_TRIGGERPRESCALER_DIV8

Prescaler for External ETR Trigger: Capture performed once every 8 events.

TIM Trigger Selection

TIM_TS_ITR0

Internal Trigger 0 (ITR0)

TIM_TS_ITR1

Internal Trigger 1 (ITR1)

TIM_TS_ITR2

Internal Trigger 2 (ITR2)

TIM_TS_ITR3

Internal Trigger 3 (ITR3)

TIM_TS_TI1F_ED

TI1 Edge Detector (TI1F_ED)

TIM_TS_TI1FP1

Filtered Timer Input 1 (TI1FP1)

TIM_TS_TI2FP2

Filtered Timer Input 2 (TI2FP2)

TIM_TS_ETRF

Filtered External Trigger input (ETRF)

TIM_TS_NONE

No trigger selected

73 HAL TIM Extension Driver

73.1 TIMEx Firmware driver registers structures

73.1.1 TIM_HallSensor_InitTypeDef

TIM_HallSensor_InitTypeDef is defined in the stm32l4xx_hal_tim_ex.h

Data Fields

- ***uint32_t IC1Polarity***
- ***uint32_t IC1Prescaler***
- ***uint32_t IC1Filter***
- ***uint32_t Commutation_Delay***

Field Documentation

- ***uint32_t TIM_HallSensor_InitTypeDef::IC1Polarity***
  Specifies the active edge of the input signal. This parameter can be a value of ***TIM_Input_Capture_Polarity***
- ***uint32_t TIM_HallSensor_InitTypeDef::IC1Prescaler***
  Specifies the Input Capture Prescaler. This parameter can be a value of ***TIM_Input_Capture_Prescaler***
- ***uint32_t TIM_HallSensor_InitTypeDef::IC1Filter***
  Specifies the input capture filter. This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF
- ***uint32_t TIM_HallSensor_InitTypeDef::Commutation_Delay***
  Specifies the pulse value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF

73.1.2 TIMEx_BreakInputConfigTypeDef

TIMEx_BreakInputConfigTypeDef is defined in the stm32l4xx_hal_tim_ex.h

Data Fields

- ***uint32_t Source***
- ***uint32_t Enable***
- ***uint32_t Polarity***

Field Documentation

- ***uint32_t TIMEx_BreakInputConfigTypeDef::Source***
  Specifies the source of the timer break input. This parameter can be a value of ***TIMEx_Break_Input_Source***
- ***uint32_t TIMEx_BreakInputConfigTypeDef::Enable***
  Specifies whether or not the break input source is enabled. This parameter can be a value of ***TIMEx_Break_Input_Source_Enable***
- ***uint32_t TIMEx_BreakInputConfigTypeDef::Polarity***
  Specifies the break input source polarity. This parameter can be a value of ***TIMEx_Break_Input_Source_Polarity*** Not relevant when analog watchdog output of the DFSDM1 used as break input source

73.2 TIMEx Firmware driver API description

The following section lists the various functions of the TIMEx library.

73.2.1 TIMER Extended features

The Timer Extended features include:

1. Complementary outputs with programmable dead-time for :
   – Output Compare
   – PWM generation (Edge and Center-aligned Mode)
   – One-pulse mode output
2. Synchronization circuit to control the timer with external signals and to interconnect several timers together.
3. Break input to put the timer output signals in reset state or in a known state.
4. Supports incremental (quadrature) encoder and hall-sensor circuitry for positioning purposes

73.2.2 How to use this driver

1. Initialize the TIM low level resources by implementing the following functions depending on the selected feature:
   – Hall Sensor output : HAL_TIMEx_HallSensor_MspInit()
2. Initialize the TIM low level resources :
   a. Enable the TIM interface clock using __HAL_RCC_TIMx_CLK_ENABLE();
   b. TIM pins configuration
      ◦ Enable the clock for the TIM GPIOs using the following function: __HAL_RCC_GPIOx_CLK_ENABLE();
      ◦ Configure these TIM pins in Alternate function mode using HAL_GPIO_Init();
3. The external Clock can be configured, if needed (the default clock is the internal clock from the APBx), using the following function: HAL_TIM_ConfigClockSource, the clock configuration should be done before any start function.
4. Configure the TIM in the desired functioning mode using one of the initialization function of this driver:
   – HAL_TIMEx_HallSensor_Init() and HAL_TIMEx_ConfigCommutEvent(): to use the Timer Hall Sensor Interface and the commutation event with the corresponding Interrupt and DMA request if needed (Note that One Timer is used to interface with the Hall sensor Interface and another Timer should be used to use the commutation event).
5. Activate the TIM peripheral using one of the start functions:
   – Complementary Output Compare : HAL_TIMEx_OCN_Start(), HAL_TIMEx_OCN_Start_DMA(), HAL_TIMEx_OC_Start_IT()
   – Complementary PWM generation : HAL_TIMEx_PWMN_Start(), HAL_TIMEx_PWMN_Start_DMA(), HAL_TIMEx_PWMN_Start_IT()
   – Complementary One-pulse mode output : HAL_TIMEx_OnePulseN_Start(), HAL_TIMEx_OnePulseN_Start_IT()
   – Hall Sensor output : HAL_TIMEx_HallSensor_Start(), HAL_TIMEx_HallSensor_Start_DMA(), HAL_TIMEx_HallSensor_Start_IT().

73.2.3 Timer Hall Sensor functions

This section provides functions allowing to:

- Initialize and configure TIM HAL Sensor.
- De-initialize TIM HAL Sensor.
- Start the Hall Sensor Interface.
- Stop the Hall Sensor Interface.
- Start the Hall Sensor Interface and enable interrupts.
- Stop the Hall Sensor Interface and disable interrupts.
- Start the Hall Sensor Interface and enable DMA transfers.
- Stop the Hall Sensor Interface and disable DMA transfers.

This section contains the following APIs:

- ***HAL_TIMEx_HallSensor_Init***
- ***HAL_TIMEx_HallSensor_DeInit***
- ***HAL_TIMEx_HallSensor_MspInit***
- ***HAL_TIMEx_HallSensor_MspDeInit***

- *HAL_TIMEx_HallSensor_Start*
- *HAL_TIMEx_HallSensor_Stop*
- *HAL_TIMEx_HallSensor_Start_IT*
- *HAL_TIMEx_HallSensor_Stop_IT*
- *HAL_TIMEx_HallSensor_Start_DMA*
- *HAL_TIMEx_HallSensor_Stop_DMA*

73.2.4 Timer Complementary Output Compare functions

This section provides functions allowing to:

- Start the Complementary Output Compare/PWM.
- Stop the Complementary Output Compare/PWM.
- Start the Complementary Output Compare/PWM and enable interrupts.
- Stop the Complementary Output Compare/PWM and disable interrupts.
- Start the Complementary Output Compare/PWM and enable DMA transfers.
- Stop the Complementary Output Compare/PWM and disable DMA transfers.

This section contains the following APIs:

- *HAL_TIMEx_OCN_Start*
- *HAL_TIMEx_OCN_Stop*
- *HAL_TIMEx_OCN_Start_IT*
- *HAL_TIMEx_OCN_Stop_IT*
- *HAL_TIMEx_OCN_Start_DMA*
- *HAL_TIMEx_OCN_Stop_DMA*

73.2.5 Timer Complementary PWM functions

This section provides functions allowing to:

- Start the Complementary PWM.
- Stop the Complementary PWM.
- Start the Complementary PWM and enable interrupts.
- Stop the Complementary PWM and disable interrupts.
- Start the Complementary PWM and enable DMA transfers.
- Stop the Complementary PWM and disable DMA transfers.
- Start the Complementary Input Capture measurement.
- Stop the Complementary Input Capture.
- Start the Complementary Input Capture and enable interrupts.
- Stop the Complementary Input Capture and disable interrupts.
- Start the Complementary Input Capture and enable DMA transfers.
- Stop the Complementary Input Capture and disable DMA transfers.
- Start the Complementary One Pulse generation.
- Stop the Complementary One Pulse.
- Start the Complementary One Pulse and enable interrupts.
- Stop the Complementary One Pulse and disable interrupts.

This section contains the following APIs:

- *HAL_TIMEx_PWMN_Start*
- *HAL_TIMEx_PWMN_Stop*
- *HAL_TIMEx_PWMN_Start_IT*
- *HAL_TIMEx_PWMN_Stop_IT*
- *HAL_TIMEx_PWMN_Start_DMA*
- *HAL_TIMEx_PWMN_Stop_DMA*

73.2.6 Timer Complementary One Pulse functions

This section provides functions allowing to:

- Start the Complementary One Pulse generation.
- Stop the Complementary One Pulse.
- Start the Complementary One Pulse and enable interrupts.
- Stop the Complementary One Pulse and disable interrupts.

This section contains the following APIs:

- ***HAL_TIMEx_OnePulseN_Start***
- ***HAL_TIMEx_OnePulseN_Stop***
- ***HAL_TIMEx_OnePulseN_Start_IT***
- ***HAL_TIMEx_OnePulseN_Stop_IT***

73.2.7 Peripheral Control functions

This section provides functions allowing to:

- Configure the commutation event in case of use of the Hall sensor interface.
- Configure Output channels for OC and PWM mode.
- Configure Complementary channels, break features and dead time.
- Configure Master synchronization.
- Configure timer remapping capabilities.
- Enable or disable channel grouping.

This section contains the following APIs:

- ***HAL_TIMEx_ConfigCommutEvent***
- ***HAL_TIMEx_ConfigCommutEvent_IT***
- ***HAL_TIMEx_ConfigCommutEvent_DMA***
- ***HAL_TIMEx_MasterConfigSynchronization***
- ***HAL_TIMEx_ConfigBreakDeadTime***
- ***HAL_TIMEx_ConfigBreakInput***
- ***HAL_TIMEx_RemapConfig***
- ***HAL_TIMEx_GroupChannel5***

73.2.8 Extended Callbacks functions

This section provides Extended TIM callback functions:

- Timer Commutation callback
- Timer Break callback

This section contains the following APIs:

- ***HAL_TIMEx_CommutCallback***
- ***HAL_TIMEx_CommutHalfCpltCallback***
- ***HAL_TIMEx_BreakCallback***
- ***HAL_TIMEx_Break2Callback***

73.2.9 Extended Peripheral State functions

This subsection permits to get in run-time the status of the peripheral and the data flow.
This section contains the following APIs:

- ***HAL_TIMEx_HallSensor_GetState***

73.2.10 Detailed description of functions

`HAL_TIMEx_HallSensor_Init`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Init (TIM_HandleTypeDef * htim, TIM_HallSensor_InitTypeDef * sConfig)

Function description

Initializes the TIM Hall Sensor Interface and initialize the associated handle.

Parameters

- **htim:** TIM Hall Sensor Interface handle
- **sConfig:** TIM Hall Sensor configuration structure

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_DeInit`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_DeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes the TIM Hall Sensor interface.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_MspInit`

Function name

void HAL_TIMEx_HallSensor_MspInit (TIM_HandleTypeDef * htim)

Function description

Initializes the TIM Hall Sensor MSP.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **None:**

`HAL_TIMEx_HallSensor_MspDeInit`

Function name

void HAL_TIMEx_HallSensor_MspDeInit (TIM_HandleTypeDef * htim)

Function description

DeInitializes TIM Hall Sensor MSP.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **None:**

`HAL_TIMEx_HallSensor_Start`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Start (TIM_HandleTypeDef * htim)

Function description

Starts the TIM Hall Sensor Interface.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_Stop`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Stop (TIM_HandleTypeDef * htim)

Function description

Stops the TIM Hall sensor Interface.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Start_IT (TIM_HandleTypeDef * htim)

Function description

Starts the TIM Hall Sensor Interface in interrupt mode.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_Stop_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Stop_IT (TIM_HandleTypeDef * htim)

Function description

Stops the TIM Hall Sensor Interface in interrupt mode.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_Start_DMA`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Start_DMA (TIM_HandleTypeDef * htim, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM Hall Sensor Interface in DMA mode.

Parameters

- **htim:** TIM Hall Sensor Interface handle
- **pData:** The destination Buffer address.
- **Length:** The length of data to be transferred from TIM peripheral to memory.

Return values

- **HAL:** status

`HAL_TIMEx_HallSensor_Stop_DMA`

Function name

HAL_StatusTypeDef HAL_TIMEx_HallSensor_Stop_DMA (TIM_HandleTypeDef * htim)

Function description

Stops the TIM Hall Sensor Interface in DMA mode.

Parameters

- **htim:** TIM Hall Sensor Interface handle

Return values

- **HAL:** status

`HAL_TIMEx_OCN_Start`

Function name

HAL_StatusTypeDef HAL_TIMEx_OCN_Start (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Output Compare signal generation on the complementary output.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_OCN_Stop`

Function name

HAL_StatusTypeDef HAL_TIMEx_OCN_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Output Compare signal generation on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

HAL_TIMEx_OCN_Start_IT

Function name

HAL_StatusTypeDef HAL_TIMEx_OCN_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the TIM Output Compare signal generation in interrupt mode on the complementary output.

Parameters

- **htim:** TIM OC handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

HAL_TIMEx_OCN_Stop_IT

Function name

HAL_StatusTypeDef HAL_TIMEx_OCN_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Output Compare signal generation in interrupt mode on the complementary output.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

HAL_TIMEx_OCN_Start_DMA

Function name

HAL_StatusTypeDef HAL_TIMEx_OCN_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM Output Compare signal generation in DMA mode on the complementary output.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
- **pData:** The source Buffer address.
- **Length:** The length of data to be transferred from memory to TIM peripheral

Return values

- **HAL:** status

`HAL_TIMEx_OCN_Stop_DMA`

Function name

HAL_StatusTypeDef HAL_TIMEx_OCN_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM Output Compare signal generation in DMA mode on the complementary output.

Parameters

- **htim:** TIM Output Compare handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_PWMN_Start`

Function name

HAL_StatusTypeDef HAL_TIMEx_PWMN_Start (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the PWM signal generation on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_PWMN_Stop`

Function name

HAL_StatusTypeDef HAL_TIMEx_PWMN_Stop (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the PWM signal generation on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_PWMN_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_PWMN_Start_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Starts the PWM signal generation in interrupt mode on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_PWMN_Stop_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_PWMN_Stop_IT (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the PWM signal generation in interrupt mode on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_PWMN_Start_DMA`

Function name

HAL_StatusTypeDef HAL_TIMEx_PWMN_Start_DMA (TIM_HandleTypeDef * htim, uint32_t Channel, uint32_t * pData, uint16_t Length)

Function description

Starts the TIM PWM signal generation in DMA mode on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected
- **pData:** The source Buffer address.
- **Length:** The length of data to be transferred from memory to TIM peripheral

Return values

- **HAL:** status

`HAL_TIMEx_PWMN_Stop_DMA`

Function name

HAL_StatusTypeDef HAL_TIMEx_PWMN_Stop_DMA (TIM_HandleTypeDef * htim, uint32_t Channel)

Function description

Stops the TIM PWM signal generation in DMA mode on the complementary output.

Parameters

- **htim:** TIM handle
- **Channel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected
  - TIM_CHANNEL_3: TIM Channel 3 selected

Return values

- **HAL:** status

`HAL_TIMEx_OnePulseN_Start`

Function name

HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Start (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Starts the TIM One Pulse signal generation on the complementary output.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIMEx_OnePulseN_Stop`

Function name

HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Stop (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Stops the TIM One Pulse signal generation on the complementary output.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIMEx_OnePulseN_Start_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Start_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Starts the TIM One Pulse signal generation in interrupt mode on the complementary channel.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channel to be enabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIMEx_OnePulseN_Stop_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_OnePulseN_Stop_IT (TIM_HandleTypeDef * htim, uint32_t OutputChannel)

Function description

Stops the TIM One Pulse signal generation in interrupt mode on the complementary channel.

Parameters

- **htim:** TIM One Pulse handle
- **OutputChannel:** TIM Channel to be disabled This parameter can be one of the following values:
  - TIM_CHANNEL_1: TIM Channel 1 selected
  - TIM_CHANNEL_2: TIM Channel 2 selected

Return values

- **HAL:** status

`HAL_TIMEx_ConfigCommutEvent`

Function name

HAL_StatusTypeDef HAL_TIMEx_ConfigCommutEvent (TIM_HandleTypeDef * htim, uint32_t InputTrigger, uint32_t CommutationSource)

Function description

Configure the TIM commutation event sequence.

Parameters

- **htim:** TIM handle
- **InputTrigger:** the Internal trigger corresponding to the Timer Interfacing with the Hall sensor This parameter can be one of the following values:
  - TIM_TS_ITR0: Internal trigger 0 selected
  - TIM_TS_ITR1: Internal trigger 1 selected
  - TIM_TS_ITR2: Internal trigger 2 selected
  - TIM_TS_ITR3: Internal trigger 3 selected
  - TIM_TS_NONE: No trigger is needed
- **CommutationSource:** the Commutation Event source This parameter can be one of the following values:
  - TIM_COMMUTATION_TRGI: Commutation source is the TRGI of the Interface Timer
  - TIM_COMMUTATION_SOFTWARE: Commutation source is set by software using the COMG bit

Return values

- **HAL:** status

Notes

- This function is mandatory to use the commutation event in order to update the configuration at each commutation detection on the TRGI input of the Timer, the typical use of this feature is with the use of another Timer(interface Timer) configured in Hall sensor interface, this interface Timer will generate the commutation at its TRGO output (connected to Timer used in this function) each time the TI1 of the Interface Timer detect a commutation at its input TI1.

`HAL_TIMEx_ConfigCommutEvent_IT`

Function name

HAL_StatusTypeDef HAL_TIMEx_ConfigCommutEvent_IT (TIM_HandleTypeDef * htim, uint32_t InputTrigger, uint32_t CommutationSource)

Function description

Configure the TIM commutation event sequence with interrupt.

Parameters

- **htim:** TIM handle
- **InputTrigger:** the Internal trigger corresponding to the Timer Interfacing with the Hall sensor This parameter can be one of the following values:
  - TIM_TS_ITR0: Internal trigger 0 selected
  - TIM_TS_ITR1: Internal trigger 1 selected
  - TIM_TS_ITR2: Internal trigger 2 selected
  - TIM_TS_ITR3: Internal trigger 3 selected
  - TIM_TS_NONE: No trigger is needed
- **CommutationSource:** the Commutation Event source This parameter can be one of the following values:
  - TIM_COMMUTATION_TRGI: Commutation source is the TRGI of the Interface Timer
  - TIM_COMMUTATION_SOFTWARE: Commutation source is set by software using the COMG bit

Return values

- **HAL:** status

Notes

- This function is mandatory to use the commutation event in order to update the configuration at each commutation detection on the TRGI input of the Timer, the typical use of this feature is with the use of another Timer(interface Timer) configured in Hall sensor interface, this interface Timer will generate the commutation at its TRGO output (connected to Timer used in this function) each time the TI1 of the Interface Timer detect a commutation at its input TI1.

`HAL_TIMEx_ConfigCommutEvent_DMA`

Function name

HAL_StatusTypeDef HAL_TIMEx_ConfigCommutEvent_DMA (TIM_HandleTypeDef * htim, uint32_t InputTrigger, uint32_t CommutationSource)

Function description

Configure the TIM commutation event sequence with DMA.

Parameters

- **htim:** TIM handle
- **InputTrigger:** the Internal trigger corresponding to the Timer Interfacing with the Hall sensor This parameter can be one of the following values:
  - TIM_TS_ITR0: Internal trigger 0 selected
  - TIM_TS_ITR1: Internal trigger 1 selected
  - TIM_TS_ITR2: Internal trigger 2 selected
  - TIM_TS_ITR3: Internal trigger 3 selected
  - TIM_TS_NONE: No trigger is needed
- **CommutationSource:** the Commutation Event source This parameter can be one of the following values:
  - TIM_COMMUTATION_TRGI: Commutation source is the TRGI of the Interface Timer
  - TIM_COMMUTATION_SOFTWARE: Commutation source is set by software using the COMG bit

Return values

- **HAL:** status

Notes

- This function is mandatory to use the commutation event in order to update the configuration at each commutation detection on the TRGI input of the Timer, the typical use of this feature is with the use of another Timer(interface Timer) configured in Hall sensor interface, this interface Timer will generate the commutation at its TRGO output (connected to Timer used in this function) each time the TI1 of the Interface Timer detect a commutation at its input TI1.
- The user should configure the DMA in his own software, in This function only the COMDE bit is set

`HAL_TIMEx_MasterConfigSynchronization`

Function name

HAL_StatusTypeDef HAL_TIMEx_MasterConfigSynchronization (TIM_HandleTypeDef * htim, TIM_MasterConfigTypeDef * sMasterConfig)

Function description

Configures the TIM in master mode.

Parameters

- **htim:** TIM handle.
- **sMasterConfig:** pointer to a TIM_MasterConfigTypeDef structure that contains the selected trigger output (TRGO) and the Master/Slave mode.

Return values

- **HAL:** status

`HAL_TIMEx_ConfigBreakDeadTime`

Function name

HAL_StatusTypeDef HAL_TIMEx_ConfigBreakDeadTime (TIM_HandleTypeDef * htim, TIM_BreakDeadTimeConfigTypeDef * sBreakDeadTimeConfig)

Function description

Configures the Break feature, dead time, Lock level, OSSI/OSSR State and the AOE(automatic output enable).

Parameters

- **htim:** TIM handle
- **sBreakDeadTimeConfig:** pointer to a TIM_ConfigBreakDeadConfigTypeDef structure that contains the BDTR Register configuration information for the TIM peripheral.

Return values

- **HAL:** status

`HAL_TIMEx_ConfigBreakInput`

Function name

HAL_StatusTypeDef HAL_TIMEx_ConfigBreakInput (TIM_HandleTypeDef * htim, uint32_t BreakInput, TIMEx_BreakInputConfigTypeDef * sBreakInputConfig)

Function description

Configures the break input source.

Parameters

- **htim:** TIM handle.
- **BreakInput:** Break input to configure This parameter can be one of the following values:
  - TIM_BREAKINPUT_BRK: Timer break input
  - TIM_BREAKINPUT_BRK2: Timer break 2 input
- **sBreakInputConfig:** Break input source configuration

Return values

- **HAL:** status

`HAL_TIMEx_GroupChannel5`

Function name

HAL_StatusTypeDef HAL_TIMEx_GroupChannel5 (TIM_HandleTypeDef * htim, uint32_t Channels)

Function description

Group channel 5 and channel 1, 2 or 3.

Parameters

- **htim:** TIM handle.
- **Channels:** specifies the reference signal(s) the OC5REF is combined with. This parameter can be any combination of the following values: TIM_GROUPCH5_NONE: No effect of OC5REF on OC1REFC, OC2REFC and OC3REFC TIM_GROUPCH5_OC1REFC: OC1REFC is the logical AND of OC1REFC and OC5REF TIM_GROUPCH5_OC2REFC: OC2REFC is the logical AND of OC2REFC and OC5REF TIM_GROUPCH5_OC3REFC: OC3REFC is the logical AND of OC3REFC and OC5REF

Return values

- **HAL:** status

`HAL_TIMEx_RemapConfig`

Function name

HAL_StatusTypeDef HAL_TIMEx_RemapConfig (TIM_HandleTypeDef * htim, uint32_t Remap)

Function description

Configures the TIMx Remapping input capabilities.

Parameters

- **htim:** TIM handle.
- **Remap:** specifies the TIM remapping source.

Return values

- **HAL:** status

`HAL_TIMEx_CommutCallback`

Function name

void HAL_TIMEx_CommutCallback (TIM_HandleTypeDef * htim)

Function description

Hall commutation changed callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIMEx_CommutHalfCpltCallback`

Function name

void HAL_TIMEx_CommutHalfCpltCallback (TIM_HandleTypeDef * htim)

Function description

Hall commutation changed half complete callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIMEx_BreakCallback`

Function name

void HAL_TIMEx_BreakCallback (TIM_HandleTypeDef * htim)

Function description

Hall Break detection callback in non-blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIMEx_Break2Callback`

Function name

void HAL_TIMEx_Break2Callback (TIM_HandleTypeDef * htim)

Function description

Hall Break2 detection callback in non blocking mode.

Parameters

- **htim:** TIM handle

Return values

- **None:**

`HAL_TIMEx_HallSensor_GetState`

Function name

HAL_TIM_StateTypeDef HAL_TIMEx_HallSensor_GetState (TIM_HandleTypeDef * htim)

Function description

Return the TIM Hall Sensor interface handle state.

Parameters

- **htim:** TIM Hall Sensor handle

Return values

- **HAL:** state

`TIMEx_DMACommutationCplt`

Function name

void TIMEx_DMACommutationCplt (DMA_HandleTypeDef * hdma)

Function description

TIM DMA Commutation callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

`TIMEx_DMACommutationHalfCplt`

Function name

void TIMEx_DMACommutationHalfCplt (DMA_HandleTypeDef * hdma)

Function description

TIM DMA Commutation half complete callback.

Parameters

- **hdma:** pointer to DMA handle.

Return values

- **None:**

73.3 TIMEx Firmware driver defines

The following section lists the various define and macros of the module.

73.3.1 TIMEx

TIMEx

TIM Extended Break input

TIM_BREAKINPUT_BRK

TIM_BREAKINPUT_BRK2

TIM Extended Break input source

TIM_BREAKINPUTSOURCE_BKIN

TIM_BREAKINPUTSOURCE_COMP1

TIM_BREAKINPUTSOURCE_COMP2

TIM_BREAKINPUTSOURCE_DFSDM1

TIM Extended Break input source enabling

TIM_BREAKINPUTSOURCE_DISABLE

TIM_BREAKINPUTSOURCE_ENABLE

TIM Extended Break input polarity

TIM_BREAKINPUTSOURCE_POLARITY_LOW

TIM_BREAKINPUTSOURCE_POLARITY_HIGH

TIM Extended Remapping

TIM_TIM1_ETR_ADC1_NONE

TIM_TIM1_ETR_ADC1_AWD1

TIM_TIM1_ETR_ADC1_AWD2

TIM_TIM1_ETR_ADC1_AWD3

TIM_TIM1_TI1_GPIO

TIM_TIM1_TI1_COMP1

TIM_TIM1_ETR_GPIO

TIM_TIM1_ETR_COMP1

TIM_TIM1_ETR_COMP2

TIM_TIM2_ITR1_TIM8_TRGO

TIM_TIM2_ITR1_OTG_FS_SOF

TIM_TIM2_ETR_GPIO

TIM_TIM2_ETR_LSE

TIM_TIM2_ETR_COMP1

TIM_TIM2_ETR_COMP2

TIM_TIM2_TI4_GPIO

TIM_TIM2_TI4_COMP1

TIM_TIM2_TI4_COMP2

TIM_TIM2_TI4_COMP1_COMP2

TIM_TIM3_TI1_GPIO

TIM_TIM3_TI1_COMP1

TIM_TIM3_TI1_COMP2

TIM_TIM3_TI1_COMP1_COMP2

TIM_TIM3_ETR_GPIO

TIM_TIM3_ETR_COMP1

TIM_TIM8_TI1_GPIO

TIM_TIM8_TI1_COMP2

TIM_TIM8_ETR_GPIO

TIM_TIM8_ETR_COMP1

TIM_TIM8_ETR_COMP2

TIM_TIM15_TI1_GPIO

TIM_TIM15_TI1_LSE

TIM_TIM15_ENCODERMODE_NONE

TIM_TIM15_ENCODERMODE_TIM2

TIM_TIM15_ENCODERMODE_TIM3

TIM_TIM15_ENCODERMODE_TIM4

TIM_TIM16_TI1_GPIO

TIM_TIM16_TI1_LSI

TIM_TIM16_TI1_LSE

TIM_TIM16_TI1_RTC

TIM_TIM17_TI1_GPIO

TIM_TIM17_TI1_MSI

TIM_TIM17_TI1_HSE_32

TIM_TIM17_TI1_MCO

74 HAL TSC Generic Driver

74.1 TSC Firmware driver registers structures

74.1.1 TSC_InitTypeDef

TSC_InitTypeDef is defined in the stm32l4xx_hal_tsc.h

Data Fields

- ***uint32_t CTPulseHighLength***
- ***uint32_t CTPulseLowLength***
- ***FunctionalState SpreadSpectrum***
- ***uint32_t SpreadSpectrumDeviation***
- ***uint32_t SpreadSpectrumPrescaler***
- ***uint32_t PulseGeneratorPrescaler***
- ***uint32_t MaxCountValue***
- ***uint32_t IODefaultMode***
- ***uint32_t SynchroPinPolarity***
- ***uint32_t AcquisitionMode***
- ***FunctionalState MaxCountInterrupt***
- ***uint32_t ChannelIOs***
- ***uint32_t ShieldIOs***
- ***uint32_t SamplingIOs***

Field Documentation

- ***uint32_t TSC_InitTypeDef::CTPulseHighLength***
  Charge-transfer high pulse length This parameter can be a value of ***TSC_CTPulseHL_Config***
- ***uint32_t TSC_InitTypeDef::CTPulseLowLength***
  Charge-transfer low pulse length This parameter can be a value of ***TSC_CTPulseLL_Config***
- ***FunctionalState TSC_InitTypeDef::SpreadSpectrum***
  Spread spectrum activation This parameter can be set to ENABLE or DISABLE.
- ***uint32_t TSC_InitTypeDef::SpreadSpectrumDeviation***
  Spread spectrum deviation This parameter must be a number between Min_Data = 0 and Max_Data = 127
- ***uint32_t TSC_InitTypeDef::SpreadSpectrumPrescaler***
  Spread spectrum prescaler This parameter can be a value of ***TSC_SpreadSpec_Prescaler***
- ***uint32_t TSC_InitTypeDef::PulseGeneratorPrescaler***
  Pulse generator prescaler This parameter can be a value of ***TSC_PulseGenerator_Prescaler***
- ***uint32_t TSC_InitTypeDef::MaxCountValue***
  Max count value This parameter can be a value of ***TSC_MaxCount_Value***
- ***uint32_t TSC_InitTypeDef::IODefaultMode***
  IO default mode This parameter can be a value of ***TSC_IO_Default_Mode***
- ***uint32_t TSC_InitTypeDef::SynchroPinPolarity***
  Synchro pin polarity This parameter can be a value of ***TSC_Synchro_Pin_Polarity***
- ***uint32_t TSC_InitTypeDef::AcquisitionMode***
  Acquisition mode This parameter can be a value of ***TSC_Acquisition_Mode***
- ***FunctionalState TSC_InitTypeDef::MaxCountInterrupt***
  Max count interrupt activation This parameter can be set to ENABLE or DISABLE.
- ***uint32_t TSC_InitTypeDef::ChannelIOs***
  Channel IOs mask

- ***uint32_t TSC_InitTypeDef::ShieldIOs***
  Shield IOs mask
- ***uint32_t TSC_InitTypeDef::SamplingIOs***
  Sampling IOs mask

74.1.2 TSC_IOConfigTypeDef

TSC_IOConfigTypeDef is defined in the stm32l4xx_hal_tsc.h

Data Fields

- ***uint32_t ChannelIOs***
- ***uint32_t ShieldIOs***
- ***uint32_t SamplingIOs***

Field Documentation

- ***uint32_t TSC_IOConfigTypeDef::ChannelIOs***
  Channel IOs mask
- ***uint32_t TSC_IOConfigTypeDef::ShieldIOs***
  Shield IOs mask
- ***uint32_t TSC_IOConfigTypeDef::SamplingIOs***
  Sampling IOs mask

74.1.3 __TSC_HandleTypeDef

__TSC_HandleTypeDef is defined in the stm32l4xx_hal_tsc.h

Data Fields

- ***TSC_TypeDef * Instance***
- ***TSC_InitTypeDef Init***
- ***__IO HAL_TSC_StateTypeDef State***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***TSC_TypeDef* __TSC_HandleTypeDef::Instance***
  Register base address
- ***TSC_InitTypeDef __TSC_HandleTypeDef::Init***
  Initialization parameters
- ***__IO HAL_TSC_StateTypeDef __TSC_HandleTypeDef::State***
  Peripheral state
- ***HAL_LockTypeDef __TSC_HandleTypeDef::Lock***
  Lock feature
- ***__IO uint32_t __TSC_HandleTypeDef::ErrorCode***
  I2C Error code

74.2 TSC Firmware driver API description

The following section lists the various functions of the TSC library.

74.2.1 TSC specific features

1. Proven and robust surface charge transfer acquisition principle
2. Supports up to 3 capacitive sensing channels per group
3. Capacitive sensing channels can be acquired in parallel offering a very good response time
4. Spread spectrum feature to improve system robustness in noisy environments
5. Full hardware management of the charge transfer acquisition sequence
6. Programmable charge transfer frequency
7. Programmable sampling capacitor I/O pin

8. Programmable channel I/O pin
9. Programmable max count value to avoid long acquisition when a channel is faulty
10. Dedicated end of acquisition and max count error flags with interrupt capability
11. One sampling capacitor for up to 3 capacitive sensing channels to reduce the system components
12. Compatible with proximity, touchkey, linear and rotary touch sensor implementation

74.2.2 How to use this driver

1. Enable the TSC interface clock using __HAL_RCC_TSC_CLK_ENABLE() macro.
2. GPIO pins configuration
   – Enable the clock for the TSC GPIOs using __HAL_RCC_GPIOx_CLK_ENABLE() macro.
   – Configure the TSC pins used as sampling IOs in alternate function output Open-Drain mode, and TSC pins used as channel/shield IOs in alternate function output Push-Pull mode using HAL_GPIO_Init() function.
3. Interrupts configuration
   – Configure the NVIC (if the interrupt model is used) using HAL_NVIC_SetPriority() and HAL_NVIC_EnableIRQ() and function.
4. TSC configuration
   – Configure all TSC parameters and used TSC IOs using HAL_TSC_Init() function.

TSC peripheral alternate functions are mapped on AF9.

Acquisition sequence

- Discharge all IOs using HAL_TSC_IODischarge() function.
- Wait a certain time allowing a good discharge of all capacitors. This delay depends of the sampling capacitor and electrodes design.
- Select the channel IOs to be acquired using HAL_TSC_IOConfig() function.
- Launch the acquisition using either HAL_TSC_Start() or HAL_TSC_Start_IT() function. If the synchronized mode is selected, the acquisition will start as soon as the signal is received on the synchro pin.
- Wait the end of acquisition using either HAL_TSC_PollForAcquisition() or HAL_TSC_GetState() function or using WFI instruction for example.
- Check the group acquisition status using HAL_TSC_GroupGetStatus() function.
- Read the acquisition value using HAL_TSC_GroupGetValue() function.

Callback registration

The compilation flag USE_HAL_TSC_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks. Use Functions @ref HAL_TSC_RegisterCallback() to register an interrupt callback.

Function @ref HAL_TSC_RegisterCallback() allows to register following callbacks:

- ConvCpltCallback : callback for conversion complete process.
- ErrorCallback : callback for error detection.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit.

This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_TSC_UnRegisterCallback to reset a callback to the default weak function. @ref HAL_TSC_UnRegisterCallback takes as parameters the HAL peripheral handle, and the Callback ID.

This function allows to reset following callbacks:

- ConvCpltCallback : callback for conversion complete process.
- ErrorCallback : callback for error detection.
- MspInitCallback : callback for Msp Init.
- MspDeInitCallback : callback for Msp DeInit.

By default, after the @ref HAL_TSC_Init() and when the state is @ref HAL_TSC_STATE_RESET all callbacks are set to the corresponding weak functions: examples @ref HAL_TSC_ConvCpltCallback(), @ref HAL_TSC_ErrorCallback(). Exception done for MspInit and MspDeInit functions that are reset to the legacy weak functions in the @ref HAL_TSC_Init()/ @ref HAL_TSC_DeInit() only when these callbacks are null (not registered beforehand). If MspInit or MspDeInit are not null, the @ref HAL_TSC_Init()/ @ref HAL_TSC_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand) whatever the state.

Callbacks can be registered/unregistered in @ref HAL_TSC_STATE_READY state only. Exception done MspInit/ MspDeInit functions that can be registered/unregistered in @ref HAL_TSC_STATE_READY or @ref HAL_TSC_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/ DeInit. Then, the user first registers the MspInit/MspDeInit user callbacks using @ref HAL_TSC_RegisterCallback() before calling @ref HAL_TSC_DeInit() or @ref HAL_TSC_Init() function.

When the compilation flag USE_HAL_TSC_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and all callbacks are set to the corresponding weak functions.

74.2.3 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the TSC.
- De-initialize the TSC.

This section contains the following APIs:

- ***HAL_TSC_Init***
- ***HAL_TSC_DeInit***
- ***HAL_TSC_MspInit***
- ***HAL_TSC_MspDeInit***

74.2.4 IO Operation functions

This section provides functions allowing to:

- Start acquisition in polling mode.
- Start acquisition in interrupt mode.
- Stop conversion in polling mode.
- Stop conversion in interrupt mode.
- Poll for acquisition completed.
- Get group acquisition status.
- Get group acquisition value.

This section contains the following APIs:

- ***HAL_TSC_Start***
- ***HAL_TSC_Start_IT***
- ***HAL_TSC_Stop***
- ***HAL_TSC_Stop_IT***
- ***HAL_TSC_PollForAcquisition***
- ***HAL_TSC_GroupGetStatus***
- ***HAL_TSC_GroupGetValue***

74.2.5 Peripheral Control functions

This section provides functions allowing to:

- Configure TSC IOs
- Discharge TSC IOs

This section contains the following APIs:

- ***HAL_TSC_IOConfig***
- ***HAL_TSC_IODischarge***

74.2.6 State and Errors functions

This subsection provides functions allowing to

- Get TSC state.

This section contains the following APIs:

- ***HAL_TSC_GetState***

74.2.7 Detailed description of functions

HAL_TSC_Init

Function name

HAL_StatusTypeDef HAL_TSC_Init (TSC_HandleTypeDef * htsc)

Function description

Initialize the TSC peripheral according to the specified parameters in the TSC_InitTypeDef structure and initialize the associated handle.

Parameters

- **htsc:** TSC handle

Return values

- **HAL:** status

HAL_TSC_DeInit

Function name

HAL_StatusTypeDef HAL_TSC_DeInit (TSC_HandleTypeDef * htsc)

Function description

Deinitialize the TSC peripheral registers to their default reset values.

Parameters

- **htsc:** TSC handle

Return values

- **HAL:** status

HAL_TSC_MspInit

Function name

void HAL_TSC_MspInit (TSC_HandleTypeDef * htsc)

Function description

Initialize the TSC MSP.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **None:**

HAL_TSC_MspDeInit

Function name

void HAL_TSC_MspDeInit (TSC_HandleTypeDef * htsc)

Function description

DeInitialize the TSC MSP.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **None:**

`HAL_TSC_Start`

Function name

HAL_StatusTypeDef HAL_TSC_Start (TSC_HandleTypeDef * htsc)

Function description

Start the acquisition.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **HAL:** status

`HAL_TSC_Start_IT`

Function name

HAL_StatusTypeDef HAL_TSC_Start_IT (TSC_HandleTypeDef * htsc)

Function description

Start the acquisition in interrupt mode.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **HAL:** status.

`HAL_TSC_Stop`

Function name

HAL_StatusTypeDef HAL_TSC_Stop (TSC_HandleTypeDef * htsc)

Function description

Stop the acquisition previously launched in polling mode.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **HAL:** status

HAL_TSC_Stop_IT

Function name

HAL_StatusTypeDef HAL_TSC_Stop_IT (TSC_HandleTypeDef * htsc)

Function description

Stop the acquisition previously launched in interrupt mode.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **HAL:** status

HAL_TSC_PollForAcquisition

Function name

HAL_StatusTypeDef HAL_TSC_PollForAcquisition (TSC_HandleTypeDef * htsc)

Function description

Start acquisition and wait until completion.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **HAL:** state

Notes

- There is no need of a timeout parameter as the max count error is already managed by the TSC peripheral.

HAL_TSC_GroupGetStatus

Function name

TSC_GroupStatusTypeDef HAL_TSC_GroupGetStatus (TSC_HandleTypeDef * htsc, uint32_t gx_index)

Function description

Get the acquisition status for a group.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.
- **gx_index:** Index of the group

Return values

- **Group:** status

HAL_TSC_GroupGetValue

Function name

uint32_t HAL_TSC_GroupGetValue (TSC_HandleTypeDef * htsc, uint32_t gx_index)

Function description

Get the acquisition measure for a group.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.
- **gx_index:** Index of the group

Return values

- **Acquisition:** measure

`HAL_TSC_IOConfig`

Function name

HAL_StatusTypeDef HAL_TSC_IOConfig (TSC_HandleTypeDef * htsc, TSC_IOConfigTypeDef * config)

Function description

Configure TSC IOs.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.
- **config:** Pointer to the configuration structure.

Return values

- **HAL:** status

`HAL_TSC_IODischarge`

Function name

HAL_StatusTypeDef HAL_TSC_IODischarge (TSC_HandleTypeDef * htsc, FunctionalState choice)

Function description

Discharge TSC IOs.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.
- **choice:** This parameter can be set to ENABLE or DISABLE.

Return values

- **HAL:** status

`HAL_TSC_GetState`

Function name

HAL_TSC_StateTypeDef HAL_TSC_GetState (TSC_HandleTypeDef * htsc)

Function description

Return the TSC handle state.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **HAL:** state

`HAL_TSC_IRQHandler`

Function name

void HAL_TSC_IRQHandler (TSC_HandleTypeDef * htsc)

Function description

Handle TSC interrupt request.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **None:**

`HAL_TSC_ConvCpltCallback`

Function name

void HAL_TSC_ConvCpltCallback (TSC_HandleTypeDef * htsc)

Function description

Acquisition completed callback in non-blocking mode.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **None:**

`HAL_TSC_ErrorCallback`

Function name

void HAL_TSC_ErrorCallback (TSC_HandleTypeDef * htsc)

Function description

Error callback in non-blocking mode.

Parameters

- **htsc:** Pointer to a TSC_HandleTypeDef structure that contains the configuration information for the specified TSC.

Return values

- **None:**

74.3 TSC Firmware driver defines

The following section lists the various define and macros of the module.

74.3.1 TSC

TSC

Acquisition Mode

TSC_ACQ_MODE_NORMAL

Normal acquisition mode (acquisition starts as soon as START bit is set)

TSC_ACQ_MODE_SYNCHRO

Synchronized acquisition mode (acquisition starts if START bit is set and when the selected signal is detected on the SYNC input pin)

CTPulse High Length

TSC_CTPH_1CYCLE

Charge transfer pulse high during 1 cycle (PGCLK)

TSC_CTPH_2CYCLES

Charge transfer pulse high during 2 cycles (PGCLK)

TSC_CTPH_3CYCLES

Charge transfer pulse high during 3 cycles (PGCLK)

TSC_CTPH_4CYCLES

Charge transfer pulse high during 4 cycles (PGCLK)

TSC_CTPH_5CYCLES

Charge transfer pulse high during 5 cycles (PGCLK)

TSC_CTPH_6CYCLES

Charge transfer pulse high during 6 cycles (PGCLK)

TSC_CTPH_7CYCLES

Charge transfer pulse high during 7 cycles (PGCLK)

TSC_CTPH_8CYCLES

Charge transfer pulse high during 8 cycles (PGCLK)

TSC_CTPH_9CYCLES

Charge transfer pulse high during 9 cycles (PGCLK)

TSC_CTPH_10CYCLES

Charge transfer pulse high during 10 cycles (PGCLK)

TSC_CTPH_11CYCLES

Charge transfer pulse high during 11 cycles (PGCLK)

TSC_CTPH_12CYCLES

Charge transfer pulse high during 12 cycles (PGCLK)

TSC_CTPH_13CYCLES

Charge transfer pulse high during 13 cycles (PGCLK)

TSC_CTPH_14CYCLES

Charge transfer pulse high during 14 cycles (PGCLK)

TSC_CTPH_15CYCLES

Charge transfer pulse high during 15 cycles (PGCLK)

TSC_CTPH_16CYCLES

Charge transfer pulse high during 16 cycles (PGCLK)

CTPulse Low Length

TSC_CTPL_1CYCLE

Charge transfer pulse low during 1 cycle (PGCLK)

TSC_CTPL_2CYCLES

Charge transfer pulse low during 2 cycles (PGCLK)

TSC_CTPL_3CYCLES

Charge transfer pulse low during 3 cycles (PGCLK)

TSC_CTPL_4CYCLES

Charge transfer pulse low during 4 cycles (PGCLK)

TSC_CTPL_5CYCLES

Charge transfer pulse low during 5 cycles (PGCLK)

TSC_CTPL_6CYCLES

Charge transfer pulse low during 6 cycles (PGCLK)

TSC_CTPL_7CYCLES

Charge transfer pulse low during 7 cycles (PGCLK)

TSC_CTPL_8CYCLES

Charge transfer pulse low during 8 cycles (PGCLK)

TSC_CTPL_9CYCLES

Charge transfer pulse low during 9 cycles (PGCLK)

TSC_CTPL_10CYCLES

Charge transfer pulse low during 10 cycles (PGCLK)

TSC_CTPL_11CYCLES

Charge transfer pulse low during 11 cycles (PGCLK)

TSC_CTPL_12CYCLES

Charge transfer pulse low during 12 cycles (PGCLK)

TSC_CTPL_13CYCLES

Charge transfer pulse low during 13 cycles (PGCLK)

TSC_CTPL_14CYCLES

Charge transfer pulse low during 14 cycles (PGCLK)

TSC_CTPL_15CYCLES

Charge transfer pulse low during 15 cycles (PGCLK)

TSC_CTPL_16CYCLES

Charge transfer pulse low during 16 cycles (PGCLK)

TSC Error Code definition

HAL_TSC_ERROR_NONE

No error

TSC Exported Macros

__HAL_TSC_RESET_HANDLE_STATE

Description:

- Reset TSC handle state.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_ENABLE

Description:

- Enable the TSC peripheral.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_DISABLE

Description:

- Disable the TSC peripheral.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_START_ACQ

Description:

- Start acquisition.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_STOP_ACQ

Description:

- Stop acquisition.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_SET_IODEF_OUTPPLOW

Description:

- Set IO default mode to output push-pull low.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_SET_IODEF_INFLOAT

Description:

- Set IO default mode to input floating.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_SET_SYNC_POL_FALL

Description:

- Set synchronization polarity to falling edge.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_SET_SYNC_POL_RISE_HIGH

Description:

- Set synchronization polarity to rising edge and high level.

Parameters:

- __HANDLE__: TSC handle

Return value:

- None

__HAL_TSC_ENABLE_IT

Description:

- Enable TSC interrupt.

Parameters:

- __HANDLE__: TSC handle
- __INTERRUPT__: TSC interrupt

Return value:

- None

__HAL_TSC_DISABLE_IT

Description:

- Disable TSC interrupt.

Parameters:

- __HANDLE__: TSC handle
- __INTERRUPT__: TSC interrupt

Return value:

- None

__HAL_TSC_GET_IT_SOURCE

Description:

- Check whether the specified TSC interrupt source is enabled or not.

Parameters:

- __HANDLE__: TSC Handle
- __INTERRUPT__: TSC interrupt

Return value:

- SET: or RESET

__HAL_TSC_GET_FLAG

Description:

- Check whether the specified TSC flag is set or not.

Parameters:

- __HANDLE__: TSC handle
- __FLAG__: TSC flag

Return value:

- SET: or RESET

__HAL_TSC_CLEAR_FLAG

Description:

- Clear the TSC's pending flag.

Parameters:

- __HANDLE__: TSC handle
- __FLAG__: TSC flag

Return value:

- None

__HAL_TSC_ENABLE_HYSTERESIS

Description:

- Enable schmitt trigger hysteresis on a group of IOs.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_DISABLE_HYSTERESIS

Description:

- Disable schmitt trigger hysteresis on a group of IOs.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_OPEN_ANALOG_SWITCH

Description:

- Open analog switch on a group of IOs.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_CLOSE_ANALOG_SWITCH

Description:

- Close analog switch on a group of IOs.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_ENABLE_CHANNEL

Description:

- Enable a group of IOs in channel mode.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_DISABLE_CHANNEL

Description:

- Disable a group of channel IOs.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_ENABLE_SAMPLING

Description:

- Enable a group of IOs in sampling mode.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_DISABLE_SAMPLING

Description:

- Disable a group of sampling IOs.

Parameters:

- __HANDLE__: TSC handle
- __GX_IOY_MASK__: IOs mask

Return value:

- None

__HAL_TSC_ENABLE_GROUP

Description:

- Enable acquisition groups.

Parameters:

- __HANDLE__: TSC handle
- __GX_MASK__: Groups mask

Return value:

- None

__HAL_TSC_DISABLE_GROUP

Description:

- Disable acquisition groups.

Parameters:

- __HANDLE__: TSC handle
- __GX_MASK__: Groups mask

Return value:

- None

__HAL_TSC_GET_GROUP_STATUS

Description:

- Gets acquisition group status.

Parameters:

- __HANDLE__: TSC Handle
- __GX_INDEX__: Group index

Return value:

- SET: or RESET

Flags definition

TSC_FLAG_EOA

End of acquisition flag

TSC_FLAG_MCE

Max count error flag

Group definition

TSC_GROUP1

TSC_GROUP2

TSC_GROUP3

TSC_GROUP4

TSC_GROUP5

TSC_GROUP6

TSC_GROUP7

TSC_GROUP8

TSC_GROUPX_NOT_SUPPORTED
TSC GroupX not supported

TSC_GROUP1_IO1
TSC Group1 IO1

TSC_GROUP1_IO2
TSC Group1 IO2

TSC_GROUP1_IO3
TSC Group1 IO3

TSC_GROUP1_IO4
TSC Group1 IO4

TSC_GROUP2_IO1
TSC Group2 IO1

TSC_GROUP2_IO2
TSC Group2 IO2

TSC_GROUP2_IO3
TSC Group2 IO3

TSC_GROUP2_IO4
TSC Group2 IO4

TSC_GROUP3_IO1
TSC Group3 IO1

TSC_GROUP3_IO2
TSC Group3 IO2

TSC_GROUP3_IO3
TSC Group3 IO3

TSC_GROUP3_IO4
TSC Group3 IO4

TSC_GROUP4_IO1
TSC Group4 IO1

TSC_GROUP4_IO2
TSC Group4 IO2

TSC_GROUP4_IO3

TSC Group4 IO3

TSC_GROUP4_IO4

TSC Group4 IO4

TSC_GROUP5_IO1

TSC Group5 IO1

TSC_GROUP5_IO2

TSC Group5 IO2

TSC_GROUP5_IO3

TSC Group5 IO3

TSC_GROUP5_IO4

TSC Group5 IO4

TSC_GROUP6_IO1

TSC Group6 IO1

TSC_GROUP6_IO2

TSC Group6 IO2

TSC_GROUP6_IO3

TSC Group6 IO3

TSC_GROUP6_IO4

TSC Group6 IO4

TSC_GROUP7_IO1

TSC Group7 IO1

TSC_GROUP7_IO2

TSC Group7 IO2

TSC_GROUP7_IO3

TSC Group7 IO3

TSC_GROUP7_IO4

TSC Group7 IO4

TSC_GROUP8_IO1

TSC Group8 IO1

TSC_GROUP8_IO2

TSC Group8 IO2

TSC_GROUP8_IO3

TSC Group8 IO3

TSC_GROUP8_IO4

TSC Group8 IO4

Interrupts definition

TSC_IT_EOA

End of acquisition interrupt enable

TSC_IT_MCE

Max count error interrupt enable

IO Default Mode

TSC_IODEF_OUT_PP_LOW

I/Os are forced to output push-pull low

TSC_IODEF_IN_FLOAT

I/Os are in input floating

Max Count Value

TSC_MCV_255

255 maximum number of charge transfer pulses

TSC_MCV_511

511 maximum number of charge transfer pulses

TSC_MCV_1023

1023 maximum number of charge transfer pulses

TSC_MCV_2047

2047 maximum number of charge transfer pulses

TSC_MCV_4095

4095 maximum number of charge transfer pulses

TSC_MCV_8191

8191 maximum number of charge transfer pulses

TSC_MCV_16383

16383 maximum number of charge transfer pulses

Pulse Generator Prescaler

TSC_PG_PRESC_DIV1

Pulse Generator HCLK Div1

TSC_PG_PRESC_DIV2

Pulse Generator HCLK Div2

TSC_PG_PRESC_DIV4

Pulse Generator HCLK Div4

TSC_PG_PRESC_DIV8

Pulse Generator HCLK Div8

TSC_PG_PRESC_DIV16

Pulse Generator HCLK Div16

TSC_PG_PRESC_DIV32

Pulse Generator HCLK Div32

TSC_PG_PRESC_DIV64

Pulse Generator HCLK Div64

TSC_PG_PRESC_DIV128

Pulse Generator HCLK Div128

Spread Spectrum Prescaler

TSC_SS_PRESC_DIV1

Spread Spectrum Prescaler Div1

TSC_SS_PRESC_DIV2

Spread Spectrum Prescaler Div2

Synchro Pin Polarity

TSC_SYNC_POLARITY_FALLING

Falling edge only

TSC_SYNC_POLARITY_RISING

Rising edge and high level

75 HAL UART Generic Driver

75.1 UART Firmware driver registers structures

75.1.1 UART_InitTypeDef

UART_InitTypeDef is defined in the stm32l4xx_hal_uart.h

Data Fields

- ***uint32_t BaudRate***
- ***uint32_t WordLength***
- ***uint32_t StopBits***
- ***uint32_t Parity***
- ***uint32_t Mode***
- ***uint32_t HwFlowCtl***
- ***uint32_t OverSampling***
- ***uint32_t OneBitSampling***
- ***uint32_t ClockPrescaler***

Field Documentation

- ***uint32_t UART_InitTypeDef::BaudRate***

  This member configures the UART communication baud rate. The baud rate register is computed using the following formula: Baud Rate Register = ((256 * lpuart_ker_ckpres) / ((huart->Init.BaudRate))) where lpuart_ker_ck_pres is the UART input clock (divided by a prescaler if applicable)

  – If oversampling is 16 or in LIN mode, Baud Rate Register = ((uart_ker_ckpres) / ((huart->Init.BaudRate)))

  – If oversampling is 8, Baud Rate Register[15:4] = ((2 * uart_ker_ckpres) / ((huart->Init.BaudRate)))[15:4] Baud Rate Register[3] = 0 Baud Rate Register[2:0] = (((2 * uart_ker_ckpres) / ((huart->Init.BaudRate)))[3:0]) >> 1 where uart_ker_ck_pres is the UART input clock (divided by a prescaler if applicable)

- ***uint32_t UART_InitTypeDef::WordLength***

  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***UARTEx_Word_Length***.

- ***uint32_t UART_InitTypeDef::StopBits***

  Specifies the number of stop bits transmitted. This parameter can be a value of ***UART_Stop_Bits***.

- ***uint32_t UART_InitTypeDef::Parity***

  Specifies the parity mode. This parameter can be a value of ***UART_Parity***

  Note:

  – When parity is enabled, the computed parity is inserted at the MSB position of the transmitted data (9th bit when the word length is set to 9 data bits; 8th bit when the word length is set to 8 data bits).

- ***uint32_t UART_InitTypeDef::Mode***

  Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of ***UART_Mode***.

- ***uint32_t UART_InitTypeDef::HwFlowCtl***

  Specifies whether the hardware flow control mode is enabled or disabled. This parameter can be a value of ***UART_Hardware_Flow_Control***.

- ***uint32_t UART_InitTypeDef::OverSampling***

  Specifies whether the Over sampling 8 is enabled or disabled, to achieve higher speed (up to f_PCLK/8). This parameter can be a value of ***UART_Over_Sampling***.

- ***uint32_t UART_InitTypeDef::OneBitSampling***

  Specifies whether a single sample or three samples' majority vote is selected. Selecting the single sample method increases the receiver tolerance to clock deviations. This parameter can be a value of ***UART_OneBit_Sampling***.

- ***uint32_t UART_InitTypeDef::ClockPrescaler***

  Specifies the prescaler value used to divide the UART clock source. This parameter can be a value of *UART_ClockPrescaler*.

75.1.2 UART_AdvFeatureInitTypeDef

UART_AdvFeatureInitTypeDef is defined in the stm32l4xx_hal_uart.h

Data Fields

- ***uint32_t AdvFeatureInit***
- ***uint32_t TxPinLevelInvert***
- ***uint32_t RxPinLevelInvert***
- ***uint32_t DataInvert***
- ***uint32_t Swap***
- ***uint32_t OverrunDisable***
- ***uint32_t DMADisableonRxError***
- ***uint32_t AutoBaudRateEnable***
- ***uint32_t AutoBaudRateMode***
- ***uint32_t MSBFirst***

Field Documentation

- ***uint32_t UART_AdvFeatureInitTypeDef::AdvFeatureInit***

  Specifies which advanced UART features is initialized. Several Advanced Features may be initialized at the same time . This parameter can be a value of *UART_Advanced_Features_Initialization_Type*.
- ***uint32_t UART_AdvFeatureInitTypeDef::TxPinLevelInvert***

  Specifies whether the TX pin active level is inverted. This parameter can be a value of *UART_Tx_Inv*.
- ***uint32_t UART_AdvFeatureInitTypeDef::RxPinLevelInvert***

  Specifies whether the RX pin active level is inverted. This parameter can be a value of *UART_Rx_Inv*.
- ***uint32_t UART_AdvFeatureInitTypeDef::DataInvert***

  Specifies whether data are inverted (positive/direct logic vs negative/inverted logic). This parameter can be a value of *UART_Data_Inv*.
- ***uint32_t UART_AdvFeatureInitTypeDef::Swap***

  Specifies whether TX and RX pins are swapped. This parameter can be a value of *UART_Rx_Tx_Swap*.
- ***uint32_t UART_AdvFeatureInitTypeDef::OverrunDisable***

  Specifies whether the reception overrun detection is disabled. This parameter can be a value of *UART_Overrun_Disable*.
- ***uint32_t UART_AdvFeatureInitTypeDef::DMADisableonRxError***

  Specifies whether the DMA is disabled in case of reception error. This parameter can be a value of *UART_DMA_Disable_on_Rx_Error*.
- ***uint32_t UART_AdvFeatureInitTypeDef::AutoBaudRateEnable***

  Specifies whether auto Baud rate detection is enabled. This parameter can be a value of *UART_AutoBaudRate_Enable*.
- ***uint32_t UART_AdvFeatureInitTypeDef::AutoBaudRateMode***

  If auto Baud rate detection is enabled, specifies how the rate detection is carried out. This parameter can be a value of *UART_AutoBaud_Rate_Mode*.
- ***uint32_t UART_AdvFeatureInitTypeDef::MSBFirst***

  Specifies whether MSB is sent first on UART line. This parameter can be a value of *UART_MSB_First*.

75.1.3 __UART_HandleTypeDef

__UART_HandleTypeDef is defined in the stm32l4xx_hal_uart.h

Data Fields

- ***USART_TypeDef * Instance***
- ***UART_InitTypeDef Init***
- ***UART_AdvFeatureInitTypeDef AdvancedInit***

- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint16_t Mask***
- ***uint32_t FifoMode***
- ***uint16_t NbRxDataToProcess***
- ***uint16_t NbTxDataToProcess***
- ***void(* RxISR***
- ***void(* TxISR***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_UART_StateTypeDef gState***
- ***__IO HAL_UART_StateTypeDef RxState***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* __UART_HandleTypeDef::Instance***
  UART registers base address
- ***UART_InitTypeDef __UART_HandleTypeDef::Init***
  UART communication parameters
- ***UART_AdvFeatureInitTypeDef __UART_HandleTypeDef::AdvancedInit***
  UART Advanced Features initialization parameters
- ***uint8_t* __UART_HandleTypeDef::pTxBuffPtr***
  Pointer to UART Tx transfer Buffer
- ***uint16_t __UART_HandleTypeDef::TxXferSize***
  UART Tx Transfer size
- ***__IO uint16_t __UART_HandleTypeDef::TxXferCount***
  UART Tx Transfer Counter
- ***uint8_t* __UART_HandleTypeDef::pRxBuffPtr***
  Pointer to UART Rx transfer Buffer
- ***uint16_t __UART_HandleTypeDef::RxXferSize***
  UART Rx Transfer size
- ***__IO uint16_t __UART_HandleTypeDef::RxXferCount***
  UART Rx Transfer Counter
- ***uint16_t __UART_HandleTypeDef::Mask***
  UART Rx RDR register mask
- ***uint32_t __UART_HandleTypeDef::FifoMode***
  Specifies if the FIFO mode is being used. This parameter can be a value of *UARTEx_FIFO_mode*.
- ***uint16_t __UART_HandleTypeDef::NbRxDataToProcess***
  Number of data to process during RX ISR execution
- ***uint16_t __UART_HandleTypeDef::NbTxDataToProcess***
  Number of data to process during TX ISR execution
- ***void(* __UART_HandleTypeDef::RxISR)(struct __UART_HandleTypeDef *huart)***
  Function pointer on Rx IRQ handler
- ***void(* __UART_HandleTypeDef::TxISR)(struct __UART_HandleTypeDef *huart)***
  Function pointer on Tx IRQ handler

- ***DMA_HandleTypeDef* __UART_HandleTypeDef::hdmatx***
  UART Tx DMA Handle parameters
- ***DMA_HandleTypeDef* __UART_HandleTypeDef::hdmarx***
  UART Rx DMA Handle parameters
- ***HAL_LockTypeDef __UART_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_UART_StateTypeDef __UART_HandleTypeDef::gState***
  UART state information related to global Handle management and also related to Tx operations. This parameter can be a value of **HAL_UART_StateTypeDef**
- ***__IO HAL_UART_StateTypeDef __UART_HandleTypeDef::RxState***
  UART state information related to Rx operations. This parameter can be a value of **HAL_UART_StateTypeDef**
- ***__IO uint32_t __UART_HandleTypeDef::ErrorCode***
  UART Error code

75.2 UART Firmware driver API description

The following section lists the various functions of the UART library.

75.2.1 How to use this driver

The UART HAL driver can be used as follows:

1. Declare a UART_HandleTypeDef handle structure (eg. UART_HandleTypeDef huart).
2. Initialize the UART low level resources by implementing the HAL_UART_MspInit() API:
   - Enable the USARTx interface clock.
   - UART pins configuration:
     - Enable the clock for the UART GPIOs.
     - Configure these UART pins as alternate function pull-up.
   - NVIC configuration if you need to use interrupt process (HAL_UART_Transmit_IT() and HAL_UART_Receive_IT() APIs):
     - Configure the USARTx interrupt priority.
     - Enable the NVIC USART IRQ handle.
   - UART interrupts handling:

Note: The specific UART interrupts (Transmission complete interrupt, RXNE interrupt, RX/TX FIFOs related interrupts and Error Interrupts) are managed using the macros __HAL_UART_ENABLE_IT() and __HAL_UART_DISABLE_IT() inside the transmit and receive processes.

   - DMA Configuration if you need to use DMA process (HAL_UART_Transmit_DMA() and HAL_UART_Receive_DMA() APIs):
     - Declare a DMA handle structure for the Tx/Rx channel.
     - Enable the DMAx interface clock.
     - Configure the declared DMA handle structure with the required Tx/Rx parameters.
     - Configure the DMA Tx/Rx channel.
     - Associate the initialized DMA handle to the UART DMA Tx/Rx handle.
     - Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx channel.
3. Program the Baud Rate, Word Length, Stop Bit, Parity, Prescaler value , Hardware flow control and Mode (Receiver/Transmitter) in the huart handle Init structure.
4. If required, program UART advanced features (TX/RX pins swap, auto Baud rate detection,...) in the huart handle AdvancedInit structure.
5. For the UART asynchronous mode, initialize the UART registers by calling the HAL_UART_Init() API.
6. For the UART Half duplex mode, initialize the UART registers by calling the HAL_HalfDuplex_Init() API.
7. For the UART LIN (Local Interconnection Network) mode, initialize the UART registers by calling the HAL_LIN_Init() API.

8. For the UART Multiprocessor mode, initialize the UART registers by calling the HAL_MultiProcessor_Init() API.
9. For the UART RS485 Driver Enabled mode, initialize the UART registers by calling the HAL_RS485Ex_Init() API.

Note: These API's (HAL_UART_Init(), HAL_HalfDuplex_Init(), HAL_LIN_Init(), HAL_MultiProcessor_Init(), also configure the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_UART_MspInit() API.

75.2.2 Callback registration

The compilation define USE_HAL_UART_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_UART_RegisterCallback() to register a user callback. Function @ref HAL_UART_RegisterCallback() allows to register following callbacks:

- TxHalfCpltCallback : Tx Half Complete Callback.
- TxCpltCallback : Tx Complete Callback.
- RxHalfCpltCallback : Rx Half Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- AbortTransmitCpltCallback : Abort Transmit Complete Callback.
- AbortReceiveCpltCallback : Abort Receive Complete Callback.
- WakeupCallback : Wakeup Callback.
- RxFifoFullCallback : Rx Fifo Full Callback.
- TxFifoEmptyCallback : Tx Fifo Empty Callback.
- MspInitCallback : UART MspInit.
- MspDeInitCallback : UART MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_UART_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_UART_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- TxHalfCpltCallback : Tx Half Complete Callback.
- TxCpltCallback : Tx Complete Callback.
- RxHalfCpltCallback : Rx Half Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- AbortTransmitCpltCallback : Abort Transmit Complete Callback.
- AbortReceiveCpltCallback : Abort Receive Complete Callback.
- WakeupCallback : Wakeup Callback.
- RxFifoFullCallback : Rx Fifo Full Callback.
- TxFifoEmptyCallback : Tx Fifo Empty Callback.
- MspInitCallback : UART MspInit.
- MspDeInitCallback : UART MspDeInit.

By default, after the @ref HAL_UART_Init() and when the state is HAL_UART_STATE_RESET all callbacks are set to the corresponding weak (surcharged) functions: examples @ref HAL_UART_TxCpltCallback(), @ref HAL_UART_RxHalfCpltCallback(). Exception done for MspInit and MspDeInit functions that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_UART_Init() and @ref HAL_UART_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_UART_Init() and @ref HAL_UART_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_UART_STATE_READY state only. Exception done MspInit/ MspDeInit that can be registered/unregistered in HAL_UART_STATE_READY or HAL_UART_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_UART_RegisterCallback() before calling @ref HAL_UART_DeInit() or @ref HAL_UART_Init() function.

When The compilation define USE_HAL_UART_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and weak (surcharged) callbacks are used.

75.2.3 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx or the UARTy in asynchronous mode.

- For the asynchronous mode the parameters below can be configured:
  - Baud Rate
  - Word Length
  - Stop Bit
  - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit.
  - Hardware flow control
  - Receiver/transmitter modes
  - Over Sampling Method
  - One-Bit Sampling Method
- For the asynchronous mode, the following advanced features can be configured as well:
  - TX and/or RX pin level inversion
  - data logical level inversion
  - RX and TX pins swap
  - RX overrun detection disabling
  - DMA disabling on RX error
  - MSB first on communication line
  - auto Baud rate detection

The HAL_UART_Init(), HAL_HalfDuplex_Init(), HAL_LIN_Init()and HAL_MultiProcessor_Init()API follow respectively the UART asynchronous, UART Half duplex, UART LIN mode and UART multiprocessor mode configuration procedures (details for the procedures are available in reference manual).

This section contains the following APIs:

- ***HAL_UART_Init***
- ***HAL_HalfDuplex_Init***
- ***HAL_LIN_Init***
- ***HAL_MultiProcessor_Init***
- ***HAL_UART_DeInit***
- ***HAL_UART_MspInit***
- ***HAL_UART_MspDeInit***

75.2.4 IO operation functions

This section contains the following APIs:

- ***HAL_UART_Transmit***
- ***HAL_UART_Receive***
- ***HAL_UART_Transmit_IT***
- ***HAL_UART_Receive_IT***
- ***HAL_UART_Transmit_DMA***
- ***HAL_UART_Receive_DMA***
- ***HAL_UART_DMAPause***
- ***HAL_UART_DMAResume***

- ***HAL_UART_DMAStop***
- ***HAL_UART_Abort***
- ***HAL_UART_AbortTransmit***
- ***HAL_UART_AbortReceive***
- ***HAL_UART_Abort_IT***
- ***HAL_UART_AbortTransmit_IT***
- ***HAL_UART_AbortReceive_IT***
- ***HAL_UART_IRQHandler***
- ***HAL_UART_TxCpltCallback***
- ***HAL_UART_TxHalfCpltCallback***
- ***HAL_UART_RxCpltCallback***
- ***HAL_UART_RxHalfCpltCallback***
- ***HAL_UART_ErrorCallback***
- ***HAL_UART_AbortCpltCallback***
- ***HAL_UART_AbortTransmitCpltCallback***
- ***HAL_UART_AbortReceiveCpltCallback***

75.2.5 Peripheral Control functions

This subsection provides a set of functions allowing to control the UART.

- HAL_UART_ReceiverTimeout_Config() API allows to configure the receiver timeout value on the fly
- HAL_UART_EnableReceiverTimeout() API enables the receiver timeout feature
- HAL_UART_DisableReceiverTimeout() API disables the receiver timeout feature
- HAL_MultiProcessor_EnableMuteMode() API enables mute mode
- HAL_MultiProcessor_DisableMuteMode() API disables mute mode
- HAL_MultiProcessor_EnterMuteMode() API enters mute mode
- UART_SetConfig() API configures the UART peripheral
- UART_AdvFeatureConfig() API optionally configures the UART advanced features
- UART_CheckIdleState() API ensures that TEACK and/or REACK are set after initialization
- HAL_HalfDuplex_EnableTransmitter() API disables receiver and enables transmitter
- HAL_HalfDuplex_EnableReceiver() API disables transmitter and enables receiver
- HAL_LIN_SendBreak() API transmits the break characters

This section contains the following APIs:

- ***HAL_UART_ReceiverTimeout_Config***
- ***HAL_UART_EnableReceiverTimeout***
- ***HAL_UART_DisableReceiverTimeout***
- ***HAL_MultiProcessor_EnableMuteMode***
- ***HAL_MultiProcessor_DisableMuteMode***
- ***HAL_MultiProcessor_EnterMuteMode***
- ***HAL_HalfDuplex_EnableTransmitter***
- ***HAL_HalfDuplex_EnableReceiver***
- ***HAL_LIN_SendBreak***

75.2.6 Peripheral State and Error functions

This subsection provides functions allowing to :

- Return the UART handle state.
- Return the UART handle error code

This section contains the following APIs:

- ***HAL_UART_GetState***

- *HAL_UART_GetError*

75.2.7 Detailed description of functions

`HAL_UART_Init`

Function name

HAL_StatusTypeDef HAL_UART_Init (UART_HandleTypeDef * huart)

Function description

Initialize the UART mode according to the specified parameters in the UART_InitTypeDef and initialize the associated handle.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`HAL_HalfDuplex_Init`

Function name

HAL_StatusTypeDef HAL_HalfDuplex_Init (UART_HandleTypeDef * huart)

Function description

Initialize the half-duplex mode according to the specified parameters in the UART_InitTypeDef and creates the associated handle.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`HAL_LIN_Init`

Function name

HAL_StatusTypeDef HAL_LIN_Init (UART_HandleTypeDef * huart, uint32_t BreakDetectLength)

Function description

Initialize the LIN mode according to the specified parameters in the UART_InitTypeDef and creates the associated handle.

Parameters

- **huart:** UART handle.
- **BreakDetectLength:** Specifies the LIN break detection length. This parameter can be one of the following values:
  - UART_LINBREAKDETECTLENGTH_10B 10-bit break detection
  - UART_LINBREAKDETECTLENGTH_11B 11-bit break detection

Return values

- **HAL:** status

HAL_MultiProcessor_Init

Function name

HAL_StatusTypeDef HAL_MultiProcessor_Init (UART_HandleTypeDef * huart, uint8_t Address, uint32_t WakeUpMethod)

Function description

Initialize the multiprocessor mode according to the specified parameters in the UART_InitTypeDef and initialize the associated handle.

Parameters

- **huart:** UART handle.
- **Address:** UART node address (4-, 6-, 7- or 8-bit long).
- **WakeUpMethod:** Specifies the UART wakeup method. This parameter can be one of the following values:
  - UART_WAKEUPMETHOD_IDLELINE WakeUp by an idle line detection
  - UART_WAKEUPMETHOD_ADDRESSMARK WakeUp by an address mark

Return values

- **HAL:** status

Notes

- If the user resorts to idle line detection wake up, the Address parameter is useless and ignored by the initialization function.
- If the user resorts to address mark wake up, the address length detection is configured by default to 4 bits only. For the UART to be able to manage 6-, 7- or 8-bit long addresses detection, the API HAL_MultiProcessorEx_AddressLength_Set() must be called after HAL_MultiProcessor_Init().

HAL_UART_DeInit

Function name

HAL_StatusTypeDef HAL_UART_DeInit (UART_HandleTypeDef * huart)

Function description

DeInitialize the UART peripheral.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_UART_MspInit

Function name

void HAL_UART_MspInit (UART_HandleTypeDef * huart)

Function description

Initialize the UART MSP.

Parameters

- **huart:** UART handle.

Return values

- **None:**

HAL_UART_MspDeInit

Function name

void HAL_UART_MspDeInit (UART_HandleTypeDef * huart)

Function description

DeInitialize the UART MSP.

Parameters

- **huart:** UART handle.

Return values

- **None:**

HAL_UART_Transmit

Function name

HAL_StatusTypeDef HAL_UART_Transmit (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Send an amount of data in blocking mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be sent.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data is handled as a set of u16. In this case, Size must indicate the number of u16 provided through pData.
- When FIFO mode is enabled, writing a data in the TDR register adds one data to the TXFIFO. Write operations to the TDR register are performed when TXFNF flag is set. From hardware perspective, TXFNF flag and TXE are mapped on the same bit-field.

HAL_UART_Receive

Function name

HAL_StatusTypeDef HAL_UART_Receive (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be received.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the received data is handled as a set of u16. In this case, Size must indicate the number of u16 available through pData.
- When FIFO mode is enabled, the RXFNE flag is set as long as the RXFIFO is not empty. Read operations from the RDR register are performed when RXFNE flag is set. From hardware perspective, RXFNE flag and RXNE are mapped on the same bit-field.

`HAL_UART_Transmit_IT`

Function name

HAL_StatusTypeDef HAL_UART_Transmit_IT (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)

Function description

Send an amount of data in interrupt mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be sent.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data is handled as a set of u16. In this case, Size must indicate the number of u16 provided through pData.

`HAL_UART_Receive_IT`

Function name

HAL_StatusTypeDef HAL_UART_Receive_IT (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in interrupt mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be received.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the received data is handled as a set of u16. In this case, Size must indicate the number of u16 available through pData.

HAL_UART_Transmit_DMA

Function name

HAL_StatusTypeDef HAL_UART_Transmit_DMA (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)

Function description

Send an amount of data in DMA mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be sent.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data is handled as a set of u16. In this case, Size must indicate the number of u16 provided through pData.

HAL_UART_Receive_DMA

Function name

HAL_StatusTypeDef HAL_UART_Receive_DMA (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)

Function description

Receive an amount of data in DMA mode.

Parameters

- **huart:** UART handle.
- **pData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be received.

Return values

- **HAL:** status

Notes

- When the UART parity is enabled (PCE = 1), the received data contain the parity bit (MSB position).
- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the received data is handled as a set of u16. In this case, Size must indicate the number of u16 available through pData.

HAL_UART_DMAPause

Function name

HAL_StatusTypeDef HAL_UART_DMAPause (UART_HandleTypeDef * huart)

Function description

Pause the DMA Transfer.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`HAL_UART_DMAResume`

Function name

HAL_StatusTypeDef HAL_UART_DMAResume (UART_HandleTypeDef * huart)

Function description

Resume the DMA Transfer.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`HAL_UART_DMAStop`

Function name

HAL_StatusTypeDef HAL_UART_DMAStop (UART_HandleTypeDef * huart)

Function description

Stop the DMA Transfer.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`HAL_UART_Abort`

Function name

HAL_StatusTypeDef HAL_UART_Abort (UART_HandleTypeDef * huart)

Function description

Abort ongoing transfers (blocking mode).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable UART Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_UART_AbortTransmit`

Function name

HAL_StatusTypeDef HAL_UART_AbortTransmit (UART_HandleTypeDef * huart)

Function description

Abort ongoing Transmit transfer (blocking mode).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable UART Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_UART_AbortReceive`

Function name

HAL_StatusTypeDef HAL_UART_AbortReceive (UART_HandleTypeDef * huart)

Function description

Abort ongoing Receive transfer (blocking mode).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable UART Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_UART_Abort_IT`

Function name

HAL_StatusTypeDef HAL_UART_Abort_IT (UART_HandleTypeDef * huart)

Function description

Abort ongoing transfers (Interrupt mode).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable UART Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

`HAL_UART_AbortTransmit_IT`

Function name

HAL_StatusTypeDef HAL_UART_AbortTransmit_IT (UART_HandleTypeDef * huart)

Function description

Abort ongoing Transmit transfer (Interrupt mode).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Tx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable UART Interrupts (Tx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

`HAL_UART_AbortReceive_IT`

Function name

HAL_StatusTypeDef HAL_UART_AbortReceive_IT (UART_HandleTypeDef * huart)

Function description

Abort ongoing Receive transfer (Interrupt mode).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing Rx transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable UART Interrupts (Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

`HAL_UART_IRQHandler`

Function name

void HAL_UART_IRQHandler (UART_HandleTypeDef * huart)

Function description

Handle UART interrupt request.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_TxHalfCpltCallback`

Function name

void HAL_UART_TxHalfCpltCallback (UART_HandleTypeDef * huart)

Function description

Tx Half Transfer completed callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_TxCpltCallback`

Function name

void HAL_UART_TxCpltCallback (UART_HandleTypeDef * huart)

Function description

Tx Transfer completed callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_RxHalfCpltCallback`

Function name

void HAL_UART_RxHalfCpltCallback (UART_HandleTypeDef * huart)

Function description

Rx Half Transfer completed callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_RxCpltCallback`

Function name

void HAL_UART_RxCpltCallback (UART_HandleTypeDef * huart)

Function description

Rx Transfer completed callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_ErrorCallback`

Function name

void HAL_UART_ErrorCallback (UART_HandleTypeDef * huart)

Function description

UART error callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_AbortCpltCallback`

Function name

void HAL_UART_AbortCpltCallback (UART_HandleTypeDef * huart)

Function description

UART Abort Complete callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_AbortTransmitCpltCallback`

Function name

void HAL_UART_AbortTransmitCpltCallback (UART_HandleTypeDef * huart)

Function description

UART Abort Complete callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UART_AbortReceiveCpltCallback`

Function name

void HAL_UART_AbortReceiveCpltCallback (UART_HandleTypeDef * huart)

Function description

UART Abort Receive Complete callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

HAL_UART_ReceiverTimeout_Config

Function name

void HAL_UART_ReceiverTimeout_Config (UART_HandleTypeDef * huart, uint32_t TimeoutValue)

Function description

Update on the fly the receiver timeout value in RTOR register.

Parameters

- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **TimeoutValue:** receiver timeout value in number of baud blocks. The timeout value must be less or equal to 0x0FFFFFFF.

Return values

- **None:**

HAL_UART_EnableReceiverTimeout

Function name

HAL_StatusTypeDef HAL_UART_EnableReceiverTimeout (UART_HandleTypeDef * huart)

Function description

Enable the UART receiver timeout feature.

Parameters

- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

HAL_UART_DisableReceiverTimeout

Function name

HAL_StatusTypeDef HAL_UART_DisableReceiverTimeout (UART_HandleTypeDef * huart)

Function description

Disable the UART receiver timeout feature.

Parameters

- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values

- **HAL:** status

HAL_LIN_SendBreak

Function name

HAL_StatusTypeDef HAL_LIN_SendBreak (UART_HandleTypeDef * huart)

Function description

Transmit break characters.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_MultiProcessor_EnableMuteMode

Function name

HAL_StatusTypeDef HAL_MultiProcessor_EnableMuteMode (UART_HandleTypeDef * huart)

Function description

Enable UART in mute mode (does not mean UART enters mute mode; to enter mute mode, HAL_MultiProcessor_EnterMuteMode() API must be called).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_MultiProcessor_DisableMuteMode

Function name

HAL_StatusTypeDef HAL_MultiProcessor_DisableMuteMode (UART_HandleTypeDef * huart)

Function description

Disable UART mute mode (does not mean the UART actually exits mute mode as it may not have been in mute mode at this very moment).

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_MultiProcessor_EnterMuteMode

Function name

void HAL_MultiProcessor_EnterMuteMode (UART_HandleTypeDef * huart)

Function description

Enter UART mute mode (means UART actually enters mute mode).

Parameters

- **huart:** UART handle.

Return values

- **None:**

Notes

- To exit from mute mode, HAL_MultiProcessor_DisableMuteMode() API must be called.

`HAL_HalfDuplex_EnableTransmitter`

Function name

HAL_StatusTypeDef HAL_HalfDuplex_EnableTransmitter (UART_HandleTypeDef * huart)

Function description

Enable the UART transmitter and disable the UART receiver.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`HAL_HalfDuplex_EnableReceiver`

Function name

HAL_StatusTypeDef HAL_HalfDuplex_EnableReceiver (UART_HandleTypeDef * huart)

Function description

Enable the UART receiver and disable the UART transmitter.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status.

`HAL_UART_GetState`

Function name

HAL_UART_StateTypeDef HAL_UART_GetState (UART_HandleTypeDef * huart)

Function description

Return the UART handle state.

Parameters

- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART.

Return values

- **HAL:** state

`HAL_UART_GetError`

Function name

uint32_t HAL_UART_GetError (UART_HandleTypeDef * huart)

Function description

Return the UART handle error code.

Parameters

- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART.

Return values

- **UART:** Error Code

`UART_SetConfig`

Function name

HAL_StatusTypeDef UART_SetConfig (UART_HandleTypeDef * huart)

Function description

Initialize the callbacks to their default values.

Parameters

- **huart:** UART handle.
- **huart:** UART handle.

Return values

- **none:** Configure the UART peripheral.
- **HAL:** status

`UART_CheckIdleState`

Function name

HAL_StatusTypeDef UART_CheckIdleState (UART_HandleTypeDef * huart)

Function description

Check the UART Idle State.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

`UART_WaitOnFlagUntilTimeout`

Function name

HAL_StatusTypeDef UART_WaitOnFlagUntilTimeout (UART_HandleTypeDef * huart, uint32_t Flag, FlagStatus Status, uint32_t Tickstart, uint32_t Timeout)

Function description

Handle UART Communication Timeout.

Parameters

- **huart:** UART handle.
- **Flag:** Specifies the UART flag to check
- **Status:** Flag status (SET or RESET)
- **Tickstart:** Tick start value
- **Timeout:** Timeout duration

Return values

- **HAL:** status

`UART_AdvFeatureConfig`

Function name

void UART_AdvFeatureConfig (UART_HandleTypeDef * huart)

Function description

Configure the UART peripheral advanced features.

Parameters

- **huart:** UART handle.

Return values

- **None:**

75.3 UART Firmware driver defines

The following section lists the various define and macros of the module.

75.3.1 UART

UART

UART Advanced Feature Initialization Type

UART_ADVFEATURE_NO_INIT

No advanced feature initialization

UART_ADVFEATURE_TXINVERT_INIT

TX pin active level inversion

UART_ADVFEATURE_RXINVERT_INIT

RX pin active level inversion

UART_ADVFEATURE_DATAINVERT_INIT

Binary data inversion

UART_ADVFEATURE_SWAP_INIT

TX/RX pins swap

UART_ADVFEATURE_RXOVERRUNDISABLE_INIT

RX overrun disable

UART_ADVFEATURE_DMADISABLEONERROR_INIT

DMA disable on Reception Error

UART_ADVFEATURE_AUTOBAUDRATE_INIT

Auto Baud rate detection initialization

UART_ADVFEATURE_MSBFIRST_INIT

Most significant bit sent/received first

UART Advanced Feature Auto BaudRate Enable

UART_ADVFEATURE_AUTOBAUDRATE_DISABLE

RX Auto Baud rate detection enable

UART_ADVFEATURE_AUTOBAUDRATE_ENABLE

RX Auto Baud rate detection disable

UART Advanced Feature AutoBaud Rate Mode

UART_ADVFEATURE_AUTOBAUDRATE_ONSTARTBIT

Auto Baud rate detection on start bit

UART_ADVFEATURE_AUTOBAUDRATE_ONFALLINGEDGE

Auto Baud rate detection on falling edge

UART_ADVFEATURE_AUTOBAUDRATE_ON0X7FFRAME

Auto Baud rate detection on 0x7F frame detection

UART_ADVFEATURE_AUTOBAUDRATE_ON0X55FRAME

Auto Baud rate detection on 0x55 frame detection

UART Clock Prescaler

UART_PRESCALER_DIV1

fclk_pres = fclk

UART_PRESCALER_DIV2

fclk_pres = fclk/2

UART_PRESCALER_DIV4

fclk_pres = fclk/4

UART_PRESCALER_DIV6

fclk_pres = fclk/6

UART_PRESCALER_DIV8

fclk_pres = fclk/8

UART_PRESCALER_DIV10

fclk_pres = fclk/10

UART_PRESCALER_DIV12

fclk_pres = fclk/12

UART_PRESCALER_DIV16

fclk_pres = fclk/16

UART_PRESCALER_DIV32

fclk_pres = fclk/32

UART_PRESCALER_DIV64

fclk_pres = fclk/64

UART_PRESCALER_DIV128

fclk_pres = fclk/128

UART_PRESCALER_DIV256

fclk_pres = fclk/256

UART Driver Enable Assertion Time LSB Position In CR1 Register

UART_CR1_DEAT_ADDRESS_LSB_POS

UART Driver Enable assertion time LSB position in CR1 register

UART Driver Enable DeAssertion Time LSB Position In CR1 Register

UART_CR1_DEDT_ADDRESS_LSB_POS

UART Driver Enable de-assertion time LSB position in CR1 register

UART Address-matching LSB Position In CR2 Register

UART_CR2_ADDRESS_LSB_POS

UART address-matching LSB position in CR2 register

UART Advanced Feature Binary Data Inversion

UART_ADVFEATURE_DATAINV_DISABLE

Binary data inversion disable

UART_ADVFEATURE_DATAINV_ENABLE

Binary data inversion enable

UART Advanced Feature DMA Disable On Rx Error

UART_ADVFEATURE_DMA_ENABLEONRXERROR

DMA enable on Reception Error

UART_ADVFEATURE_DMA_DISABLEONRXERROR

DMA disable on Reception Error

UART DMA Rx

UART_DMA_RX_DISABLE

UART DMA RX disabled

UART_DMA_RX_ENABLE

UART DMA RX enabled

UART DMA Tx

UART_DMA_TX_DISABLE

UART DMA TX disabled

UART_DMA_TX_ENABLE

UART DMA TX enabled

UART DriverEnable Polarity

UART_DE_POLARITY_HIGH

Driver enable signal is active high

UART_DE_POLARITY_LOW

Driver enable signal is active low

UART Error Definition

HAL_UART_ERROR_NONE

No error

HAL_UART_ERROR_PE

Parity error

HAL_UART_ERROR_NE

Noise error

HAL_UART_ERROR_FE

Frame error

HAL_UART_ERROR_ORE

Overrun error

HAL_UART_ERROR_DMA

DMA transfer error

HAL_UART_ERROR_RTO

Receiver Timeout error

UART Exported Macros

__HAL_UART_RESET_HANDLE_STATE

Description:

- Reset UART handle states.

Parameters:

- __HANDLE__: UART handle.

Return value:

- None

__HAL_UART_FLUSH_DRREGISTER

Description:

- Flush the UART Data registers.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_CLEAR_FLAG

Description:

- Clear the specified UART pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - UART_CLEAR_PEF Parity Error Clear Flag
  - UART_CLEAR_FEF Framing Error Clear Flag
  - UART_CLEAR_NEF Noise detected Clear Flag
  - UART_CLEAR_OREF Overrun Error Clear Flag
  - UART_CLEAR_IDLEF IDLE line detected Clear Flag
  - UART_CLEAR_TXFECF TXFIFO empty clear Flag
  - UART_CLEAR_TCF Transmission Complete Clear Flag
  - UART_CLEAR_RTOF Receiver Timeout clear flag
  - UART_CLEAR_LBDF LIN Break Detection Clear Flag
  - UART_CLEAR_CTSF CTS Interrupt Clear Flag
  - UART_CLEAR_CMF Character Match Clear Flag
  - UART_CLEAR_WUF Wake Up from stop mode Clear Flag

Return value:

- None

__HAL_UART_CLEAR_PEFLAG

Description:

- Clear the UART PE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_CLEAR_FEFLAG

Description:

- Clear the UART FE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_CLEAR_NEFLAG

Description:

- Clear the UART NE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_CLEAR_OREFLAG

Description:

- Clear the UART ORE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_CLEAR_IDLEFLAG

Description:

- Clear the UART IDLE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_CLEAR_TXFECF

Description:

- Clear the UART TX FIFO empty clear flag.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_GET_FLAG

Description:

- Check whether the specified UART flag is set or not.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - UART_FLAG_TXFT TXFIFO threshold flag
  - UART_FLAG_RXFT RXFIFO threshold flag
  - UART_FLAG_RXFF RXFIFO Full flag
  - UART_FLAG_TXFE TXFIFO Empty flag
  - UART_FLAG_REACK Receive enable acknowledge flag
  - UART_FLAG_TEACK Transmit enable acknowledge flag
  - UART_FLAG_WUF Wake up from stop mode flag
  - UART_FLAG_RWU Receiver wake up flag (if the UART in mute mode)
  - UART_FLAG_SBKF Send Break flag
  - UART_FLAG_CMF Character match flag
  - UART_FLAG_BUSY Busy flag
  - UART_FLAG_ABRF Auto Baud rate detection flag
  - UART_FLAG_ABRE Auto Baud rate detection error flag
  - UART_FLAG_CTS CTS Change flag
  - UART_FLAG_LBDF LIN Break detection flag
  - UART_FLAG_TXE Transmit data register empty flag
  - UART_FLAG_TXFNF UART TXFIFO not full flag
  - UART_FLAG_TC Transmission Complete flag
  - UART_FLAG_RXNE Receive data register not empty flag
  - UART_FLAG_RXFNE UART RXFIFO not empty flag
  - UART_FLAG_RTOF Receiver Timeout flag
  - UART_FLAG_IDLE Idle Line detection flag
  - UART_FLAG_ORE Overrun Error flag
  - UART_FLAG_NE Noise Error flag
  - UART_FLAG_FE Framing Error flag
  - UART_FLAG_PE Parity Error flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_UART_ENABLE_IT

Description:

- Enable the specified UART interrupt.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __INTERRUPT__: specifies the UART interrupt source to enable. This parameter can be one of the following values:
  - UART_IT_RXFF RXFIFO Full interrupt
  - UART_IT_TXFE TXFIFO Empty interrupt
  - UART_IT_RXFT RXFIFO threshold interrupt
  - UART_IT_TXFT TXFIFO threshold interrupt
  - UART_IT_WUF Wakeup from stop mode interrupt
  - UART_IT_CM Character match interrupt
  - UART_IT_CTS CTS change interrupt
  - UART_IT_LBD LIN Break detection interrupt
  - UART_IT_TXE Transmit Data Register empty interrupt
  - UART_IT_TXFNF TX FIFO not full interrupt
  - UART_IT_TC Transmission complete interrupt
  - UART_IT_RXNE Receive Data register not empty interrupt
  - UART_IT_RXFNE RXFIFO not empty interrupt
  - UART_IT_RTO Receive Timeout interrupt
  - UART_IT_IDLE Idle line detection interrupt
  - UART_IT_PE Parity Error interrupt
  - UART_IT_ERR Error interrupt (frame error, noise error, overrun error)

Return value:

- None

__HAL_UART_DISABLE_IT

Description:

- Disable the specified UART interrupt.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __INTERRUPT__: specifies the UART interrupt source to disable. This parameter can be one of the following values:
  - UART_IT_RXFF RXFIFO Full interrupt
  - UART_IT_TXFE TXFIFO Empty interrupt
  - UART_IT_RXFT RXFIFO threshold interrupt
  - UART_IT_TXFT TXFIFO threshold interrupt
  - UART_IT_WUF Wakeup from stop mode interrupt
  - UART_IT_CM Character match interrupt
  - UART_IT_CTS CTS change interrupt
  - UART_IT_LBD LIN Break detection interrupt
  - UART_IT_TXE Transmit Data Register empty interrupt
  - UART_IT_TXFNF TX FIFO not full interrupt
  - UART_IT_TC Transmission complete interrupt
  - UART_IT_RXNE Receive Data register not empty interrupt
  - UART_IT_RXFNE RXFIFO not empty interrupt
  - UART_IT_RTO Receive Timeout interrupt
  - UART_IT_IDLE Idle line detection interrupt
  - UART_IT_PE Parity Error interrupt
  - UART_IT_ERR Error interrupt (Frame error, noise error, overrun error)

Return value:

- None

__HAL_UART_GET_IT

Description:

- Check whether the specified UART interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __INTERRUPT__: specifies the UART interrupt to check. This parameter can be one of the following values:
  - UART_IT_RXFF RXFIFO Full interrupt
  - UART_IT_TXFE TXFIFO Empty interrupt
  - UART_IT_RXFT RXFIFO threshold interrupt
  - UART_IT_TXFT TXFIFO threshold interrupt
  - UART_IT_WUF Wakeup from stop mode interrupt
  - UART_IT_CM Character match interrupt
  - UART_IT_CTS CTS change interrupt
  - UART_IT_LBD LIN Break detection interrupt
  - UART_IT_TXE Transmit Data Register empty interrupt
  - UART_IT_TXFNF TX FIFO not full interrupt
  - UART_IT_TC Transmission complete interrupt
  - UART_IT_RXNE Receive Data register not empty interrupt
  - UART_IT_RXFNE RXFIFO not empty interrupt
  - UART_IT_RTO Receive Timeout interrupt
  - UART_IT_IDLE Idle line detection interrupt
  - UART_IT_PE Parity Error interrupt
  - UART_IT_ERR Error interrupt (Frame error, noise error, overrun error)

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_UART_GET_IT_SOURCE

Description:

- Check whether the specified UART interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __INTERRUPT__: specifies the UART interrupt source to check. This parameter can be one of the following values:
  - UART_IT_RXFF RXFIFO Full interrupt
  - UART_IT_TXFE TXFIFO Empty interrupt
  - UART_IT_RXFT RXFIFO threshold interrupt
  - UART_IT_TXFT TXFIFO threshold interrupt
  - UART_IT_WUF Wakeup from stop mode interrupt
  - UART_IT_CM Character match interrupt
  - UART_IT_CTS CTS change interrupt
  - UART_IT_LBD LIN Break detection interrupt
  - UART_IT_TXE Transmit Data Register empty interrupt
  - UART_IT_TXFNF TX FIFO not full interrupt
  - UART_IT_TC Transmission complete interrupt
  - UART_IT_RXNE Receive Data register not empty interrupt
  - UART_IT_RXFNE RXFIFO not empty interrupt
  - UART_IT_RTO Receive Timeout interrupt
  - UART_IT_IDLE Idle line detection interrupt
  - UART_IT_PE Parity Error interrupt
  - UART_IT_ERR Error interrupt (Frame error, noise error, overrun error)

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_UART_CLEAR_IT

Description:

- Clear the specified UART ISR flag, in setting the proper ICR register flag.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __IT_CLEAR__: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt This parameter can be one of the following values:
  - UART_CLEAR_PEF Parity Error Clear Flag
  - UART_CLEAR_FEF Framing Error Clear Flag
  - UART_CLEAR_NEF Noise detected Clear Flag
  - UART_CLEAR_OREF Overrun Error Clear Flag
  - UART_CLEAR_IDLEF IDLE line detected Clear Flag
  - UART_CLEAR_RTOF Receiver timeout clear flag
  - UART_CLEAR_TXFECF TXFIFO empty Clear Flag
  - UART_CLEAR_TCF Transmission Complete Clear Flag
  - UART_CLEAR_LBDF LIN Break Detection Clear Flag
  - UART_CLEAR_CTSF CTS Interrupt Clear Flag
  - UART_CLEAR_CMF Character Match Clear Flag
  - UART_CLEAR_WUF Wake Up from stop mode Clear Flag

Return value:

- None

__HAL_UART_SEND_REQ

Description:

- Set a specific UART request flag.

Parameters:

- __HANDLE__: specifies the UART Handle.
- __REQ__: specifies the request flag to set This parameter can be one of the following values:
  - UART_AUTOBAUD_REQUEST Auto-Baud Rate Request
  - UART_SENDBREAK_REQUEST Send Break Request
  - UART_MUTE_MODE_REQUEST Mute Mode Request
  - UART_RXDATA_FLUSH_REQUEST Receive Data flush Request
  - UART_TXDATA_FLUSH_REQUEST Transmit data flush Request

Return value:

- None

__HAL_UART_ONE_BIT_SAMPLE_ENABLE

Description:

- Enable the UART one bit sample method.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_ONE_BIT_SAMPLE_DISABLE

Description:

- Disable the UART one bit sample method.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_ENABLE

Description:

- Enable UART.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_DISABLE

Description:

- Disable UART.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_UART_HWCONTROL_CTS_ENABLE

Description:

- Enable CTS flow control.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

Notes:

- This macro allows to enable CTS hardware flow control for a given UART instance, without need to call HAL_UART_Init() function. As involving direct access to UART registers, usage of this macro should be fully endorsed by user. As macro is expected to be used for modifying CTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of HAL_UART_Init())macro could only be called when corresponding UART instance is disabled (i.e. __HAL_UART_DISABLE(__HANDLE__)) and should be followed by an Enable macro (i.e. __HAL_UART_ENABLE(__HANDLE__)).

__HAL_UART_HWCONTROL_CTS_DISABLE

Description:

- Disable CTS flow control.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

Notes:

- This macro allows to disable CTS hardware flow control for a given UART instance, without need to call HAL_UART_Init() function. As involving direct access to UART registers, usage of this macro should be fully endorsed by user. As macro is expected to be used for modifying CTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of HAL_UART_Init())macro could only be called when corresponding UART instance is disabled (i.e. __HAL_UART_DISABLE(__HANDLE__)) and should be followed by an Enable macro (i.e. __HAL_UART_ENABLE(__HANDLE__)).

__HAL_UART_HWCONTROL_RTS_ENABLE

Description:

- Enable RTS flow control.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

Notes:

- This macro allows to enable RTS hardware flow control for a given UART instance, without need to call HAL_UART_Init() function. As involving direct access to UART registers, usage of this macro should be fully endorsed by user. As macro is expected to be used for modifying RTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of HAL_UART_Init())macro could only be called when corresponding UART instance is disabled (i.e. __HAL_UART_DISABLE(__HANDLE__)) and should be followed by an Enable macro (i.e. __HAL_UART_ENABLE(__HANDLE__)).

__HAL_UART_HWCONTROL_RTS_DISABLE

Description:

- Disable RTS flow control.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

Notes:

- This macro allows to disable RTS hardware flow control for a given UART instance, without need to call HAL_UART_Init() function. As involving direct access to UART registers, usage of this macro should be fully endorsed by user. As macro is expected to be used for modifying RTS Hw flow control feature activation, without need for USART instance Deinit/Init, following conditions for macro call should be fulfilled : UART instance should have already been initialised (through call of HAL_UART_Init())macro could only be called when corresponding UART instance is disabled (i.e. __HAL_UART_DISABLE(__HANDLE__)) and should be followed by an Enable macro (i.e. __HAL_UART_ENABLE(__HANDLE__)).

UART Status Flags

UART_FLAG_TXFT

UART TXFIFO threshold flag

UART_FLAG_RXFT

UART RXFIFO threshold flag

UART_FLAG_RXFF

UART RXFIFO Full flag

UART_FLAG_TXFE

UART TXFIFO Empty flag

UART_FLAG_REACK

UART receive enable acknowledge flag

UART_FLAG_TEACK

UART transmit enable acknowledge flag

UART_FLAG_WUF

UART wake-up from stop mode flag

UART_FLAG_RWU

UART receiver wake-up from mute mode flag

UART_FLAG_SBKF

UART send break flag

UART_FLAG_CMF

UART character match flag

UART_FLAG_BUSY

UART busy flag

UART_FLAG_ABRF

UART auto Baud rate flag

UART_FLAG_ABRE

UART auto Baud rate error

UART_FLAG_RTOF

UART receiver timeout flag

UART_FLAG_CTS

UART clear to send flag

UART_FLAG_CTSIF

UART clear to send interrupt flag

UART_FLAG_LBDF

UART LIN break detection flag

UART_FLAG_TXE

UART transmit data register empty

UART_FLAG_TXFNF

UART TXFIFO not full

UART_FLAG_TC

UART transmission complete

UART_FLAG_RXNE

UART read data register not empty

UART_FLAG_RXFNE

UART RXFIFO not empty

UART_FLAG_IDLE

UART idle flag

UART_FLAG_ORE

UART overrun error

UART_FLAG_NE

UART noise error

UART_FLAG_FE

UART frame error

UART_FLAG_PE

UART parity error

UART Half Duplex Selection

UART_HALF_DUPLEX_DISABLE

UART half-duplex disabled

UART_HALF_DUPLEX_ENABLE

UART half-duplex enabled

UART Hardware Flow Control

UART_HWCONTROL_NONE

No hardware control

UART_HWCONTROL_RTS

Request To Send

UART_HWCONTROL_CTS

Clear To Send

UART_HWCONTROL_RTS_CTS

Request and Clear To Send

UART Interruptions Flag Mask

UART_IT_MASK

UART interruptions flags mask

UART Interrupts Definition

UART_IT_PE

UART parity error interruption

UART_IT_TXE

UART transmit data register empty interruption

UART_IT_TXFNF

UART TX FIFO not full interruption

UART_IT_TC

UART transmission complete interruption

UART_IT_RXNE

UART read data register not empty interruption

UART_IT_RXFNE

UART RXFIFO not empty interruption

UART_IT_IDLE

UART idle interruption

UART_IT_LBD

UART LIN break detection interruption

UART_IT_CTS

UART CTS interruption

UART_IT_CM

UART character match interruption

UART_IT_WUF

UART wake-up from stop mode interruption

UART_IT_RXFF

UART RXFIFO full interruption

UART_IT_TXFE

UART TXFIFO empty interruption

UART_IT_RXFT

UART RXFIFO threshold reached interruption

UART_IT_TXFT

UART TXFIFO threshold reached interruption

UART_IT_RTO

UART receiver timeout interruption

UART_IT_ERR

UART error interruption

UART_IT_ORE

UART overrun error interruption

UART_IT_NE

UART noise error interruption

UART_IT_FE

UART frame error interruption

UART Interruption Clear Flags

UART_CLEAR_PEF

Parity Error Clear Flag

UART_CLEAR_FEF

Framing Error Clear Flag

UART_CLEAR_NEF

Noise Error detected Clear Flag

UART_CLEAR_OREF

Overrun Error Clear Flag

UART_CLEAR_IDLEF

IDLE line detected Clear Flag

UART_CLEAR_TXFECF

TXFIFO empty clear flag

UART_CLEAR_TCF

Transmission Complete Clear Flag

UART_CLEAR_LBDF

LIN Break Detection Clear Flag

UART_CLEAR_CTSF

CTS Interrupt Clear Flag

UART_CLEAR_CMF

Character Match Clear Flag

UART_CLEAR_WUF

Wake Up from stop mode Clear Flag

UART_CLEAR_RTOF

UART receiver timeout clear flag

UART Local Interconnection Network mode

UART_LIN_DISABLE

Local Interconnect Network disable

UART_LIN_ENABLE

Local Interconnect Network enable

UART LIN Break Detection

UART_LINBREAKDETECTLENGTH_10B

LIN 10-bit break detection length

UART_LINBREAKDETECTLENGTH_11B

LIN 11-bit break detection length

UART Transfer Mode

UART_MODE_RX

RX mode

UART_MODE_TX

TX mode

UART_MODE_TX_RX

RX and TX mode

UART Advanced Feature MSB First

UART_ADVFEATURE_MSBFIRST_DISABLE

Most significant bit sent/received first disable

UART_ADVFEATURE_MSBFIRST_ENABLE

Most significant bit sent/received first enable

UART Advanced Feature Mute Mode Enable

UART_ADVFEATURE_MUTEMODE_DISABLE

UART mute mode disable

UART_ADVFEATURE_MUTEMODE_ENABLE

UART mute mode enable

UART One Bit Sampling Method

UART_ONE_BIT_SAMPLE_DISABLE

One-bit sampling disable

UART_ONE_BIT_SAMPLE_ENABLE

One-bit sampling enable

UART Advanced Feature Overrun Disable

UART_ADVFEATURE_OVERRUN_ENABLE

RX overrun enable

UART_ADVFEATURE_OVERRUN_DISABLE

RX overrun disable

UART Over Sampling

UART_OVERSAMPLING_16

Oversampling by 16

UART_OVERSAMPLING_8

Oversampling by 8

UART Parity

UART_PARITY_NONE

No parity

UART_PARITY_EVEN

Even parity

UART_PARITY_ODD

Odd parity

UART Receiver Timeout

UART_RECEIVER_TIMEOUT_DISABLE

UART Receiver Timeout disable

UART_RECEIVER_TIMEOUT_ENABLE

UART Receiver Timeout enable

UART Request Parameters

UART_AUTOBAUD_REQUEST

Auto-Baud Rate Request

UART_SENDBREAK_REQUEST

Send Break Request

UART_MUTE_MODE_REQUEST

Mute Mode Request

UART_RXDATA_FLUSH_REQUEST

Receive Data flush Request

UART_TXDATA_FLUSH_REQUEST

Transmit data flush Request

UART Advanced Feature RX Pin Active Level Inversion

UART_ADVFEATURE_RXINV_DISABLE

RX pin active level inversion disable

UART_ADVFEATURE_RXINV_ENABLE

RX pin active level inversion enable

UART Advanced Feature RX TX Pins Swap

UART_ADVFEATURE_SWAP_DISABLE

TX/RX pins swap disable

UART_ADVFEATURE_SWAP_ENABLE

TX/RX pins swap enable

UART State

UART_STATE_DISABLE

UART disabled

UART_STATE_ENABLE

UART enabled

UART State Code Definition

HAL_UART_STATE_RESET

Peripheral is not initialized Value is allowed for gState and RxState

HAL_UART_STATE_READY

Peripheral Initialized and ready for use Value is allowed for gState and RxState

HAL_UART_STATE_BUSY

an internal process is ongoing Value is allowed for gState only

HAL_UART_STATE_BUSY_TX

Data Transmission process is ongoing Value is allowed for gState only

HAL_UART_STATE_BUSY_RX

Data Reception process is ongoing Value is allowed for RxState only

HAL_UART_STATE_BUSY_TX_RX

Data Transmission and Reception process is ongoing Not to be used for neither gState nor RxState. Value is result of combination (Or) between gState and RxState values

HAL_UART_STATE_TIMEOUT

Timeout state Value is allowed for gState only

HAL_UART_STATE_ERROR

Error Value is allowed for gState only

UART Number of Stop Bits

UART_STOPBITS_0_5

UART frame with 0.5 stop bit

UART_STOPBITS_1

UART frame with 1 stop bit

UART_STOPBITS_1_5

UART frame with 1.5 stop bits

UART_STOPBITS_2

UART frame with 2 stop bits

UART Advanced Feature Stop Mode Enable

UART_ADVFEATURE_STOPMODE_DISABLE

UART stop mode disable

UART_ADVFEATURE_STOPMODE_ENABLE

UART stop mode enable

UART polling-based communications time-out value

HAL_UART_TIMEOUT_VALUE

UART polling-based communications time-out value

UART Advanced Feature TX Pin Active Level Inversion

UART_ADVFEATURE_TXINV_DISABLE

TX pin active level inversion disable

UART_ADVFEATURE_TXINV_ENABLE

TX pin active level inversion enable

UART WakeUp From Stop Selection

UART_WAKEUP_ON_ADDRESS

UART wake-up on address

UART_WAKEUP_ON_STARTBIT

UART wake-up on start bit

UART_WAKEUP_ON_READDATA_NONEMPTY

UART wake-up on receive data register not empty or RXFIFO is not empty

UART WakeUp Methods

UART_WAKEUPMETHOD_IDLELINE

UART wake-up on idle line

UART_WAKEUPMETHOD_ADDRESSMARK

UART wake-up on address mark

76 HAL UART Extension Driver

76.1 UARTEx Firmware driver registers structures

76.1.1 UART_WakeUpTypeDef

UART_WakeUpTypeDef is defined in the stm32l4xx_hal_uart_ex.h

Data Fields

- ***uint32_t WakeUpEvent***
- ***uint16_t AddressLength***
- ***uint8_t Address***

Field Documentation

- ***uint32_t UART_WakeUpTypeDef::WakeUpEvent***

  Specifies which event will activate the Wakeup from Stop mode flag (WUF). This parameter can be a value of ***UART_WakeUp_from_Stop_Selection***. If set to UART_WAKEUP_ON_ADDRESS, the two other fields below must be filled up.
- ***uint16_t UART_WakeUpTypeDef::AddressLength***

  Specifies whether the address is 4 or 7-bit long. This parameter can be a value of ***UARTEx_WakeUp_Address_Length***.
- ***uint8_t UART_WakeUpTypeDef::Address***

  UART/USART node address (7-bit long max).

76.2 UARTEx Firmware driver API description

The following section lists the various functions of the UARTEx library.

76.2.1 UART peripheral extended features

76.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx or the UARTy in asynchronous mode.

- For the asynchronous mode the parameters below can be configured:
  - Baud Rate
  - Word Length
  - Stop Bit
  - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit.
  - Hardware flow control
  - Receiver/transmitter modes
  - Over Sampling Method
  - One-Bit Sampling Method
- For the asynchronous mode, the following advanced features can be configured as well:
  - TX and/or RX pin level inversion
  - data logical level inversion
  - RX and TX pins swap
  - RX overrun detection disabling
  - DMA disabling on RX error
  - MSB first on communication line
  - auto Baud rate detection

The HAL_RS485Ex_Init() API follows the UART RS485 mode configuration procedures (details for the procedures are available in reference manual).

This section contains the following APIs:

- ***HAL_RS485Ex_Init***

76.2.3 IO operation functions

This section contains the following APIs:

- ***HAL_UARTEx_WakeupCallback***
- ***HAL_UARTEx_RxFifoFullCallback***
- ***HAL_UARTEx_TxFifoEmptyCallback***

76.2.4 Peripheral Control functions

This section provides the following functions:

- HAL_UARTEx_EnableClockStopMode() API enables the UART clock (HSI or LSE only) during stop mode
- HAL_UARTEx_DisableClockStopMode() API disables the above functionality
- HAL_MultiProcessorEx_AddressLength_Set() API optionally sets the UART node address detection length to more than 4 bits for multiprocessor address mark wake up.
- HAL_UARTEx_StopModeWakeUpSourceConfig() API defines the wake-up from stop mode trigger: address match, Start Bit detection or RXNE bit status.
- HAL_UARTEx_EnableStopMode() API enables the UART to wake up the MCU from stop mode
- HAL_UARTEx_DisableStopMode() API disables the above functionality
- HAL_UARTEx_EnableFifoMode() API enables the FIFO mode
- HAL_UARTEx_DisableFifoMode() API disables the FIFO mode
- HAL_UARTEx_SetTxFifoThreshold() API sets the TX FIFO threshold
- HAL_UARTEx_SetRxFifoThreshold() API sets the RX FIFO threshold

This section contains the following APIs:

- ***HAL_MultiProcessorEx_AddressLength_Set***
- ***HAL_UARTEx_StopModeWakeUpSourceConfig***
- ***HAL_UARTEx_EnableStopMode***
- ***HAL_UARTEx_DisableStopMode***
- ***HAL_UARTEx_EnableFifoMode***
- ***HAL_UARTEx_DisableFifoMode***
- ***HAL_UARTEx_SetTxFifoThreshold***
- ***HAL_UARTEx_SetRxFifoThreshold***

76.2.5 Detailed description of functions

`HAL_RS485Ex_Init`

Function name

HAL_StatusTypeDef HAL_RS485Ex_Init (UART_HandleTypeDef * huart, uint32_t Polarity, uint32_t AssertionTime, uint32_t DeassertionTime)

Function description

Initialize the RS485 Driver enable feature according to the specified parameters in the UART_InitTypeDef and creates the associated handle.

Parameters

- **huart:** UART handle.
- **Polarity:** Select the driver enable polarity. This parameter can be one of the following values:
  - UART_DE_POLARITY_HIGH DE signal is active high
  - UART_DE_POLARITY_LOW DE signal is active low
- **AssertionTime:** Driver Enable assertion time: 5-bit value defining the time between the activation of the DE (Driver Enable) signal and the beginning of the start bit. It is expressed in sample time units (1/8 or 1/16 bit time, depending on the oversampling rate)
- **DeassertionTime:** Driver Enable deassertion time: 5-bit value defining the time between the end of the last stop bit, in a transmitted message, and the de-activation of the DE (Driver Enable) signal. It is expressed in sample time units (1/8 or 1/16 bit time, depending on the oversampling rate).

Return values

- **HAL:** status

`HAL_UARTEx_WakeupCallback`

Function name

void HAL_UARTEx_WakeupCallback (UART_HandleTypeDef * huart)

Function description

UART wakeup from Stop mode callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UARTEx_RxFifoFullCallback`

Function name

void HAL_UARTEx_RxFifoFullCallback (UART_HandleTypeDef * huart)

Function description

UART RX Fifo full callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

`HAL_UARTEx_TxFifoEmptyCallback`

Function name

void HAL_UARTEx_TxFifoEmptyCallback (UART_HandleTypeDef * huart)

Function description

UART TX Fifo empty callback.

Parameters

- **huart:** UART handle.

Return values

- **None:**

HAL_UARTEx_StopModeWakeUpSourceConfig

Function name

HAL_StatusTypeDef HAL_UARTEx_StopModeWakeUpSourceConfig (UART_HandleTypeDef * huart, UART_WakeUpTypeDef WakeUpSelection)

Function description

Set Wakeup from Stop mode interrupt flag selection.

Parameters

- **huart:** UART handle.
- **WakeUpSelection:** Address match, Start Bit detection or RXNE/RXFNE bit status. This parameter can be one of the following values:
  - UART_WAKEUP_ON_ADDRESS
  - UART_WAKEUP_ON_STARTBIT
  - UART_WAKEUP_ON_READDATA_NONEMPTY

Return values

- **HAL:** status

Notes

- It is the application responsibility to enable the interrupt used as usart_wkup interrupt source before entering low-power mode.

HAL_UARTEx_EnableStopMode

Function name

HAL_StatusTypeDef HAL_UARTEx_EnableStopMode (UART_HandleTypeDef * huart)

Function description

Enable UART Stop Mode.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

Notes

- The UART is able to wake up the MCU from Stop 1 mode as long as UART clock is HSI or LSE.

HAL_UARTEx_DisableStopMode

Function name

HAL_StatusTypeDef HAL_UARTEx_DisableStopMode (UART_HandleTypeDef * huart)

Function description

Disable UART Stop Mode.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_MultiProcessorEx_AddressLength_Set

Function name

HAL_StatusTypeDef HAL_MultiProcessorEx_AddressLength_Set (UART_HandleTypeDef * huart, uint32_t AddressLength)

Function description

By default in multiprocessor mode, when the wake up method is set to address mark, the UART handles only 4-bit long addresses detection; this API allows to enable longer addresses detection (6-, 7- or 8-bit long).

Parameters

- **huart:** UART handle.
- **AddressLength:** This parameter can be one of the following values:
  - UART_ADDRESS_DETECT_4B 4-bit long address
  - UART_ADDRESS_DETECT_7B 6-, 7- or 8-bit long address

Return values

- **HAL:** status

Notes

- Addresses detection lengths are: 6-bit address detection in 7-bit data mode, 7-bit address detection in 8-bit data mode, 8-bit address detection in 9-bit data mode.

HAL_UARTEx_EnableFifoMode

Function name

HAL_StatusTypeDef HAL_UARTEx_EnableFifoMode (UART_HandleTypeDef * huart)

Function description

Enable the FIFO mode.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_UARTEx_DisableFifoMode

Function name

HAL_StatusTypeDef HAL_UARTEx_DisableFifoMode (UART_HandleTypeDef * huart)

Function description

Disable the FIFO mode.

Parameters

- **huart:** UART handle.

Return values

- **HAL:** status

HAL_UARTEx_SetTxFifoThreshold

Function name

HAL_StatusTypeDef HAL_UARTEx_SetTxFifoThreshold (UART_HandleTypeDef * huart, uint32_t Threshold)

Function description

Set the TXFIFO threshold.

Parameters

- **huart:** UART handle.
- **Threshold:** TX FIFO threshold value This parameter can be one of the following values:
  - UART_TXFIFO_THRESHOLD_1_8
  - UART_TXFIFO_THRESHOLD_1_4
  - UART_TXFIFO_THRESHOLD_1_2
  - UART_TXFIFO_THRESHOLD_3_4
  - UART_TXFIFO_THRESHOLD_7_8
  - UART_TXFIFO_THRESHOLD_8_8

Return values

- **HAL:** status

`HAL_UARTEx_SetRxFifoThreshold`

Function name

HAL_StatusTypeDef HAL_UARTEx_SetRxFifoThreshold (UART_HandleTypeDef * huart, uint32_t Threshold)

Function description

Set the RXFIFO threshold.

Parameters

- **huart:** UART handle.
- **Threshold:** RX FIFO threshold value This parameter can be one of the following values:
  - UART_RXFIFO_THRESHOLD_1_8
  - UART_RXFIFO_THRESHOLD_1_4
  - UART_RXFIFO_THRESHOLD_1_2
  - UART_RXFIFO_THRESHOLD_3_4
  - UART_RXFIFO_THRESHOLD_7_8
  - UART_RXFIFO_THRESHOLD_8_8

Return values

- **HAL:** status

76.3 UARTEx Firmware driver defines

The following section lists the various define and macros of the module.

76.3.1 UARTEx

UARTEx

UARTEx FIFO mode

UART_FIFOMODE_DISABLE

FIFO mode disable

UART_FIFOMODE_ENABLE

FIFO mode enable

UARTEx RXFIFO threshold level

UART_RXFIFO_THRESHOLD_1_8

RXFIFO FIFO reaches 1/8 of its depth

UART_RXFIFO_THRESHOLD_1_4

RXFIFO FIFO reaches 1/4 of its depth

UART_RXFIFO_THRESHOLD_1_2

RXFIFO FIFO reaches 1/2 of its depth

UART_RXFIFO_THRESHOLD_3_4

RXFIFO FIFO reaches 3/4 of its depth

UART_RXFIFO_THRESHOLD_7_8

RXFIFO FIFO reaches 7/8 of its depth

UART_RXFIFO_THRESHOLD_8_8

RXFIFO FIFO becomes full

UARTEx TXFIFO threshold level

UART_TXFIFO_THRESHOLD_1_8

TXFIFO reaches 1/8 of its depth

UART_TXFIFO_THRESHOLD_1_4

TXFIFO reaches 1/4 of its depth

UART_TXFIFO_THRESHOLD_1_2

TXFIFO reaches 1/2 of its depth

UART_TXFIFO_THRESHOLD_3_4

TXFIFO reaches 3/4 of its depth

UART_TXFIFO_THRESHOLD_7_8

TXFIFO reaches 7/8 of its depth

UART_TXFIFO_THRESHOLD_8_8

TXFIFO becomes empty

UARTEx WakeUp Address Length

UART_ADDRESS_DETECT_4B

4-bit long wake-up address

UART_ADDRESS_DETECT_7B

7-bit long wake-up address

UARTEx Word Length

UART_WORDLENGTH_7B

7-bit long UART frame

UART_WORDLENGTH_8B

8-bit long UART frame

UART_WORDLENGTH_9B

9-bit long UART frame

77 HAL USART Generic Driver

77.1 USART Firmware driver registers structures

77.1.1 USART_InitTypeDef

USART_InitTypeDef is defined in the stm32l4xx_hal_usart.h

Data Fields

- ***uint32_t BaudRate***
- ***uint32_t WordLength***
- ***uint32_t StopBits***
- ***uint32_t Parity***
- ***uint32_t Mode***
- ***uint32_t CLKPolarity***
- ***uint32_t CLKPhase***
- ***uint32_t CLKLastBit***
- ***uint32_t ClockPrescaler***

Field Documentation

- ***uint32_t USART_InitTypeDef::BaudRate***

  This member configures the Usart communication baud rate. The baud rate is computed using the following formula: Baud Rate Register[15:4] = ((2 * fclk_pres) / ((huart->Init.BaudRate)))[15:4] Baud Rate Register[3] = 0 Baud Rate Register[2:0] = (((2 * fclk_pres) / ((huart->Init.BaudRate)))[3:0]) >> 1 where fclk_pres is the USART input clock frequency (fclk) (divided by a prescaler if applicable)

  Note:

  – Oversampling by 8 is systematically applied to achieve high baud rates.

- ***uint32_t USART_InitTypeDef::WordLength***

  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***USARTEx_Word_Length***.

- ***uint32_t USART_InitTypeDef::StopBits***

  Specifies the number of stop bits transmitted. This parameter can be a value of ***USART_Stop_Bits***.

- ***uint32_t USART_InitTypeDef::Parity***

  Specifies the parity mode. This parameter can be a value of ***USART_Parity***

  Note:

  – When parity is enabled, the computed parity is inserted at the MSB position of the transmitted data (9th bit when the word length is set to 9 data bits; 8th bit when the word length is set to 8 data bits).

- ***uint32_t USART_InitTypeDef::Mode***

  Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of ***USART_Mode***.

- ***uint32_t USART_InitTypeDef::CLKPolarity***

  Specifies the steady state of the serial clock. This parameter can be a value of ***USART_Clock_Polarity***.

- ***uint32_t USART_InitTypeDef::CLKPhase***

  Specifies the clock transition on which the bit capture is made. This parameter can be a value of ***USART_Clock_Phase***.

- ***uint32_t USART_InitTypeDef::CLKLastBit***

  Specifies whether the clock pulse corresponding to the last transmitted data bit (MSB) has to be output on the SCLK pin in synchronous mode. This parameter can be a value of ***USART_Last_Bit***.

- ***uint32_t USART_InitTypeDef::ClockPrescaler***

  Specifies the prescaler value used to divide the USART clock source. This parameter can be a value of ***USART_ClockPrescaler***.

77.1.2 __USART_HandleTypeDef

__USART_HandleTypeDef is defined in the stm32l4xx_hal_usart.h

Data Fields

- ***USART_TypeDef * Instance***
- ***USART_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***uint16_t Mask***
- ***uint16_t NbRxDataToProcess***
- ***uint16_t NbTxDataToProcess***
- ***uint32_t SlaveMode***
- ***uint32_t FifoMode***
- ***void(* RxISR***
- ***void(* TxISR***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_USART_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* __USART_HandleTypeDef::Instance***
  USART registers base address
- ***USART_InitTypeDef __USART_HandleTypeDef::Init***
  USART communication parameters
- ***uint8_t* __USART_HandleTypeDef::pTxBuffPtr***
  Pointer to USART Tx transfer Buffer
- ***uint16_t __USART_HandleTypeDef::TxXferSize***
  USART Tx Transfer size
- ***__IO uint16_t __USART_HandleTypeDef::TxXferCount***
  USART Tx Transfer Counter
- ***uint8_t* __USART_HandleTypeDef::pRxBuffPtr***
  Pointer to USART Rx transfer Buffer
- ***uint16_t __USART_HandleTypeDef::RxXferSize***
  USART Rx Transfer size
- ***__IO uint16_t __USART_HandleTypeDef::RxXferCount***
  USART Rx Transfer Counter
- ***uint16_t __USART_HandleTypeDef::Mask***
  USART Rx RDR register mask
- ***uint16_t __USART_HandleTypeDef::NbRxDataToProcess***
  Number of data to process during RX ISR execution
- ***uint16_t __USART_HandleTypeDef::NbTxDataToProcess***
  Number of data to process during TX ISR execution
- ***uint32_t __USART_HandleTypeDef::SlaveMode***
  Enable/Disable UART SPI Slave Mode. This parameter can be a value of ***USARTEx_Slave_Mode***

- ***uint32_t __USART_HandleTypeDef::FifoMode***
  Specifies if the FIFO mode will be used. This parameter can be a value of ***USARTEx_FIFO_mode***.
- ***void(* __USART_HandleTypeDef::RxISR)(struct __USART_HandleTypeDef *husart)***
  Function pointer on Rx IRQ handler
- ***void(* __USART_HandleTypeDef::TxISR)(struct __USART_HandleTypeDef *husart)***
  Function pointer on Tx IRQ handler
- ***DMA_HandleTypeDef* __USART_HandleTypeDef::hdmatx***
  USART Tx DMA Handle parameters
- ***DMA_HandleTypeDef* __USART_HandleTypeDef::hdmarx***
  USART Rx DMA Handle parameters
- ***HAL_LockTypeDef __USART_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_USART_StateTypeDef __USART_HandleTypeDef::State***
  USART communication state
- ***__IO uint32_t __USART_HandleTypeDef::ErrorCode***
  USART Error code

77.2 USART Firmware driver API description

The following section lists the various functions of the USART library.

77.2.1 How to use this driver

The USART HAL driver can be used as follows:

1. Declare a USART_HandleTypeDef handle structure (eg. USART_HandleTypeDef husart).
2. Initialize the USART low level resources by implementing the HAL_USART_MspInit() API:
   – Enable the USARTx interface clock.
   – USART pins configuration:
     ◦ Enable the clock for the USART GPIOs.
     ◦ Configure these USART pins as alternate function pull-up.
   – NVIC configuration if you need to use interrupt process (HAL_USART_Transmit_IT(), HAL_USART_Receive_IT() and HAL_USART_TransmitReceive_IT() APIs):
     ◦ Configure the USARTx interrupt priority.
     ◦ Enable the NVIC USART IRQ handle.
   – USART interrupts handling:

Note: The specific USART interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_USART_ENABLE_IT() and __HAL_USART_DISABLE_IT() inside the transmit and receive process.

   – DMA Configuration if you need to use DMA process (HAL_USART_Transmit_DMA() HAL_USART_Receive_DMA() and HAL_USART_TransmitReceive_DMA() APIs):
     ◦ Declare a DMA handle structure for the Tx/Rx channel.
     ◦ Enable the DMAx interface clock.
     ◦ Configure the declared DMA handle structure with the required Tx/Rx parameters.
     ◦ Configure the DMA Tx/Rx channel.
     ◦ Associate the initialized DMA handle to the USART DMA Tx/Rx handle.
     ◦ Configure the priority and enable the NVIC for the transfer complete interrupt on the DMA Tx/Rx channel.
3. Program the Baud Rate, Word Length, Stop Bit, Parity, and Mode (Receiver/Transmitter) in the husart handle Init structure.
4. Initialize the USART registers by calling the HAL_USART_Init() API:
   – This API configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customized HAL_USART_MspInit(&husart) API.

Note: To configure and enable/disable the USART to wake up the MCU from stop mode, resort to UART API's HAL_UARTEx_StopModeWakeUpSourceConfig(), HAL_UARTEx_EnableStopMode() and HAL_UARTEx_DisableStopMode() in casting the USART handle to UART type UART_HandleTypeDef.

77.2.2 Callback registration

The compilation define USE_HAL_USART_REGISTER_CALLBACKS when set to 1 allows the user to configure dynamically the driver callbacks.

Use Function @ref HAL_USART_RegisterCallback() to register a user callback. Function @ref HAL_USART_RegisterCallback() allows to register following callbacks:

- TxHalfCpltCallback : Tx Half Complete Callback.
- TxCpltCallback : Tx Complete Callback.
- RxHalfCpltCallback : Rx Half Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- TxRxCpltCallback : Tx Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- RxFifoFullCallback : Rx Fifo Full Callback.
- TxFifoEmptyCallback : Tx Fifo Empty Callback.
- MspInitCallback : USART MspInit.
- MspDeInitCallback : USART MspDeInit. This function takes as parameters the HAL peripheral handle, the Callback ID and a pointer to the user callback function.

Use function @ref HAL_USART_UnRegisterCallback() to reset a callback to the default weak (surcharged) function. @ref HAL_USART_UnRegisterCallback() takes as parameters the HAL peripheral handle, and the Callback ID. This function allows to reset following callbacks:

- TxHalfCpltCallback : Tx Half Complete Callback.
- TxCpltCallback : Tx Complete Callback.
- RxHalfCpltCallback : Rx Half Complete Callback.
- RxCpltCallback : Rx Complete Callback.
- TxRxCpltCallback : Tx Rx Complete Callback.
- ErrorCallback : Error Callback.
- AbortCpltCallback : Abort Complete Callback.
- RxFifoFullCallback : Rx Fifo Full Callback.
- TxFifoEmptyCallback : Tx Fifo Empty Callback.
- MspInitCallback : USART MspInit.
- MspDeInitCallback : USART MspDeInit.

By default, after the @ref HAL_USART_Init() and when the state is HAL_USART_STATE_RESET all callbacks are set to the corresponding weak (surcharged) functions: examples @ref HAL_USART_TxCpltCallback(), @ref HAL_USART_RxHalfCpltCallback(). Exception done for MspInit and MspDeInit functions that are respectively reset to the legacy weak (surcharged) functions in the @ref HAL_USART_Init() and @ref HAL_USART_DeInit() only when these callbacks are null (not registered beforehand). If not, MspInit or MspDeInit are not null, the @ref HAL_USART_Init() and @ref HAL_USART_DeInit() keep and use the user MspInit/MspDeInit callbacks (registered beforehand).

Callbacks can be registered/unregistered in HAL_USART_STATE_READY state only. Exception done MspInit/MspDeInit that can be registered/unregistered in HAL_USART_STATE_READY or HAL_USART_STATE_RESET state, thus registered (user) MspInit/DeInit callbacks can be used during the Init/DeInit. In that case first register the MspInit/MspDeInit user callbacks using @ref HAL_USART_RegisterCallback() before calling @ref HAL_USART_DeInit() or @ref HAL_USART_Init() function.

When The compilation define USE_HAL_USART_REGISTER_CALLBACKS is set to 0 or not defined, the callback registration feature is not available and weak (surcharged) callbacks are used.

77.2.3 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USART in asynchronous and in synchronous modes.

- For the asynchronous mode only these parameters can be configured:
  - Baud Rate
  - Word Length
  - Stop Bit
  - Parity: If the parity is enabled, then the MSB bit of the data written in the data register is transmitted but is changed by the parity bit.
  - USART polarity
  - USART phase
  - USART LastBit
  - Receiver/transmitter modes

The HAL_USART_Init() function follows the USART synchronous configuration procedure (details for the procedure are available in reference manual).

This section contains the following APIs:

- ***HAL_USART_Init***
- ***HAL_USART_DeInit***
- ***HAL_USART_MspInit***
- ***HAL_USART_MspDeInit***

77.2.4 IO operation functions

This subsection provides a set of functions allowing to manage the USART synchronous data transfers.

The USART supports master mode only: it cannot receive or send data related to an input clock (SCLK is always an output).

1. There are two modes of transfer:
   - Blocking mode: The communication is performed in polling mode. The HAL status of all data processing is returned by the same function after finishing transfer.
   - No-Blocking mode: The communication is performed using Interrupts or DMA, These API's return the HAL status. The end of the data processing will be indicated through the dedicated USART IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_USART_TxCpltCallback(), HAL_USART_RxCpltCallback() and HAL_USART_TxRxCpltCallback() user callbacks will be executed respectively at the end of the transmit or Receive process The HAL_USART_ErrorCallback()user callback will be executed when a communication error is detected
2. Blocking mode API's are :
   - HAL_USART_Transmit() in simplex mode
   - HAL_USART_Receive() in full duplex receive only
   - HAL_USART_TransmitReceive() in full duplex mode
3. Non-Blocking mode API's with Interrupt are :
   - HAL_USART_Transmit_IT() in simplex mode
   - HAL_USART_Receive_IT() in full duplex receive only
   - HAL_USART_TransmitReceive_IT() in full duplex mode
   - HAL_USART_IRQHandler()
4. No-Blocking mode API's with DMA are :
   - HAL_USART_Transmit_DMA() in simplex mode
   - HAL_USART_Receive_DMA() in full duplex receive only
   - HAL_USART_TransmitReceive_DMA() in full duplex mode
   - HAL_USART_DMAPause()
   - HAL_USART_DMAResume()
   - HAL_USART_DMAStop()

5. A set of Transfer Complete Callbacks are provided in Non_Blocking mode:
   - HAL_USART_TxCpltCallback()
   - HAL_USART_RxCpltCallback()
   - HAL_USART_TxHalfCpltCallback()
   - HAL_USART_RxHalfCpltCallback()
   - HAL_USART_ErrorCallback()
   - HAL_USART_TxRxCpltCallback()
6. Non-Blocking mode transfers could be aborted using Abort API's :
   - HAL_USART_Abort()
   - HAL_USART_Abort_IT()
7. For Abort services based on interrupts (HAL_USART_Abort_IT), a Abort Complete Callbacks is provided:
   - HAL_USART_AbortCpltCallback()
8. In Non-Blocking mode transfers, possible errors are split into 2 categories. Errors are handled as follows :
   - Error is considered as Recoverable and non blocking : Transfer could go till end, but error severity is to be evaluated by user : this concerns Frame Error, Parity Error or Noise Error in Interrupt mode reception . Received character is then retrieved and stored in Rx buffer, Error code is set to allow user to identify error type, and HAL_USART_ErrorCallback() user callback is executed. Transfer is kept ongoing on USART side. If user wants to abort it, Abort services should be called by user.
   - Error is considered as Blocking : Transfer could not be completed properly and is aborted. This concerns Overrun Error In Interrupt mode reception and all errors in DMA mode. Error code is set to allow user to identify error type, and HAL_USART_ErrorCallback() user callback is executed.

This section contains the following APIs:

- ***HAL_USART_Transmit***
- ***HAL_USART_Receive***
- ***HAL_USART_TransmitReceive***
- ***HAL_USART_Transmit_IT***
- ***HAL_USART_Receive_IT***
- ***HAL_USART_TransmitReceive_IT***
- ***HAL_USART_Transmit_DMA***
- ***HAL_USART_Receive_DMA***
- ***HAL_USART_TransmitReceive_DMA***
- ***HAL_USART_DMAPause***
- ***HAL_USART_DMAResume***
- ***HAL_USART_DMAStop***
- ***HAL_USART_Abort***
- ***HAL_USART_Abort_IT***
- ***HAL_USART_IRQHandler***
- ***HAL_USART_TxCpltCallback***
- ***HAL_USART_TxHalfCpltCallback***
- ***HAL_USART_RxCpltCallback***
- ***HAL_USART_RxHalfCpltCallback***
- ***HAL_USART_TxRxCpltCallback***
- ***HAL_USART_ErrorCallback***
- ***HAL_USART_AbortCpltCallback***

77.2.5 Peripheral State and Error functions

This subsection provides functions allowing to :

- Return the USART handle state
- Return the USART handle error code

This section contains the following APIs:

- *HAL_USART_GetState*
- *HAL_USART_GetError*

77.2.6 Detailed description of functions

`HAL_USART_Init`

Function name

HAL_StatusTypeDef HAL_USART_Init (USART_HandleTypeDef * husart)

Function description

Initialize the USART mode according to the specified parameters in the USART_InitTypeDef and initialize the associated handle.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

`HAL_USART_DeInit`

Function name

HAL_StatusTypeDef HAL_USART_DeInit (USART_HandleTypeDef * husart)

Function description

DeInitialize the USART peripheral.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

`HAL_USART_MspInit`

Function name

void HAL_USART_MspInit (USART_HandleTypeDef * husart)

Function description

Initialize the USART MSP.

Parameters

- **husart:** USART handle.

Return values

- **None:**

`HAL_USART_MspDeInit`

Function name

void HAL_USART_MspDeInit (USART_HandleTypeDef * husart)

Function description

DeInitialize the USART MSP.

Parameters

- **husart:** USART handle.

Return values

- **None:**

`HAL_USART_Transmit`

Function name

HAL_StatusTypeDef HAL_USART_Transmit (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size, uint32_t Timeout)

Function description

Simplex send an amount of data in blocking mode.

Parameters

- **husart:** USART handle.
- **pTxData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be sent.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data is handled as a set of u16. In this case, Size must indicate the number of u16 provided through pTxData.

`HAL_USART_Receive`

Function name

HAL_StatusTypeDef HAL_USART_Receive (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)

Function description

Receive an amount of data in blocking mode.

Parameters

- **husart:** USART handle.
- **pRxData:** Pointer to data buffer (u8 or u16 data elements).
- **Size:** Amount of data elements (u8 or u16) to be received.
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- To receive synchronous data, dummy data are simultaneously transmitted.
- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the received data is handled as a set of u16. In this case, Size must indicate the number of u16 available through pRxData.

HAL_USART_TransmitReceive

Function name

HAL_StatusTypeDef HAL_USART_TransmitReceive (USART_HandleTypeDef * husart, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)

Function description

Full-Duplex Send and Receive an amount of data in blocking mode.

Parameters

- **husart:** USART handle.
- **pTxData:** pointer to TX data buffer (u8 or u16 data elements).
- **pRxData:** pointer to RX data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be sent (same amount to be received).
- **Timeout:** Timeout duration.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data and the received data are handled as sets of u16. In this case, Size must indicate the number of u16 available through pTxData and through pRxData.

HAL_USART_Transmit_IT

Function name

HAL_StatusTypeDef HAL_USART_Transmit_IT (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size)

Function description

Send an amount of data in interrupt mode.

Parameters

- **husart:** USART handle.
- **pTxData:** pointer to data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be sent.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data is handled as a set of u16. In this case, Size must indicate the number of u16 provided through pTxData.

HAL_USART_Receive_IT

Function name

HAL_StatusTypeDef HAL_USART_Receive_IT (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size)

Function description

Receive an amount of data in interrupt mode.

Parameters

- **husart:** USART handle.
- **pRxData:** pointer to data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be received.

Return values

- **HAL:** status

Notes

- To receive synchronous data, dummy data are simultaneously transmitted.
- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the received data is handled as a set of u16. In this case, Size must indicate the number of u16 available through pRxData.

`HAL_USART_TransmitReceive_IT`

Function name

HAL_StatusTypeDef HAL_USART_TransmitReceive_IT (USART_HandleTypeDef * husart, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)

Function description

Full-Duplex Send and Receive an amount of data in interrupt mode.

Parameters

- **husart:** USART handle.
- **pTxData:** pointer to TX data buffer (u8 or u16 data elements).
- **pRxData:** pointer to RX data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be sent (same amount to be received).

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data and the received data are handled as sets of u16. In this case, Size must indicate the number of u16 available through pTxData and through pRxData.

`HAL_USART_Transmit_DMA`

Function name

HAL_StatusTypeDef HAL_USART_Transmit_DMA (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size)

Function description

Send an amount of data in DMA mode.

Parameters

- **husart:** USART handle.
- **pTxData:** pointer to data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be sent.

Return values

- **HAL:** status

Notes

- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data is handled as a set of u16. In this case, Size must indicate the number of u16 provided through pTxData.

HAL_USART_Receive_DMA

Function name

HAL_StatusTypeDef HAL_USART_Receive_DMA (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size)

Function description

Receive an amount of data in DMA mode.

Parameters

- **husart:** USART handle.
- **pRxData:** pointer to data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be received.

Return values

- **HAL:** status

Notes

- When the USART parity is enabled (PCE = 1), the received data contain the parity bit (MSB position).
- The USART DMA transmit channel must be configured in order to generate the clock for the slave.
- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the received data is handled as a set of u16. In this case, Size must indicate the number of u16 available through pRxData.

HAL_USART_TransmitReceive_DMA

Function name

HAL_StatusTypeDef HAL_USART_TransmitReceive_DMA (USART_HandleTypeDef * husart, uint8_t * pTxData, uint8_t * pRxData, uint16_t Size)

Function description

Full-Duplex Transmit Receive an amount of data in non-blocking mode.

Parameters

- **husart:** USART handle.
- **pTxData:** pointer to TX data buffer (u8 or u16 data elements).
- **pRxData:** pointer to RX data buffer (u8 or u16 data elements).
- **Size:** amount of data elements (u8 or u16) to be received/sent.

Return values

- **HAL:** status

Notes

- When the USART parity is enabled (PCE = 1) the data received contain the parity bit.
- When UART parity is not enabled (PCE = 0), and Word Length is configured to 9 bits (M1-M0 = 01), the sent data and the received data are handled as sets of u16. In this case, Size must indicate the number of u16 available through pTxData and through pRxData.

HAL_USART_DMAPause

Function name

HAL_StatusTypeDef HAL_USART_DMAPause (USART_HandleTypeDef * husart)

Function description

Pause the DMA Transfer.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

HAL_USART_DMAResume

Function name

HAL_StatusTypeDef HAL_USART_DMAResume (USART_HandleTypeDef * husart)

Function description

Resume the DMA Transfer.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

HAL_USART_DMAStop

Function name

HAL_StatusTypeDef HAL_USART_DMAStop (USART_HandleTypeDef * husart)

Function description

Stop the DMA Transfer.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

HAL_USART_Abort

Function name

HAL_StatusTypeDef HAL_USART_Abort (USART_HandleTypeDef * husart)

Function description

Abort ongoing transfers (blocking mode).

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable USART Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort (in case of transfer in DMA mode)Set handle State to READY
- This procedure is executed in blocking mode : when exiting function, Abort is considered as completed.

`HAL_USART_Abort_IT`

Function name

HAL_StatusTypeDef HAL_USART_Abort_IT (USART_HandleTypeDef * husart)

Function description

Abort ongoing transfers (Interrupt mode).

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

Notes

- This procedure could be used for aborting any ongoing transfer started in Interrupt or DMA mode. This procedure performs following operations : Disable USART Interrupts (Tx and Rx)Disable the DMA transfer in the peripheral register (if enabled)Abort DMA transfer by calling HAL_DMA_Abort_IT (in case of transfer in DMA mode)Set handle State to READYAt abort completion, call user abort complete callback
- This procedure is executed in Interrupt mode, meaning that abort procedure could be considered as completed only when user abort complete callback is executed (not when exiting function).

`HAL_USART_IRQHandler`

Function name

void HAL_USART_IRQHandler (USART_HandleTypeDef * husart)

Function description

Handle USART interrupt request.

Parameters

- **husart:** USART handle.

Return values

- **None:**

`HAL_USART_TxHalfCpltCallback`

Function name

void HAL_USART_TxHalfCpltCallback (USART_HandleTypeDef * husart)

Function description

Tx Half Transfer completed callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_TxCpltCallback

Function name

void HAL_USART_TxCpltCallback (USART_HandleTypeDef * husart)

Function description

Tx Transfer completed callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_RxCpltCallback

Function name

void HAL_USART_RxCpltCallback (USART_HandleTypeDef * husart)

Function description

Rx Transfer completed callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_RxHalfCpltCallback

Function name

void HAL_USART_RxHalfCpltCallback (USART_HandleTypeDef * husart)

Function description

Rx Half Transfer completed callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_TxRxCpltCallback

Function name

void HAL_USART_TxRxCpltCallback (USART_HandleTypeDef * husart)

Function description

Tx/Rx Transfers completed callback for the non-blocking process.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_ErrorCallback

Function name

void HAL_USART_ErrorCallback (USART_HandleTypeDef * husart)

Function description

USART error callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_AbortCpltCallback

Function name

void HAL_USART_AbortCpltCallback (USART_HandleTypeDef * husart)

Function description

USART Abort Complete callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USART_GetState

Function name

HAL_USART_StateTypeDef HAL_USART_GetState (USART_HandleTypeDef * husart)

Function description

Return the USART handle state.

Parameters

- **husart:** pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART.

Return values

- **USART:** handle state

HAL_USART_GetError

Function name

uint32_t HAL_USART_GetError (USART_HandleTypeDef * husart)

Function description

Return the USART error code.

Parameters

- **husart:** pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART.

Return values

- **USART:** handle Error Code

77.3 USART Firmware driver defines

The following section lists the various define and macros of the module.

77.3.1 USART

USART

USART Clock

USART_CLOCK_DISABLE

USART clock disable

USART_CLOCK_ENABLE

USART clock enable

USART Clock Prescaler

USART_PRESCALER_DIV1

fclk_pres = fclk

USART_PRESCALER_DIV2

fclk_pres = fclk/2

USART_PRESCALER_DIV4

fclk_pres = fclk/4

USART_PRESCALER_DIV6

fclk_pres = fclk/6

USART_PRESCALER_DIV8

fclk_pres = fclk/8

USART_PRESCALER_DIV10

fclk_pres = fclk/10

USART_PRESCALER_DIV12

fclk_pres = fclk/12

USART_PRESCALER_DIV16

fclk_pres = fclk/16

USART_PRESCALER_DIV32

fclk_pres = fclk/32

USART_PRESCALER_DIV64

fclk_pres = fclk/64

USART_PRESCALER_DIV128

fclk_pres = fclk/128

USART_PRESCALER_DIV256

fclk_pres = fclk/256

USART Clock Phase

USART_PHASE_1EDGE

USART frame phase on first clock transition

USART_PHASE_2EDGE

USART frame phase on second clock transition

USART Clock Polarity

USART_POLARITY_LOW

Driver enable signal is active high

USART_POLARITY_HIGH

Driver enable signal is active low

USART Error Definition

HAL_USART_ERROR_NONE

No error

HAL_USART_ERROR_PE

Parity error

HAL_USART_ERROR_NE

Noise error

HAL_USART_ERROR_FE

Frame error

HAL_USART_ERROR_ORE

Overrun error

HAL_USART_ERROR_DMA

DMA transfer error

HAL_USART_ERROR_UDR

SPI slave underrun error

USART Exported Macros

__HAL_USART_RESET_HANDLE_STATE

Description:

- Reset USART handle state.

Parameters:

- __HANDLE__: USART handle.

Return value:

- None

__HAL_USART_GET_FLAG

Description:

- Check whether the specified USART flag is set or not.

Parameters:

- __HANDLE__: specifies the USART Handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - USART_FLAG_TXFT TXFIFO threshold flag
  - USART_FLAG_RXFT RXFIFO threshold flag
  - USART_FLAG_RXFF RXFIFO Full flag
  - USART_FLAG_TXFE TXFIFO Empty flag
  - USART_FLAG_REACK Receive enable acknowledge flag
  - USART_FLAG_TEACK Transmit enable acknowledge flag
  - USART_FLAG_BUSY Busy flag
  - USART_FLAG_UDR SPI slave underrun error flag
  - USART_FLAG_TXE Transmit data register empty flag
  - USART_FLAG_TXFNF TXFIFO not full flag
  - USART_FLAG_TC Transmission Complete flag
  - USART_FLAG_RXNE Receive data register not empty flag
  - USART_FLAG_RXFNE RXFIFO not empty flag
  - USART_FLAG_IDLE Idle Line detection flag
  - USART_FLAG_ORE OverRun Error flag
  - USART_FLAG_NE Noise Error flag
  - USART_FLAG_FE Framing Error flag
  - USART_FLAG_PE Parity Error flag

Return value:

- The: new state of __FLAG__ (TRUE or FALSE).

__HAL_USART_CLEAR_FLAG

Description:

- Clear the specified USART pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - USART_CLEAR_PEF Parity Error Clear Flag
  - USART_CLEAR_FEF Framing Error Clear Flag
  - USART_CLEAR_NEF Noise detected Clear Flag
  - USART_CLEAR_OREF Overrun Error Clear Flag
  - USART_CLEAR_IDLEF IDLE line detected Clear Flag
  - USART_CLEAR_TXFECF TXFIFO empty clear Flag
  - USART_CLEAR_TCF Transmission Complete Clear Flag
  - USART_CLEAR_UDRF SPI slave underrun error Clear Flag

Return value:

- None

__HAL_USART_CLEAR_PEFLAG

Description:

- Clear the USART PE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_CLEAR_FEFLAG

Description:

- Clear the USART FE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_CLEAR_NEFLAG

Description:

- Clear the USART NE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_CLEAR_OREFLAG

Description:

- Clear the USART ORE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_CLEAR_IDLEFLAG

Description:

- Clear the USART IDLE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_CLEAR_TXFECF

Description:

- Clear the USART TX FIFO empty clear flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_CLEAR_UDRFLAG

Description:

- Clear SPI slave underrun error flag.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_ENABLE_IT

Description:

- Enable the specified USART interrupt.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __INTERRUPT__: specifies the USART interrupt source to enable. This parameter can be one of the following values:
  - USART_IT_RXFF RXFIFO Full interrupt
  - USART_IT_TXFE TXFIFO Empty interrupt
  - USART_IT_RXFT RXFIFO threshold interrupt
  - USART_IT_TXFT TXFIFO threshold interrupt
  - USART_IT_TXE Transmit Data Register empty interrupt
  - USART_IT_TXFNF TX FIFO not full interrupt
  - USART_IT_TC Transmission complete interrupt
  - USART_IT_RXNE Receive Data register not empty interrupt
  - USART_IT_RXFNE RXFIFO not empty interrupt
  - USART_IT_IDLE Idle line detection interrupt
  - USART_IT_PE Parity Error interrupt
  - USART_IT_ERR Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

__HAL_USART_DISABLE_IT

Description:

- Disable the specified USART interrupt.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __INTERRUPT__: specifies the USART interrupt source to disable. This parameter can be one of the following values:
  - USART_IT_RXFF RXFIFO Full interrupt
  - USART_IT_TXFE TXFIFO Empty interrupt
  - USART_IT_RXFT RXFIFO threshold interrupt
  - USART_IT_TXFT TXFIFO threshold interrupt
  - USART_IT_TXE Transmit Data Register empty interrupt
  - USART_IT_TXFNF TX FIFO not full interrupt
  - USART_IT_TC Transmission complete interrupt
  - USART_IT_RXNE Receive Data register not empty interrupt
  - USART_IT_RXFNE RXFIFO not empty interrupt
  - USART_IT_IDLE Idle line detection interrupt
  - USART_IT_PE Parity Error interrupt
  - USART_IT_ERR Error interrupt(Frame error, noise error, overrun error)

Return value:

- None

__HAL_USART_GET_IT

Description:

- Check whether the specified USART interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __INTERRUPT__: specifies the USART interrupt source to check. This parameter can be one of the following values:
  - USART_IT_RXFF RXFIFO Full interrupt
  - USART_IT_TXFE TXFIFO Empty interrupt
  - USART_IT_RXFT RXFIFO threshold interrupt
  - USART_IT_TXFT TXFIFO threshold interrupt
  - USART_IT_TXE Transmit Data Register empty interrupt
  - USART_IT_TXFNF TX FIFO not full interrupt
  - USART_IT_TC Transmission complete interrupt
  - USART_IT_RXNE Receive Data register not empty interrupt
  - USART_IT_RXFNE RXFIFO not empty interrupt
  - USART_IT_IDLE Idle line detection interrupt
  - USART_IT_ORE OverRun Error interrupt
  - USART_IT_NE Noise Error interrupt
  - USART_IT_FE Framing Error interrupt
  - USART_IT_PE Parity Error interrupt

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_USART_GET_IT_SOURCE

Description:

- Check whether the specified USART interrupt source is enabled or not.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __INTERRUPT__: specifies the USART interrupt source to check. This parameter can be one of the following values:
  - USART_IT_RXFF RXFIFO Full interrupt
  - USART_IT_TXFE TXFIFO Empty interrupt
  - USART_IT_RXFT RXFIFO threshold interrupt
  - USART_IT_TXFT TXFIFO threshold interrupt
  - USART_IT_TXE Transmit Data Register empty interrupt
  - USART_IT_TXFNF TX FIFO not full interrupt
  - USART_IT_TC Transmission complete interrupt
  - USART_IT_RXNE Receive Data register not empty interrupt
  - USART_IT_RXFNE RXFIFO not empty interrupt
  - USART_IT_IDLE Idle line detection interrupt
  - USART_IT_ORE OverRun Error interrupt
  - USART_IT_NE Noise Error interrupt
  - USART_IT_FE Framing Error interrupt
  - USART_IT_PE Parity Error interrupt

Return value:

- The: new state of __INTERRUPT__ (SET or RESET).

__HAL_USART_CLEAR_IT

Description:

- Clear the specified USART ISR flag, in setting the proper ICR register flag.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __IT_CLEAR__: specifies the interrupt clear register flag that needs to be set to clear the corresponding interrupt. This parameter can be one of the following values:
  - USART_CLEAR_PEF Parity Error Clear Flag
  - USART_CLEAR_FEF Framing Error Clear Flag
  - USART_CLEAR_NEF Noise detected Clear Flag
  - USART_CLEAR_OREF Overrun Error Clear Flag
  - USART_CLEAR_IDLEF IDLE line detected Clear Flag
  - USART_CLEAR_TXFECF TXFIFO empty clear Flag
  - USART_CLEAR_TCF Transmission Complete Clear Flag

Return value:

- None

__HAL_USART_SEND_REQ

Description:

- Set a specific USART request flag.

Parameters:

- __HANDLE__: specifies the USART Handle.
- __REQ__: specifies the request flag to set. This parameter can be one of the following values:
  - USART_RXDATA_FLUSH_REQUEST Receive Data flush Request
  - USART_TXDATA_FLUSH_REQUEST Transmit data flush Request

Return value:

- None

__HAL_USART_ONE_BIT_SAMPLE_ENABLE

Description:

- Enable the USART one bit sample method.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_ONE_BIT_SAMPLE_DISABLE

Description:

- Disable the USART one bit sample method.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_ENABLE

Description:

- Enable USART.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_DISABLE

Description:

- Disable USART.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

USART Flags

USART_FLAG_TXFT

USART TXFIFO threshold flag

USART_FLAG_RXFT

USART RXFIFO threshold flag

USART_FLAG_RXFF

USART RXFIFO Full flag

USART_FLAG_TXFE

USART TXFIFO Empty flag

USART_FLAG_REACK

USART receive enable acknowledge flag

USART_FLAG_TEACK

USART transmit enable acknowledge flag

USART_FLAG_BUSY

USART busy flag

USART_FLAG_UDR

SPI slave underrun error flag

USART_FLAG_TXE

USART transmit data register empty

USART_FLAG_TXFNF

USART TXFIFO not full

USART_FLAG_TC

USART transmission complete

USART_FLAG_RXNE

USART read data register not empty

USART_FLAG_RXFNE

USART RXFIFO not empty

USART_FLAG_IDLE

USART idle flag

USART_FLAG_ORE

USART overrun error

USART_FLAG_NE

USART noise error

USART_FLAG_FE

USART frame error

USART_FLAG_PE

USART parity error

USART Interruption Flags Mask

USART_IT_MASK

USART interruptions flags mask

USART_CR_MASK

USART control register mask

USART_CR_POS

USART control register position

USART_ISR_MASK

USART ISR register mask

USART_ISR_POS

USART ISR register position

USART Interrupts Definition

USART_IT_PE

USART parity error interruption

USART_IT_TXE

USART transmit data register empty interruption

USART_IT_TXFNF

USART TX FIFO not full interruption

USART_IT_TC

USART transmission complete interruption

USART_IT_RXNE

USART read data register not empty interruption

USART_IT_RXFNE

USART RXFIFO not empty interruption

USART_IT_IDLE

USART idle interruption

USART_IT_ERR

USART error interruption

USART_IT_ORE

USART overrun error interruption

USART_IT_NE

USART noise error interruption

USART_IT_FE

USART frame error interruption

USART_IT_RXFF

USART RXFIFO full interruption

USART_IT_TXFE

USART TXFIFO empty interruption

USART_IT_RXFT

USART RXFIFO threshold reached interruption

USART_IT_TXFT

USART TXFIFO threshold reached interruption

USART Interruption Clear Flags

USART_CLEAR_PEF

Parity Error Clear Flag

USART_CLEAR_FEF

Framing Error Clear Flag

USART_CLEAR_NEF

Noise Error detected Clear Flag

USART_CLEAR_OREF

OverRun Error Clear Flag

USART_CLEAR_IDLEF

IDLE line detected Clear Flag

USART_CLEAR_TCF

Transmission Complete Clear Flag

USART_CLEAR_UDRF

SPI slave underrun error Clear Flag

USART_CLEAR_TXFECF

TXFIFO Empty Clear Flag

USART Last Bit

USART_LASTBIT_DISABLE

USART frame last data bit clock pulse not output to SCLK pin

USART_LASTBIT_ENABLE

USART frame last data bit clock pulse output to SCLK pin

USART Mode

USART_MODE_RX

RX mode

USART_MODE_TX

TX mode

USART_MODE_TX_RX

RX and TX mode

USART Over Sampling

USART_OVERSAMPLING_16

Oversampling by 16

USART_OVERSAMPLING_8

Oversampling by 8

USART Parity

USART_PARITY_NONE

No parity

USART_PARITY_EVEN

Even parity

USART_PARITY_ODD

Odd parity

USART Request Parameters

USART_RXDATA_FLUSH_REQUEST

Receive Data flush Request

USART_TXDATA_FLUSH_REQUEST

Transmit data flush Request

USART Number of Stop Bits

USART_STOPBITS_0_5

USART frame with 0.5 stop bit

USART_STOPBITS_1

USART frame with 1 stop bit

USART_STOPBITS_1_5

USART frame with 1.5 stop bits

USART_STOPBITS_2

USART frame with 2 stop bits

78 HAL USART Extension Driver

78.1 USARTEx Firmware driver API description

The following section lists the various functions of the USARTEx library.

78.1.1 USART peripheral extended features

78.1.2 IO operation functions

This section contains the following APIs:

- ***HAL_USARTEx_RxFifoFullCallback***
- ***HAL_USARTEx_TxFifoEmptyCallback***

78.1.3 Peripheral Control functions

This section provides the following functions:

- HAL_USARTEx_EnableSPISlaveMode() API enables the SPI slave mode
- HAL_USARTEx_DisableSPISlaveMode() API disables the SPI slave mode
- HAL_USARTEx_ConfigNSS API configures the Slave Select input pin (NSS)
- HAL_USARTEx_EnableFifoMode() API enables the FIFO mode
- HAL_USARTEx_DisableFifoMode() API disables the FIFO mode
- HAL_USARTEx_SetTxFifoThreshold() API sets the TX FIFO threshold
- HAL_USARTEx_SetRxFifoThreshold() API sets the RX FIFO threshold

This section contains the following APIs:

- ***HAL_USARTEx_EnableSlaveMode***
- ***HAL_USARTEx_DisableSlaveMode***
- ***HAL_USARTEx_ConfigNSS***
- ***HAL_USARTEx_EnableFifoMode***
- ***HAL_USARTEx_DisableFifoMode***
- ***HAL_USARTEx_SetTxFifoThreshold***
- ***HAL_USARTEx_SetRxFifoThreshold***

78.1.4 Detailed description of functions

`HAL_USARTEx_RxFifoFullCallback`

Function name

void HAL_USARTEx_RxFifoFullCallback (USART_HandleTypeDef * husart)

Function description

USART RX Fifo full callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

`HAL_USARTEx_TxFifoEmptyCallback`

Function name

void HAL_USARTEx_TxFifoEmptyCallback (USART_HandleTypeDef * husart)

Function description

USART TX Fifo empty callback.

Parameters

- **husart:** USART handle.

Return values

- **None:**

HAL_USARTEx_EnableSlaveMode

Function name

HAL_StatusTypeDef HAL_USARTEx_EnableSlaveMode (USART_HandleTypeDef * husart)

Function description

Enable the SPI slave mode.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

Notes

- When the USART operates in SPI slave mode, it handles data flow using the serial interface clock derived from the external SCLK signal provided by the external master SPI device.
- In SPI slave mode, the USART must be enabled before starting the master communications (or between frames while the clock is stable). Otherwise, if the USART slave is enabled while the master is in the middle of a frame, it will become desynchronized with the master.
- The data register of the slave needs to be ready before the first edge of the communication clock or before the end of the ongoing communication, otherwise the SPI slave will transmit zeros.

HAL_USARTEx_DisableSlaveMode

Function name

HAL_StatusTypeDef HAL_USARTEx_DisableSlaveMode (USART_HandleTypeDef * husart)

Function description

Disable the SPI slave mode.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

HAL_USARTEx_ConfigNSS

Function name

HAL_StatusTypeDef HAL_USARTEx_ConfigNSS (USART_HandleTypeDef * husart, uint32_t NSSConfig)

Function description

Configure the Slave Select input pin (NSS).

Parameters

- **husart:** USART handle.
- **NSSConfig:** NSS configuration. This parameter can be one of the following values:
  - USART_NSS_HARD
  - USART_NSS_SOFT

Return values

- **HAL:** status

Notes

- Software NSS management: SPI slave will always be selected and NSS input pin will be ignored.
- Hardware NSS management: the SPI slave selection depends on NSS input pin. The slave is selected when NSS is low and deselected when NSS is high.

HAL_USARTEx_EnableFifoMode

Function name

HAL_StatusTypeDef HAL_USARTEx_EnableFifoMode (USART_HandleTypeDef * husart)

Function description

Enable the FIFO mode.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

HAL_USARTEx_DisableFifoMode

Function name

HAL_StatusTypeDef HAL_USARTEx_DisableFifoMode (USART_HandleTypeDef * husart)

Function description

Disable the FIFO mode.

Parameters

- **husart:** USART handle.

Return values

- **HAL:** status

HAL_USARTEx_SetTxFifoThreshold

Function name

HAL_StatusTypeDef HAL_USARTEx_SetTxFifoThreshold (USART_HandleTypeDef * husart, uint32_t Threshold)

Function description

Set the TXFIFO threshold.

Parameters

- **husart:** USART handle.
- **Threshold:** TX FIFO threshold value This parameter can be one of the following values:
  - USART_TXFIFO_THRESHOLD_1_8
  - USART_TXFIFO_THRESHOLD_1_4
  - USART_TXFIFO_THRESHOLD_1_2
  - USART_TXFIFO_THRESHOLD_3_4
  - USART_TXFIFO_THRESHOLD_7_8
  - USART_TXFIFO_THRESHOLD_8_8

Return values

- **HAL:** status

`HAL_USARTEx_SetRxFifoThreshold`

Function name

HAL_StatusTypeDef HAL_USARTEx_SetRxFifoThreshold (USART_HandleTypeDef * husart, uint32_t Threshold)

Function description

Set the RXFIFO threshold.

Parameters

- **husart:** USART handle.
- **Threshold:** RX FIFO threshold value This parameter can be one of the following values:
  - USART_RXFIFO_THRESHOLD_1_8
  - USART_RXFIFO_THRESHOLD_1_4
  - USART_RXFIFO_THRESHOLD_1_2
  - USART_RXFIFO_THRESHOLD_3_4
  - USART_RXFIFO_THRESHOLD_7_8
  - USART_RXFIFO_THRESHOLD_8_8

Return values

- **HAL:** status

78.2 USARTEx Firmware driver defines

The following section lists the various define and macros of the module.

78.2.1 USARTEx

USARTEx

USARTEx FIFO mode

USART_FIFOMODE_DISABLE

FIFO mode disable

USART_FIFOMODE_ENABLE

FIFO mode enable

USARTEx RXFIFO threshold level

USART_RXFIFO_THRESHOLD_1_8

RXFIFO FIFO reaches 1/8 of its depth

USART_RXFIFO_THRESHOLD_1_4

RXFIFO FIFO reaches 1/4 of its depth

USART_RXFIFO_THRESHOLD_1_2

RXFIFO FIFO reaches 1/2 of its depth

USART_RXFIFO_THRESHOLD_3_4

RXFIFO FIFO reaches 3/4 of its depth

USART_RXFIFO_THRESHOLD_7_8

RXFIFO FIFO reaches 7/8 of its depth

USART_RXFIFO_THRESHOLD_8_8

RXFIFO FIFO becomes full

USARTEx Synchronous Slave mode enable

USART_SLAVEMODE_DISABLE

USART SPI Slave Mode Enable

USART_SLAVEMODE_ENABLE

USART SPI Slave Mode Disable

USARTEx Slave Select Management

USART_NSS_HARD

SPI slave selection depends on NSS input pin

USART_NSS_SOFT

SPI slave is always selected and NSS input pin is ignored

USARTEx TXFIFO threshold level

USART_TXFIFO_THRESHOLD_1_8

TXFIFO reaches 1/8 of its depth

USART_TXFIFO_THRESHOLD_1_4

TXFIFO reaches 1/4 of its depth

USART_TXFIFO_THRESHOLD_1_2

TXFIFO reaches 1/2 of its depth

USART_TXFIFO_THRESHOLD_3_4

TXFIFO reaches 3/4 of its depth

USART_TXFIFO_THRESHOLD_7_8

TXFIFO reaches 7/8 of its depth

USART_TXFIFO_THRESHOLD_8_8

TXFIFO becomes empty

USARTEx Word Length

USART_WORDLENGTH_7B

7-bit long USART frame

USART_WORDLENGTH_8B

8-bit long USART frame

USART_WORDLENGTH_9B

9-bit long USART frame

79 HAL WWDG Generic Driver

79.1 WWDG Firmware driver registers structures

79.1.1 WWDG_InitTypeDef

WWDG_InitTypeDef is defined in the stm32l4xx_hal_wwdg.h

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t Window***
- ***uint32_t Counter***
- ***uint32_t EWIMode***

Field Documentation

- ***uint32_t WWDG_InitTypeDef::Prescaler***
  Specifies the prescaler value of the WWDG. This parameter can be a value of ***WWDG_Prescaler***
- ***uint32_t WWDG_InitTypeDef::Window***
  Specifies the WWDG window value to be compared to the downcounter. This parameter must be a number Min_Data = 0x40 and Max_Data = 0x7F
- ***uint32_t WWDG_InitTypeDef::Counter***
  Specifies the WWDG free-running downcounter value. This parameter must be a number between Min_Data = 0x40 and Max_Data = 0x7F
- ***uint32_t WWDG_InitTypeDef::EWIMode***
  Specifies if WWDG Early Wakeup Interupt is enable or not. This parameter can be a value of ***WWDG_EWI_Mode***

79.1.2 WWDG_HandleTypeDef

WWDG_HandleTypeDef is defined in the stm32l4xx_hal_wwdg.h

Data Fields

- ***WWDG_TypeDef * Instance***
- ***WWDG_InitTypeDef Init***

Field Documentation

- ***WWDG_TypeDef* WWDG_HandleTypeDef::Instance***
  Register base address
- ***WWDG_InitTypeDef WWDG_HandleTypeDef::Init***
  WWDG required parameters

79.2 WWDG Firmware driver API description

The following section lists the various functions of the WWDG library.

79.2.1 Initialization and Configuration functions

This section provides functions allowing to:

- Initialize and start the WWDG according to the specified parameters in the WWDG_InitTypeDef of associated handle.
- Initialize the WWDG MSP.

This section contains the following APIs:

- ***HAL_WWDG_Init***
- ***HAL_WWDG_MspInit***

79.2.2 IO operation functions

This section provides functions allowing to:

- Refresh the WWDG.
- Handle WWDG interrupt request and associated function callback.

This section contains the following APIs:

- ***HAL_WWDG_Refresh***
- ***HAL_WWDG_IRQHandler***
- ***HAL_WWDG_EarlyWakeupCallback***

79.2.3 Detailed description of functions

`HAL_WWDG_Init`

Function name

HAL_StatusTypeDef HAL_WWDG_Init (WWDG_HandleTypeDef * hwwdg)

Function description

Initialize the WWDG according to the specified.

Parameters

- **hwwdg:** pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.

Return values

- **HAL:** status

`HAL_WWDG_MspInit`

Function name

void HAL_WWDG_MspInit (WWDG_HandleTypeDef * hwwdg)

Function description

Initialize the WWDG MSP.

Parameters

- **hwwdg:** pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.

Return values

- **None:**

Notes

- When rewriting this function in user file, mechanism may be added to avoid multiple initialize when HAL_WWDG_Init function is called again to change parameters.

`HAL_WWDG_Refresh`

Function name

HAL_StatusTypeDef HAL_WWDG_Refresh (WWDG_HandleTypeDef * hwwdg)

Function description

Refresh the WWDG.

Parameters

- **hwwdg:** pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.

Return values

- **HAL:** status

`HAL_WWDG_IRQHandler`

Function name

void HAL_WWDG_IRQHandler (WWDG_HandleTypeDef * hwwdg)

Function description

Handle WWDG interrupt request.

Parameters

- **hwwdg:** pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.

Return values

- **None:**

Notes

- The Early Wakeup Interrupt (EWI) can be used if specific safety operations or data logging must be performed before the actual reset is generated. The EWI interrupt is enabled by calling HAL_WWDG_Init function with EWIMode set to WWDG_EWI_ENABLE. When the downcounter reaches the value 0x40, and EWI interrupt is generated and the corresponding Interrupt Service Routine (ISR) can be used to trigger specific actions (such as communications or data logging), before resetting the device.

`HAL_WWDG_EarlyWakeupCallback`

Function name

void HAL_WWDG_EarlyWakeupCallback (WWDG_HandleTypeDef * hwwdg)

Function description

WWDG Early Wakeup callback.

Parameters

- **hwwdg:** pointer to a WWDG_HandleTypeDef structure that contains the configuration information for the specified WWDG module.

Return values

- **None:**

79.3 WWDG Firmware driver defines

The following section lists the various define and macros of the module.

79.3.1 WWDG

WWDG

WWDG Early Wakeup Interrupt Mode

WWDG_EWI_DISABLE

EWI Disable

WWDG_EWI_ENABLE

EWI Enable

WWDG Exported Macros

__HAL_WWDG_ENABLE

Description:

- Enable the WWDG peripheral.

Parameters:

- __HANDLE__: WWDG handle

Return value:

- None

__HAL_WWDG_ENABLE_IT

Description:

- Enable the WWDG early wakeup interrupt.

Parameters:

- __HANDLE__: WWDG handle
- __INTERRUPT__: specifies the interrupt to enable. This parameter can be one of the following values:
  - WWDG_IT_EWI: Early wakeup interrupt

Return value:

- None

Notes:

- Once enabled this interrupt cannot be disabled except by a system reset.

__HAL_WWDG_GET_IT

Description:

- Check whether the selected WWDG interrupt has occurred or not.

Parameters:

- __HANDLE__: WWDG handle
- __INTERRUPT__: specifies the it to check. This parameter can be one of the following values:
  - WWDG_FLAG_EWIF: Early wakeup interrupt IT

Return value:

- The: new state of WWDG_FLAG (SET or RESET).

__HAL_WWDG_CLEAR_IT

Description:

- Clear the WWDG interrupt pending bits.

Parameters:

- __HANDLE__: WWDG handle
- __INTERRUPT__: specifies the interrupt pending bit to clear. This parameter can be one of the following values:
  - WWDG_FLAG_EWIF: Early wakeup interrupt flag

__HAL_WWDG_GET_FLAG

Description:

- Check whether the specified WWDG flag is set or not.

Parameters:

- __HANDLE__: WWDG handle
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - WWDG_FLAG_EWIF: Early wakeup interrupt flag

Return value:

- The: new state of WWDG_FLAG (SET or RESET).

__HAL_WWDG_CLEAR_FLAG

Description:

- Clear the WWDG's pending flags.

Parameters:

- __HANDLE__: WWDG handle
- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - WWDG_FLAG_EWIF: Early wakeup interrupt flag

Return value:

- None

__HAL_WWDG_GET_IT_SOURCE

Description:

- Check whether the specified WWDG interrupt source is enabled or not.

Parameters:

- __HANDLE__: WWDG Handle.
- __INTERRUPT__: specifies the WWDG interrupt source to check. This parameter can be one of the following values:
  - WWDG_IT_EWI: Early Wakeup Interrupt

Return value:

- state: of __INTERRUPT__ (TRUE or FALSE).

WWDG Flag definition

WWDG_FLAG_EWIF

Early wakeup interrupt flag

WWDG Interrupt definition

WWDG_IT_EWI

Early wakeup interrupt

WWDG Prescaler

WWDG_PRESCALER_1

WWDG counter clock = (PCLK1/4096)/1

WWDG_PRESCALER_2

WWDG counter clock = (PCLK1/4096)/2

WWDG_PRESCALER_4

WWDG counter clock = (PCLK1/4096)/4

WWDG_PRESCALER_8

WWDG counter clock = (PCLK1/4096)/8

80 LL ADC Generic Driver

80.1 ADC Firmware driver registers structures

80.1.1 LL_ADC_CommonInitTypeDef

LL_ADC_CommonInitTypeDef is defined in the stm32l4xx_ll_adc.h

Data Fields

- ***uint32_t CommonClock***

Field Documentation

- ***uint32_t LL_ADC_CommonInitTypeDef::CommonClock***

  Set parameter common to several ADC: Clock source and prescaler. This parameter can be a value of ***ADC_LL_EC_COMMON_CLOCK_SOURCE***

  Note:

  – On this STM32 serie, if ADC group injected is used, some clock ratio constraints between ADC clock and AHB clock must be respected. Refer to reference manual.

  This feature can be modified afterwards using unitary function **LL_ADC_SetCommonClock()**.

80.1.2 LL_ADC_InitTypeDef

LL_ADC_InitTypeDef is defined in the stm32l4xx_ll_adc.h

Data Fields

- ***uint32_t Resolution***
- ***uint32_t DataAlignment***
- ***uint32_t LowPowerMode***

Field Documentation

- ***uint32_t LL_ADC_InitTypeDef::Resolution***

  Set ADC resolution. This parameter can be a value of ***ADC_LL_EC_RESOLUTION***This feature can be modified afterwards using unitary function **LL_ADC_SetResolution()**.

- ***uint32_t LL_ADC_InitTypeDef::DataAlignment***

  Set ADC conversion data alignment. This parameter can be a value of ***ADC_LL_EC_DATA_ALIGN***This feature can be modified afterwards using unitary function **LL_ADC_SetDataAlignment()**.

- ***uint32_t LL_ADC_InitTypeDef::LowPowerMode***

  Set ADC low power mode. This parameter can be a value of ***ADC_LL_EC_LP_MODE***This feature can be modified afterwards using unitary function **LL_ADC_SetLowPowerMode()**.

80.1.3 LL_ADC_REG_InitTypeDef

LL_ADC_REG_InitTypeDef is defined in the stm32l4xx_ll_adc.h

Data Fields

- ***uint32_t TriggerSource***
- ***uint32_t SequencerLength***
- ***uint32_t SequencerDiscont***
- ***uint32_t ContinuousMode***
- ***uint32_t DMATransfer***
- ***uint32_t Overrun***

Field Documentation

- ***uint32_t LL_ADC_REG_InitTypeDef::TriggerSource***

  Set ADC group regular conversion trigger source: internal (SW start) or from external peripheral (timer event, external interrupt line). This parameter can be a value of ***ADC_LL_EC_REG_TRIGGER_SOURCE***

  Note:

  – On this STM32 serie, setting trigger source to external trigger also set trigger polarity to rising edge (default setting for compatibility with some ADC on other STM32 families having this setting set by HW default value). In case of need to modify trigger edge, use function **LL_ADC_REG_SetTriggerEdge()**.

  This feature can be modified afterwards using unitary function **LL_ADC_REG_SetTriggerSource()**.

- ***uint32_t LL_ADC_REG_InitTypeDef::SequencerLength***

  Set ADC group regular sequencer length. This parameter can be a value of ***ADC_LL_EC_REG_SEQ_SCAN_LENGTH***This feature can be modified afterwards using unitary function **LL_ADC_REG_SetSequencerLength()**.

- ***uint32_t LL_ADC_REG_InitTypeDef::SequencerDiscont***

  Set ADC group regular sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks. This parameter can be a value of ***ADC_LL_EC_REG_SEQ_DISCONT_MODE***

  Note:

  – This parameter has an effect only if group regular sequencer is enabled (scan length of 2 ranks or more).

  This feature can be modified afterwards using unitary function **LL_ADC_REG_SetSequencerDiscont()**.

- ***uint32_t LL_ADC_REG_InitTypeDef::ContinuousMode***

  Set ADC continuous conversion mode on ADC group regular, whether ADC conversions are performed in single mode (one conversion per trigger) or in continuous mode (after the first trigger, following conversions launched successively automatically). This parameter can be a value of ***ADC_LL_EC_REG_CONTINUOUS_MODE*** Note: It is not possible to enable both ADC group regular continuous mode and discontinuous mode.This feature can be modified afterwards using unitary function **LL_ADC_REG_SetContinuousMode()**.

- ***uint32_t LL_ADC_REG_InitTypeDef::DMATransfer***

  Set ADC group regular conversion data transfer: no transfer or transfer by DMA, and DMA requests mode. This parameter can be a value of ***ADC_LL_EC_REG_DMA_TRANSFER***This feature can be modified afterwards using unitary function **LL_ADC_REG_SetDMATransfer()**.

- ***uint32_t LL_ADC_REG_InitTypeDef::Overrun***

  Set ADC group regular behavior in case of overrun: data preserved or overwritten. This parameter can be a value of ***ADC_LL_EC_REG_OVR_DATA_BEHAVIOR***This feature can be modified afterwards using unitary function **LL_ADC_REG_SetOverrun()**.

80.1.4 LL_ADC_INJ_InitTypeDef

LL_ADC_INJ_InitTypeDef is defined in the stm32l4xx_ll_adc.h

Data Fields

- ***uint32_t TriggerSource***
- ***uint32_t SequencerLength***
- ***uint32_t SequencerDiscont***
- ***uint32_t TrigAuto***

Field Documentation

- ***uint32_t LL_ADC_INJ_InitTypeDef::TriggerSource***

  Set ADC group injected conversion trigger source: internal (SW start) or from external peripheral (timer event, external interrupt line). This parameter can be a value of ***ADC_LL_EC_INJ_TRIGGER_SOURCE***

  Note:

  – On this STM32 serie, setting trigger source to external trigger also set trigger polarity to rising edge (default setting for compatibility with some ADC on other STM32 families having this setting set by HW default value). In case of need to modify trigger edge, use function **LL_ADC_INJ_SetTriggerEdge()**.

  This feature can be modified afterwards using unitary function **LL_ADC_INJ_SetTriggerSource()**.

- ***uint32_t LL_ADC_INJ_InitTypeDef::SequencerLength***

  Set ADC group injected sequencer length. This parameter can be a value of ***ADC_LL_EC_INJ_SEQ_SCAN_LENGTH***This feature can be modified afterwards using unitary function **LL_ADC_INJ_SetSequencerLength()**.

- ***uint32_t LL_ADC_INJ_InitTypeDef::SequencerDiscont***

  Set ADC group injected sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks. This parameter can be a value of ***ADC_LL_EC_INJ_SEQ_DISCONT_MODE***

  Note:

  – This parameter has an effect only if group injected sequencer is enabled (scan length of 2 ranks or more).

  This feature can be modified afterwards using unitary function **LL_ADC_INJ_SetSequencerDiscont()**.

- ***uint32_t LL_ADC_INJ_InitTypeDef::TrigAuto***

  Set ADC group injected conversion trigger: independent or from ADC group regular. This parameter can be a value of ***ADC_LL_EC_INJ_TRIG_AUTO*** Note: This parameter must be set to set to independent trigger if injected trigger source is set to an external trigger.This feature can be modified afterwards using unitary function **LL_ADC_INJ_SetTrigAuto()**.

80.2 ADC Firmware driver API description

The following section lists the various functions of the ADC library.

80.2.1 Detailed description of functions

`LL_ADC_DMA_GetRegAddr`

Function name

__STATIC_INLINE uint32_t LL_ADC_DMA_GetRegAddr (ADC_TypeDef * ADCx, uint32_t Register)

Function description

Function to help to configure DMA transfer from ADC: retrieve the ADC register address from ADC instance and a list of ADC registers intended to be used (most commonly) with DMA transfer.

Parameters

- **ADCx:** ADC instance
- **Register:** This parameter can be one of the following values:
  – LL_ADC_DMA_REG_REGULAR_DATA
  – LL_ADC_DMA_REG_REGULAR_DATA_MULTI (1)

  (1) Available on devices with several ADC instances.

Return values

- **ADC:** register address

Notes

- These ADC registers are data registers: when ADC conversion data is available in ADC data registers, ADC generates a DMA transfer request.
- This macro is intended to be used with LL DMA driver, refer to function "LL_DMA_ConfigAddresses()". Example: LL_DMA_ConfigAddresses(DMA1, LL_DMA_CHANNEL_1, LL_ADC_DMA_GetRegAddr(ADC1, LL_ADC_DMA_REG_REGULAR_DATA), (uint32_t)&< array or variable >, LL_DMA_DIRECTION_PERIPH_TO_MEMORY);
- For devices with several ADC: in multimode, some devices use a different data register outside of ADC instance scope (common data register). This macro manages this register difference, only ADC instance has to be set as parameter.

Reference Manual to LL API cross reference:

- DR RDATA LL_ADC_DMA_GetRegAddr
- CDR RDATA_MST LL_ADC_DMA_GetRegAddr
- CDR RDATA_SLV LL_ADC_DMA_GetRegAddr

`LL_ADC_SetCommonClock`

Function name

__STATIC_INLINE void LL_ADC_SetCommonClock (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t CommonClock)

Function description

Set parameter common to several ADC: Clock source and prescaler.

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())
- **CommonClock:** This parameter can be one of the following values:
  - LL_ADC_CLOCK_SYNC_PCLK_DIV1
  - LL_ADC_CLOCK_SYNC_PCLK_DIV2
  - LL_ADC_CLOCK_SYNC_PCLK_DIV4
  - LL_ADC_CLOCK_ASYNC_DIV1
  - LL_ADC_CLOCK_ASYNC_DIV2
  - LL_ADC_CLOCK_ASYNC_DIV4
  - LL_ADC_CLOCK_ASYNC_DIV6
  - LL_ADC_CLOCK_ASYNC_DIV8
  - LL_ADC_CLOCK_ASYNC_DIV10
  - LL_ADC_CLOCK_ASYNC_DIV12
  - LL_ADC_CLOCK_ASYNC_DIV16
  - LL_ADC_CLOCK_ASYNC_DIV32
  - LL_ADC_CLOCK_ASYNC_DIV64
  - LL_ADC_CLOCK_ASYNC_DIV128
  - LL_ADC_CLOCK_ASYNC_DIV256

Return values

- **None:**

Notes

- On this STM32 serie, if ADC group injected is used, some clock ratio constraints between ADC clock and AHB clock must be respected. Refer to reference manual.
- On this STM32 serie, setting of this feature is conditioned to ADC state: All ADC instances of the ADC common group must be disabled. This check can be done with function LL_ADC_IsEnabled() for each ADC instance or by using helper macro helper macro __LL_ADC_IS_ENABLED_ALL_COMMON_INSTANCE().

Reference Manual to LL API cross reference:

- CCR CKMODE LL_ADC_SetCommonClock
- CCR PRESC LL_ADC_SetCommonClock

`LL_ADC_GetCommonClock`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetCommonClock (ADC_Common_TypeDef * ADCxy_COMMON)

Function description

Get parameter common to several ADC: Clock source and prescaler.

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_CLOCK_SYNC_PCLK_DIV1
  - LL_ADC_CLOCK_SYNC_PCLK_DIV2
  - LL_ADC_CLOCK_SYNC_PCLK_DIV4
  - LL_ADC_CLOCK_ASYNC_DIV1
  - LL_ADC_CLOCK_ASYNC_DIV2
  - LL_ADC_CLOCK_ASYNC_DIV4
  - LL_ADC_CLOCK_ASYNC_DIV6
  - LL_ADC_CLOCK_ASYNC_DIV8
  - LL_ADC_CLOCK_ASYNC_DIV10
  - LL_ADC_CLOCK_ASYNC_DIV12
  - LL_ADC_CLOCK_ASYNC_DIV16
  - LL_ADC_CLOCK_ASYNC_DIV32
  - LL_ADC_CLOCK_ASYNC_DIV64
  - LL_ADC_CLOCK_ASYNC_DIV128
  - LL_ADC_CLOCK_ASYNC_DIV256

Reference Manual to LL API cross reference:

- CCR CKMODE LL_ADC_GetCommonClock
- CCR PRESC LL_ADC_GetCommonClock

LL_ADC_SetCommonPathInternalCh

Function name

__STATIC_INLINE void LL_ADC_SetCommonPathInternalCh (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t PathInternal)

Function description

Set parameter common to several ADC: measurement path to internal channels (VrefInt, temperature sensor, ...).

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())
- **PathInternal:** This parameter can be a combination of the following values:
  - LL_ADC_PATH_INTERNAL_NONE
  - LL_ADC_PATH_INTERNAL_VREFINT
  - LL_ADC_PATH_INTERNAL_TEMPSENSOR
  - LL_ADC_PATH_INTERNAL_VBAT

Return values

- **None:**

Notes

- One or several values can be selected. Example: (LL_ADC_PATH_INTERNAL_VREFINT | LL_ADC_PATH_INTERNAL_TEMPSENSOR) The values not selected are removed from configuration.
- Stabilization time of measurement path to internal channel: After enabling internal paths, before starting ADC conversion, a delay is required for internal voltage reference and temperature sensor stabilization time. Refer to device datasheet. Refer to literal LL_ADC_DELAY_VREFINT_STAB_US. Refer to literal LL_ADC_DELAY_TEMPSENSOR_STAB_US.
- ADC internal channel sampling time constraint: For ADC conversion of internal channels, a sampling time minimum value is required. Refer to device datasheet.

Reference Manual to LL API cross reference:

- CCR VREFEN LL_ADC_SetCommonPathInternalCh
- CCR TSEN LL_ADC_SetCommonPathInternalCh
- CCR VBATEN LL_ADC_SetCommonPathInternalCh

LL_ADC_SetCommonPathInternalChAdd

Function name

__STATIC_INLINE void LL_ADC_SetCommonPathInternalChAdd (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t PathInternal)

Function description

Set parameter common to several ADC: measurement path to internal channels (VrefInt, temperature sensor, ...).

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())
- **PathInternal:** This parameter can be a combination of the following values:
  - LL_ADC_PATH_INTERNAL_NONE
  - LL_ADC_PATH_INTERNAL_VREFINT
  - LL_ADC_PATH_INTERNAL_TEMPSENSOR
  - LL_ADC_PATH_INTERNAL_VBAT

Return values

- **None:**

Notes

- One or several values can be selected. Example: (LL_ADC_PATH_INTERNAL_VREFINT | LL_ADC_PATH_INTERNAL_TEMPSENSOR)
- Stabilization time of measurement path to internal channel: After enabling internal paths, before starting ADC conversion, a delay is required for internal voltage reference and temperature sensor stabilization time. Refer to device datasheet. Refer to literal LL_ADC_DELAY_VREFINT_STAB_US. Refer to literal LL_ADC_DELAY_TEMPSENSOR_STAB_US.
- ADC internal channel sampling time constraint: For ADC conversion of internal channels, a sampling time minimum value is required. Refer to device datasheet.

Reference Manual to LL API cross reference:

- CCR VREFEN LL_ADC_SetCommonPathInternalChAdd
- CCR TSEN LL_ADC_SetCommonPathInternalChAdd
- CCR VBATEN LL_ADC_SetCommonPathInternalChAdd

`LL_ADC_SetCommonPathInternalChRem`

Function name

__STATIC_INLINE void LL_ADC_SetCommonPathInternalChRem (ADC_Common_TypeDef * ADCxy_COMMON, uint32_t PathInternal)

Function description

Set parameter common to several ADC: measurement path to internal channels (VrefInt, temperature sensor, ...).

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())
- **PathInternal:** This parameter can be a combination of the following values:
  - LL_ADC_PATH_INTERNAL_NONE
  - LL_ADC_PATH_INTERNAL_VREFINT
  - LL_ADC_PATH_INTERNAL_TEMPSENSOR
  - LL_ADC_PATH_INTERNAL_VBAT

Return values

- **None:**

Notes

- One or several values can be selected. Example: (LL_ADC_PATH_INTERNAL_VREFINT | LL_ADC_PATH_INTERNAL_TEMPSENSOR)

Reference Manual to LL API cross reference:

- CCR VREFEN LL_ADC_SetCommonPathInternalChRem
- CCR TSEN LL_ADC_SetCommonPathInternalChRem
- CCR VBATEN LL_ADC_SetCommonPathInternalChRem

`LL_ADC_GetCommonPathInternalCh`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetCommonPathInternalCh (ADC_Common_TypeDef * ADCxy_COMMON)

Function description

Get parameter common to several ADC: measurement path to internal channels (VrefInt, temperature sensor, ...).

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())

Return values

- **Returned:** value can be a combination of the following values:
  - LL_ADC_PATH_INTERNAL_NONE
  - LL_ADC_PATH_INTERNAL_VREFINT
  - LL_ADC_PATH_INTERNAL_TEMPSENSOR
  - LL_ADC_PATH_INTERNAL_VBAT

Notes

- One or several values can be selected. Example: (LL_ADC_PATH_INTERNAL_VREFINT | LL_ADC_PATH_INTERNAL_TEMPSENSOR)

Reference Manual to LL API cross reference:

- CCR VREFEN LL_ADC_GetCommonPathInternalCh
- CCR TSEN LL_ADC_GetCommonPathInternalCh
- CCR VBATEN LL_ADC_GetCommonPathInternalCh

`LL_ADC_SetCalibrationFactor`

Function name

__STATIC_INLINE void LL_ADC_SetCalibrationFactor (ADC_TypeDef * ADCx, uint32_t SingleDiff, uint32_t CalibrationFactor)

Function description

Set ADC calibration factor in the mode single-ended or differential (for devices with differential mode available).

Parameters

- **ADCx:** ADC instance
- **SingleDiff:** This parameter can be one of the following values:
  - LL_ADC_SINGLE_ENDED
  - LL_ADC_DIFFERENTIAL_ENDED
  - LL_ADC_BOTH_SINGLE_DIFF_ENDED
- **CalibrationFactor:** Value between Min_Data=0x00 and Max_Data=0x7F

Return values

- **None:**

Notes

- This function is intended to set calibration parameters without having to perform a new calibration using LL_ADC_StartCalibration().
- For devices with differential mode available: Calibration of offset is specific to each of single-ended and differential modes (calibration factor must be specified for each of these differential modes, if used afterwards and if the application requires their calibration).
- In case of setting calibration factors of both modes single ended and differential (parameter LL_ADC_BOTH_SINGLE_DIFF_ENDED): both calibration factors must be concatenated. To perform this processing, use helper macro __LL_ADC_CALIB_FACTOR_SINGLE_DIFF().
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be enabled, without calibration on going, without conversion on going on group regular.

Reference Manual to LL API cross reference:

- CALFACT CALFACT_S LL_ADC_SetCalibrationFactor
- CALFACT CALFACT_D LL_ADC_SetCalibrationFactor

`LL_ADC_GetCalibrationFactor`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetCalibrationFactor (ADC_TypeDef * ADCx, uint32_t SingleDiff)

Function description

Get ADC calibration factor in the mode single-ended or differential (for devices with differential mode available).

Parameters

- **ADCx:** ADC instance
- **SingleDiff:** This parameter can be one of the following values:
  - LL_ADC_SINGLE_ENDED
  - LL_ADC_DIFFERENTIAL_ENDED

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x7F

Notes

- Calibration factors are set by hardware after performing a calibration run using function LL_ADC_StartCalibration().
- For devices with differential mode available: Calibration of offset is specific to each of single-ended and differential modes

Reference Manual to LL API cross reference:

- CALFACT CALFACT_S LL_ADC_GetCalibrationFactor
- CALFACT CALFACT_D LL_ADC_GetCalibrationFactor

`LL_ADC_SetResolution`

Function name

__STATIC_INLINE void LL_ADC_SetResolution (ADC_TypeDef * ADCx, uint32_t Resolution)

Function description

Set ADC resolution.

Parameters

- **ADCx:** ADC instance
- **Resolution:** This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR RES LL_ADC_SetResolution

`LL_ADC_GetResolution`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetResolution (ADC_TypeDef * ADCx)

Function description

Get ADC resolution.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Reference Manual to LL API cross reference:

- CFGR RES LL_ADC_GetResolution

`LL_ADC_SetDataAlignment`

Function name

__STATIC_INLINE void LL_ADC_SetDataAlignment (ADC_TypeDef * ADCx, uint32_t DataAlignment)

Function description

Set ADC conversion data alignment.

Parameters

- **ADCx:** ADC instance
- **DataAlignment:** This parameter can be one of the following values:
  - LL_ADC_DATA_ALIGN_RIGHT
  - LL_ADC_DATA_ALIGN_LEFT

Return values

- **None:**

Notes

- Refer to reference manual for alignments formats dependencies to ADC resolutions.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR ALIGN LL_ADC_SetDataAlignment

`LL_ADC_GetDataAlignment`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetDataAlignment (ADC_TypeDef * ADCx)

Function description

Get ADC conversion data alignment.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_DATA_ALIGN_RIGHT
  - LL_ADC_DATA_ALIGN_LEFT

Notes

- Refer to reference manual for alignments formats dependencies to ADC resolutions.

Reference Manual to LL API cross reference:

- CFGR ALIGN LL_ADC_GetDataAlignment

`LL_ADC_SetLowPowerMode`

Function name

__STATIC_INLINE void LL_ADC_SetLowPowerMode (ADC_TypeDef * ADCx, uint32_t LowPowerMode)

Function description

Set ADC low power mode.

Parameters

- **ADCx:** ADC instance
- **LowPowerMode:** This parameter can be one of the following values:
  - LL_ADC_LP_MODE_NONE
  - LL_ADC_LP_AUTOWAIT

Return values

- **None:**

Notes

- Description of ADC low power modes: ADC low power mode "auto wait": Dynamic low power mode, ADC conversions occurrences are limited to the minimum necessary in order to reduce power consumption. New ADC conversion starts only when the previous unitary conversion data (for ADC group regular) or previous sequence conversions data (for ADC group injected) has been retrieved by user software. In the meantime, ADC remains idle: does not performs any other conversion. This mode allows to automatically adapt the ADC conversions triggers to the speed of the software that reads the data. Moreover, this avoids risk of overrun for low frequency applications. How to use this low power mode: Do not use with interruption or DMA since these modes have to clear immediately the EOC flag to free the IRQ vector sequencer.Do use with polling: 1. Start conversion, 2. Later on, when conversion data is needed: poll for end of conversion to ensure that conversion is completed and retrieve ADC conversion data. This will trig another ADC conversion start. ADC low power mode "auto power-off" (feature available on this device if parameter LL_ADC_LP_AUTOPOWEROFF is available): the ADC automatically powers-off after a conversion and automatically wakes up when a new conversion is triggered (with startup time between trigger and start of sampling). This feature can be combined with low power mode "auto wait".
- With ADC low power mode "auto wait", the ADC conversion data read is corresponding to previous ADC conversion start, independently of delay during which ADC was idle. Therefore, the ADC conversion data may be outdated: does not correspond to the current voltage level on the selected ADC channel.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR AUTDLY LL_ADC_SetLowPowerMode

`LL_ADC_GetLowPowerMode`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetLowPowerMode (ADC_TypeDef * ADCx)

Function description

Get ADC low power mode:

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_LP_MODE_NONE
  - LL_ADC_LP_AUTOWAIT

Notes

- Description of ADC low power modes: ADC low power mode "auto wait": Dynamic low power mode, ADC conversions occurrences are limited to the minimum necessary in order to reduce power consumption. New ADC conversion starts only when the previous unitary conversion data (for ADC group regular) or previous sequence conversions data (for ADC group injected) has been retrieved by user software. In the meantime, ADC remains idle: does not performs any other conversion. This mode allows to automatically adapt the ADC conversions triggers to the speed of the software that reads the data. Moreover, this avoids risk of overrun for low frequency applications. How to use this low power mode: Do not use with interruption or DMA since these modes have to clear immediately the EOC flag to free the IRQ vector sequencer.Do use with polling: 1. Start conversion, 2. Later on, when conversion data is needed: poll for end of conversion to ensure that conversion is completed and retrieve ADC conversion data. This will trig another ADC conversion start. ADC low power mode "auto power-off" (feature available on this device if parameter LL_ADC_LP_AUTOPOWEROFF is available): the ADC automatically powers-off after a conversion and automatically wakes up when a new conversion is triggered (with startup time between trigger and start of sampling). This feature can be combined with low power mode "auto wait".
- With ADC low power mode "auto wait", the ADC conversion data read is corresponding to previous ADC conversion start, independently of delay during which ADC was idle. Therefore, the ADC conversion data may be outdated: does not correspond to the current voltage level on the selected ADC channel.

Reference Manual to LL API cross reference:

- CFGR AUTDLY LL_ADC_GetLowPowerMode

LL_ADC_SetOffset

Function name

__STATIC_INLINE void LL_ADC_SetOffset (ADC_TypeDef * ADCx, uint32_t Offsety, uint32_t Channel, uint32_t OffsetLevel)

Function description

Set ADC selected offset number 1, 2, 3 or 4.

Parameters

- **ADCx:** ADC instance
- **Offsety:** This parameter can be one of the following values:
  - LL_ADC_OFFSET_1
  - LL_ADC_OFFSET_2
  - LL_ADC_OFFSET_3
  - LL_ADC_OFFSET_4
- **Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- **OffsetLevel:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Notes

- This function set the 2 items of offset configuration: ADC channel to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)Offset level (offset to be subtracted from the raw converted data).
- Caution: Offset format is dependent to ADC resolution: offset has to be left-aligned on bit 11, the LSB (right bits) are set to 0.
- This function enables the offset, by default. It can be forced to disable state using function LL_ADC_SetOffsetState().
- If a channel is mapped on several offsets numbers, only the offset with the lowest value is considered for the subtraction.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.
- On STM32L4, some fast channels are available: fast analog inputs coming from GPIO pads (ADC_IN1..5).

Reference Manual to LL API cross reference:

- OFR1 OFFSET1_CH LL_ADC_SetOffset
- OFR1 OFFSET1 LL_ADC_SetOffset
- OFR1 OFFSET1_EN LL_ADC_SetOffset
- OFR2 OFFSET2_CH LL_ADC_SetOffset
- OFR2 OFFSET2 LL_ADC_SetOffset
- OFR2 OFFSET2_EN LL_ADC_SetOffset
- OFR3 OFFSET3_CH LL_ADC_SetOffset
- OFR3 OFFSET3 LL_ADC_SetOffset
- OFR3 OFFSET3_EN LL_ADC_SetOffset
- OFR4 OFFSET4_CH LL_ADC_SetOffset
- OFR4 OFFSET4 LL_ADC_SetOffset
- OFR4 OFFSET4_EN LL_ADC_SetOffset

`LL_ADC_GetOffsetChannel`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOffsetChannel (ADC_TypeDef * ADCx, uint32_t Offsety)

Function description

Get for the ADC selected offset number 1, 2, 3 or 4: Channel to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

Parameters

- **ADCx:** ADC instance
- **Offsety:** This parameter can be one of the following values:
  - LL_ADC_OFFSET_1
  - LL_ADC_OFFSET_2
  - LL_ADC_OFFSET_3
  - LL_ADC_OFFSET_4

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- (1, 2, 3, 4) For ADC channel read back from ADC register, comparison with internal channel parameter to be done using helper macro __LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL().

Notes

- Usage of the returned channel number: To reinject this channel into another function LL_ADC_xxx: the returned channel number is only partly formatted on definition of literals LL_ADC_CHANNEL_x. Therefore, it has to be compared with parts of literals LL_ADC_CHANNEL_x or using helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB(). Then the selected literal LL_ADC_CHANNEL_x can be used as parameter for another function.To get the channel number in decimal format: process the returned value with the helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB().
- On STM32L4, some fast channels are available: fast analog inputs coming from GPIO pads (ADC_IN1..5).

Reference Manual to LL API cross reference:

- OFR1 OFFSET1_CH LL_ADC_GetOffsetChannel
- OFR2 OFFSET2_CH LL_ADC_GetOffsetChannel
- OFR3 OFFSET3_CH LL_ADC_GetOffsetChannel
- OFR4 OFFSET4_CH LL_ADC_GetOffsetChannel

`LL_ADC_GetOffsetLevel`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOffsetLevel (ADC_TypeDef * ADCx, uint32_t Offsety)

Function description

Get for the ADC selected offset number 1, 2, 3 or 4: Offset level (offset to be subtracted from the raw converted data).

Parameters

- **ADCx:** ADC instance
- **Offsety:** This parameter can be one of the following values:
  - LL_ADC_OFFSET_1
  - LL_ADC_OFFSET_2
  - LL_ADC_OFFSET_3
  - LL_ADC_OFFSET_4

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0xFFF

Notes

- Caution: Offset format is dependent to ADC resolution: offset has to be left-aligned on bit 11, the LSB (right bits) are set to 0.

Reference Manual to LL API cross reference:

- OFR1 OFFSET1 LL_ADC_GetOffsetLevel
- OFR2 OFFSET2 LL_ADC_GetOffsetLevel
- OFR3 OFFSET3 LL_ADC_GetOffsetLevel
- OFR4 OFFSET4 LL_ADC_GetOffsetLevel

`LL_ADC_SetOffsetState`

Function name

__STATIC_INLINE void LL_ADC_SetOffsetState (ADC_TypeDef * ADCx, uint32_t Offsety, uint32_t OffsetState)

Function description

Set for the ADC selected offset number 1, 2, 3 or 4: force offset state disable or enable without modifying offset channel or offset value.

Parameters

- **ADCx:** ADC instance
- **Offsety:** This parameter can be one of the following values:
  - LL_ADC_OFFSET_1
  - LL_ADC_OFFSET_2
  - LL_ADC_OFFSET_3
  - LL_ADC_OFFSET_4
- **OffsetState:** This parameter can be one of the following values:
  - LL_ADC_OFFSET_DISABLE
  - LL_ADC_OFFSET_ENABLE

Return values

- **None:**

Notes

- This function should be needed only in case of offset to be enabled-disabled dynamically, and should not be needed in other cases: function LL_ADC_SetOffset() automatically enables the offset.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- OFR1 OFFSET1_EN LL_ADC_SetOffsetState
- OFR2 OFFSET2_EN LL_ADC_SetOffsetState
- OFR3 OFFSET3_EN LL_ADC_SetOffsetState
- OFR4 OFFSET4_EN LL_ADC_SetOffsetState

LL_ADC_GetOffsetState

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOffsetState (ADC_TypeDef * ADCx, uint32_t Offsety)

Function description

Get for the ADC selected offset number 1, 2, 3 or 4: offset state disabled or enabled.

Parameters

- **ADCx:** ADC instance
- **Offsety:** This parameter can be one of the following values:
  - LL_ADC_OFFSET_1
  - LL_ADC_OFFSET_2
  - LL_ADC_OFFSET_3
  - LL_ADC_OFFSET_4

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_OFFSET_DISABLE
  - LL_ADC_OFFSET_ENABLE

Reference Manual to LL API cross reference:

- OFR1 OFFSET1_EN LL_ADC_GetOffsetState
- OFR2 OFFSET2_EN LL_ADC_GetOffsetState
- OFR3 OFFSET3_EN LL_ADC_GetOffsetState
- OFR4 OFFSET4_EN LL_ADC_GetOffsetState

`LL_ADC_SetSamplingTimeCommonConfig`

Function name

__STATIC_INLINE void LL_ADC_SetSamplingTimeCommonConfig (ADC_TypeDef * ADCx, uint32_t SamplingTimeCommonConfig)

Function description

Set ADC sampling time common configuration impacting settings of sampling time channel wise.

Parameters

- **ADCx:** ADC instance
- **SamplingTimeCommonConfig:** This parameter can be one of the following values:
  - LL_ADC_SAMPLINGTIME_COMMON_DEFAULT
  - LL_ADC_SAMPLINGTIME_COMMON_3C5_REPL_2C5

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- SMPR1 SMPPLUS LL_ADC_SetSamplingTimeCommonConfig

`LL_ADC_GetSamplingTimeCommonConfig`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetSamplingTimeCommonConfig (ADC_TypeDef * ADCx)

Function description

Get ADC sampling time common configuration impacting settings of sampling time channel wise.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_SAMPLINGTIME_COMMON_DEFAULT
  - LL_ADC_SAMPLINGTIME_COMMON_3C5_REPL_2C5

Reference Manual to LL API cross reference:

- SMPR1 SMPPLUS LL_ADC_GetSamplingTimeCommonConfig

`LL_ADC_REG_SetTriggerSource`

Function name

__STATIC_INLINE void LL_ADC_REG_SetTriggerSource (ADC_TypeDef * ADCx, uint32_t TriggerSource)

Function description

Set ADC group regular conversion trigger source: internal (SW start) or from external peripheral (timer event, external interrupt line).

Parameters

- **ADCx:** ADC instance
- **TriggerSource:** This parameter can be one of the following values:
  - LL_ADC_REG_TRIG_SOFTWARE
  - LL_ADC_REG_TRIG_EXT_TIM1_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM1_TRGO2
  - LL_ADC_REG_TRIG_EXT_TIM1_CH1
  - LL_ADC_REG_TRIG_EXT_TIM1_CH2
  - LL_ADC_REG_TRIG_EXT_TIM1_CH3
  - LL_ADC_REG_TRIG_EXT_TIM2_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM2_CH2
  - LL_ADC_REG_TRIG_EXT_TIM3_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM3_CH4
  - LL_ADC_REG_TRIG_EXT_TIM4_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM4_CH4
  - LL_ADC_REG_TRIG_EXT_TIM6_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM8_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM8_TRGO2
  - LL_ADC_REG_TRIG_EXT_TIM15_TRGO
  - LL_ADC_REG_TRIG_EXT_EXTI_LINE11

Return values

- **None:**

Notes

- On this STM32 serie, setting trigger source to external trigger also set trigger polarity to rising edge (default setting for compatibility with some ADC on other STM32 families having this setting set by HW default value). In case of need to modify trigger edge, use function LL_ADC_REG_SetTriggerEdge().
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- CFGR EXTSEL LL_ADC_REG_SetTriggerSource
- CFGR EXTEN LL_ADC_REG_SetTriggerSource

LL_ADC_REG_GetTriggerSource

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetTriggerSource (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion trigger source: internal (SW start) or from external peripheral (timer event, external interrupt line).

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_TRIG_SOFTWARE
  - LL_ADC_REG_TRIG_EXT_TIM1_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM1_TRGO2
  - LL_ADC_REG_TRIG_EXT_TIM1_CH1
  - LL_ADC_REG_TRIG_EXT_TIM1_CH2
  - LL_ADC_REG_TRIG_EXT_TIM1_CH3
  - LL_ADC_REG_TRIG_EXT_TIM2_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM2_CH2
  - LL_ADC_REG_TRIG_EXT_TIM3_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM3_CH4
  - LL_ADC_REG_TRIG_EXT_TIM4_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM4_CH4
  - LL_ADC_REG_TRIG_EXT_TIM6_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM8_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM8_TRGO2
  - LL_ADC_REG_TRIG_EXT_TIM15_TRGO
  - LL_ADC_REG_TRIG_EXT_EXTI_LINE11

Notes

- To determine whether group regular trigger source is internal (SW start) or external, without detail of which peripheral is selected as external trigger, (equivalent to "if(LL_ADC_REG_GetTriggerSource(ADC1) == LL_ADC_REG_TRIG_SOFTWARE)") use function LL_ADC_REG_IsTriggerSourceSWStart.
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:

- CFGR EXTSEL LL_ADC_REG_GetTriggerSource
- CFGR EXTEN LL_ADC_REG_GetTriggerSource

LL_ADC_REG_IsTriggerSourceSWStart

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_IsTriggerSourceSWStart (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion trigger source internal (SW start) or external.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** "0" if trigger source external trigger Value "1" if trigger source SW start.

Notes

- In case of group regular trigger source set to external trigger, to determine which peripheral is selected as external trigger, use function LL_ADC_REG_GetTriggerSource().

Reference Manual to LL API cross reference:

- CFGR EXTEN LL_ADC_REG_IsTriggerSourceSWStart

`LL_ADC_REG_SetTriggerEdge`

Function name

__STATIC_INLINE void LL_ADC_REG_SetTriggerEdge (ADC_TypeDef * ADCx, uint32_t ExternalTriggerEdge)

Function description

Set ADC group regular conversion trigger polarity.

Parameters

- **ADCx:** ADC instance
- **ExternalTriggerEdge:** This parameter can be one of the following values:
  - LL_ADC_REG_TRIG_EXT_RISING
  - LL_ADC_REG_TRIG_EXT_FALLING
  - LL_ADC_REG_TRIG_EXT_RISINGFALLING

Return values

- **None:**

Notes

- Applicable only for trigger source set to external trigger.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- CFGR EXTEN LL_ADC_REG_SetTriggerEdge

`LL_ADC_REG_GetTriggerEdge`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetTriggerEdge (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion trigger polarity.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_TRIG_EXT_RISING
  - LL_ADC_REG_TRIG_EXT_FALLING
  - LL_ADC_REG_TRIG_EXT_RISINGFALLING

Notes

- Applicable only for trigger source set to external trigger.

Reference Manual to LL API cross reference:

- CFGR EXTEN LL_ADC_REG_GetTriggerEdge

`LL_ADC_REG_SetSequencerLength`

Function name

__STATIC_INLINE void LL_ADC_REG_SetSequencerLength (ADC_TypeDef * ADCx, uint32_t SequencerNbRanks)

Function description

Set ADC group regular sequencer length and scan direction.

Parameters

- **ADCx:** ADC instance
- **SequencerNbRanks:** This parameter can be one of the following values:
  - LL_ADC_REG_SEQ_SCAN_DISABLE
  - LL_ADC_REG_SEQ_SCAN_ENABLE_2RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_3RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_4RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_5RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_6RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_7RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_8RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_9RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_10RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_11RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_12RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_13RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_14RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_15RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_16RANKS

Return values

- **None:**

Notes

- Description of ADC group regular sequencer features: For devices with sequencer fully configurable (function "LL_ADC_REG_SetSequencerRanks()" available): sequencer length and each rank affectation to a channel are configurable. This function performs configuration of: Sequence length: Number of ranks in the scan sequence.Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerRanks()". For devices with sequencer not fully configurable (function "LL_ADC_REG_SetSequencerChannels()" available): sequencer length and each rank affectation to a channel are defined by channel number. This function performs configuration of: Sequence length: Number of ranks in the scan sequence is defined by number of channels set in the sequence, rank of each channel is fixed by channel HW number. (channel 0 fixed on rank 0, channel 1 fixed on rank1, ...).Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from lowest channel number to highest channel number). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerChannels()".
- Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- SQR1 L LL_ADC_REG_SetSequencerLength

LL_ADC_REG_GetSequencerLength

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetSequencerLength (ADC_TypeDef * ADCx)

Function description

Get ADC group regular sequencer length and scan direction.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_SEQ_SCAN_DISABLE
  - LL_ADC_REG_SEQ_SCAN_ENABLE_2RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_3RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_4RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_5RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_6RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_7RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_8RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_9RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_10RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_11RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_12RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_13RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_14RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_15RANKS
  - LL_ADC_REG_SEQ_SCAN_ENABLE_16RANKS

Notes

- Description of ADC group regular sequencer features: For devices with sequencer fully configurable (function "LL_ADC_REG_SetSequencerRanks()" available): sequencer length and each rank affectation to a channel are configurable. This function retrieves: Sequence length: Number of ranks in the scan sequence.Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerRanks()". For devices with sequencer not fully configurable (function "LL_ADC_REG_SetSequencerChannels()" available): sequencer length and each rank affectation to a channel are defined by channel number. This function retrieves: Sequence length: Number of ranks in the scan sequence is defined by number of channels set in the sequence, rank of each channel is fixed by channel HW number. (channel 0 fixed on rank 0, channel 1 fixed on rank1, ...).Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from lowest channel number to highest channel number). Sequencer ranks are selected using function "LL_ADC_REG_SetSequencerChannels()".
- Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.

Reference Manual to LL API cross reference:

- SQR1 L LL_ADC_REG_GetSequencerLength

LL_ADC_REG_SetSequencerDiscont

Function name

__STATIC_INLINE void LL_ADC_REG_SetSequencerDiscont (ADC_TypeDef * ADCx, uint32_t SeqDiscont)

Function description

Set ADC group regular sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.

Parameters

- **ADCx:** ADC instance
- **SeqDiscont:** This parameter can be one of the following values:
  - LL_ADC_REG_SEQ_DISCONT_DISABLE
  - LL_ADC_REG_SEQ_DISCONT_1RANK
  - LL_ADC_REG_SEQ_DISCONT_2RANKS
  - LL_ADC_REG_SEQ_DISCONT_3RANKS
  - LL_ADC_REG_SEQ_DISCONT_4RANKS
  - LL_ADC_REG_SEQ_DISCONT_5RANKS
  - LL_ADC_REG_SEQ_DISCONT_6RANKS
  - LL_ADC_REG_SEQ_DISCONT_7RANKS
  - LL_ADC_REG_SEQ_DISCONT_8RANKS

Return values

- **None:**

Notes

- It is not possible to enable both ADC group regular continuous mode and sequencer discontinuous mode.
- It is not possible to enable both ADC auto-injected mode and ADC group regular sequencer discontinuous mode.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- CFGR DISCEN LL_ADC_REG_SetSequencerDiscont
- CFGR DISCNUM LL_ADC_REG_SetSequencerDiscont

LL_ADC_REG_GetSequencerDiscont

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetSequencerDiscont (ADC_TypeDef * ADCx)

Function description

Get ADC group regular sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_SEQ_DISCONT_DISABLE
  - LL_ADC_REG_SEQ_DISCONT_1RANK
  - LL_ADC_REG_SEQ_DISCONT_2RANKS
  - LL_ADC_REG_SEQ_DISCONT_3RANKS
  - LL_ADC_REG_SEQ_DISCONT_4RANKS
  - LL_ADC_REG_SEQ_DISCONT_5RANKS
  - LL_ADC_REG_SEQ_DISCONT_6RANKS
  - LL_ADC_REG_SEQ_DISCONT_7RANKS
  - LL_ADC_REG_SEQ_DISCONT_8RANKS

Reference Manual to LL API cross reference:

- CFGR DISCEN LL_ADC_REG_GetSequencerDiscont
- CFGR DISCNUM LL_ADC_REG_GetSequencerDiscont

`LL_ADC_REG_SetSequencerRanks`

Function name

__STATIC_INLINE void LL_ADC_REG_SetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank, uint32_t Channel)

Function description

Set ADC group regular sequence: channel on the selected scan sequence rank.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_REG_RANK_1
  - LL_ADC_REG_RANK_2
  - LL_ADC_REG_RANK_3
  - LL_ADC_REG_RANK_4
  - LL_ADC_REG_RANK_5
  - LL_ADC_REG_RANK_6
  - LL_ADC_REG_RANK_7
  - LL_ADC_REG_RANK_8
  - LL_ADC_REG_RANK_9
  - LL_ADC_REG_RANK_10
  - LL_ADC_REG_RANK_11
  - LL_ADC_REG_RANK_12
  - LL_ADC_REG_RANK_13
  - LL_ADC_REG_RANK_14
  - LL_ADC_REG_RANK_15
  - LL_ADC_REG_RANK_16
- **Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.

- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).

Return values

- **None:**

Notes

- This function performs configuration of: Channels ordering into each rank of scan sequence: whatever channel can be placed into whatever rank.
- On this STM32 serie, ADC group regular sequencer is fully configurable: sequencer length and each rank affectation to a channel are configurable. Refer to description of function LL_ADC_REG_SetSequencerLength().
- Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability.
- On this STM32 serie, to measure internal channels (VrefInt, TempSensor, ...), measurement paths to internal channels must be enabled separately. This can be done using function LL_ADC_SetCommonPathInternalCh().
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- SQR1 SQ1 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ2 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ3 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ4 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ5 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ6 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ7 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ8 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ9 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ10 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ11 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ12 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ13 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ14 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ15 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ16 LL_ADC_REG_SetSequencerRanks

`LL_ADC_REG_GetSequencerRanks`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group regular sequence: channel on the selected scan sequence rank.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_REG_RANK_1
  - LL_ADC_REG_RANK_2
  - LL_ADC_REG_RANK_3
  - LL_ADC_REG_RANK_4
  - LL_ADC_REG_RANK_5
  - LL_ADC_REG_RANK_6
  - LL_ADC_REG_RANK_7
  - LL_ADC_REG_RANK_8
  - LL_ADC_REG_RANK_9
  - LL_ADC_REG_RANK_10
  - LL_ADC_REG_RANK_11
  - LL_ADC_REG_RANK_12
  - LL_ADC_REG_RANK_13
  - LL_ADC_REG_RANK_14
  - LL_ADC_REG_RANK_15
  - LL_ADC_REG_RANK_16

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- (1, 2, 3, 4) For ADC channel read back from ADC register, comparison with internal channel parameter to be done using helper macro __LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL().

Notes

- On this STM32 serie, ADC group regular sequencer is fully configurable: sequencer length and each rank affectation to a channel are configurable. Refer to description of function LL_ADC_REG_SetSequencerLength().
- Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability.
- Usage of the returned channel number: To reinject this channel into another function LL_ADC_xxx: the returned channel number is only partly formatted on definition of literals LL_ADC_CHANNEL_x. Therefore, it has to be compared with parts of literals LL_ADC_CHANNEL_x or using helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB(). Then the selected literal LL_ADC_CHANNEL_x can be used as parameter for another function.To get the channel number in decimal format: process the returned value with the helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB().

Reference Manual to LL API cross reference:

- SQR1 SQ1 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ2 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ3 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ4 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ5 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ6 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ7 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ8 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ9 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ10 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ11 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ12 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ13 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ14 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ15 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ16 LL_ADC_REG_GetSequencerRanks

`LL_ADC_REG_SetContinuousMode`

Function name

__STATIC_INLINE void LL_ADC_REG_SetContinuousMode (ADC_TypeDef * ADCx, uint32_t Continuous)

Function description

Set ADC continuous conversion mode on ADC group regular.

Parameters

- **ADCx:** ADC instance
- **Continuous:** This parameter can be one of the following values:
  - LL_ADC_REG_CONV_SINGLE
  - LL_ADC_REG_CONV_CONTINUOUS

Return values

- **None:**

Notes

- Description of ADC continuous conversion mode: single mode: one conversion per triggercontinuous mode: after the first trigger, following conversions launched successively automatically.
- It is not possible to enable both ADC group regular continuous mode and sequencer discontinuous mode.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- CFGR CONT LL_ADC_REG_SetContinuousMode

`LL_ADC_REG_GetContinuousMode`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetContinuousMode (ADC_TypeDef * ADCx)

Function description

Get ADC continuous conversion mode on ADC group regular.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_CONV_SINGLE
  - LL_ADC_REG_CONV_CONTINUOUS

Notes

- Description of ADC continuous conversion mode: single mode: one conversion per triggercontinuous mode: after the first trigger, following conversions launched successively automatically.

Reference Manual to LL API cross reference:

- CFGR CONT LL_ADC_REG_GetContinuousMode

`LL_ADC_REG_SetDMATransfer`

Function name

__STATIC_INLINE void LL_ADC_REG_SetDMATransfer (ADC_TypeDef * ADCx, uint32_t DMATransfer)

Function description

Set ADC group regular conversion data transfer: no transfer or transfer by DMA, and DMA requests mode.

Parameters

- **ADCx:** ADC instance
- **DMATransfer:** This parameter can be one of the following values:
  - LL_ADC_REG_DMA_TRANSFER_NONE
  - LL_ADC_REG_DMA_TRANSFER_LIMITED
  - LL_ADC_REG_DMA_TRANSFER_UNLIMITED

Return values

- **None:**

Notes

- If transfer by DMA selected, specifies the DMA requests mode: Limited mode (One shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular.Unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transfers (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.
- If ADC DMA requests mode is set to unlimited and DMA is set to mode non-circular: when DMA transfers size will be reached, DMA will stop transfers of ADC conversions data ADC will raise an overrun error (overrun flag and interruption if enabled).
- For devices with several ADC instances: ADC multimode DMA settings are available using function LL_ADC_SetMultiDMATransfer().
- To configure DMA source address (peripheral address), use function LL_ADC_DMA_GetRegAddr().
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR DMAEN LL_ADC_REG_SetDMATransfer
- CFGR DMACFG LL_ADC_REG_SetDMATransfer

LL_ADC_REG_GetDMATransfer

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetDMATransfer (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data transfer: no transfer or transfer by DMA, and DMA requests mode.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_DMA_TRANSFER_NONE
  - LL_ADC_REG_DMA_TRANSFER_LIMITED
  - LL_ADC_REG_DMA_TRANSFER_UNLIMITED

Notes

- If transfer by DMA selected, specifies the DMA requests mode: Limited mode (One shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular.Unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transfers (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.
- If ADC DMA requests mode is set to unlimited and DMA is set to mode non-circular: when DMA transfers size will be reached, DMA will stop transfers of ADC conversions data ADC will raise an overrun error (overrun flag and interruption if enabled).
- For devices with several ADC instances: ADC multimode DMA settings are available using function LL_ADC_GetMultiDMATransfer().
- To configure DMA source address (peripheral address), use function LL_ADC_DMA_GetRegAddr().

Reference Manual to LL API cross reference:

- CFGR DMAEN LL_ADC_REG_GetDMATransfer
- CFGR DMACFG LL_ADC_REG_GetDMATransfer

`LL_ADC_REG_SetDFSDMTransfer`

Function name

__STATIC_INLINE void LL_ADC_REG_SetDFSDMTransfer (ADC_TypeDef * ADCx, uint32_t DFSDMTransfer)

Function description

Set ADC group regular conversion data transfer to DFSDM.

Parameters

- **ADCx:** ADC instance
- **DFSDMTransfer:** This parameter can be one of the following values:
  - LL_ADC_REG_DFSDM_TRANSFER_NONE
  - LL_ADC_REG_DFSDM_TRANSFER_ENABLE

Return values

- **None:**

Notes

- DFSDM transfer cannot be used if DMA transfer is enabled.
- To configure DFSDM source address (peripheral address), use the same function as for DMA transfer: function LL_ADC_DMA_GetRegAddr().
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR DFSDMCFG LL_ADC_REG_GetDFSDMTransfer

`LL_ADC_REG_GetDFSDMTransfer`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetDFSDMTransfer (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data transfer to DFSDM.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_DFSDM_TRANSFER_NONE
  - LL_ADC_REG_DFSDM_TRANSFER_ENABLE

Reference Manual to LL API cross reference:

- CFGR DFSDMCFG LL_ADC_REG_GetDFSDMTransfer

`LL_ADC_REG_SetOverrun`

Function name

__STATIC_INLINE void LL_ADC_REG_SetOverrun (ADC_TypeDef * ADCx, uint32_t Overrun)

Function description

Set ADC group regular behavior in case of overrun: data preserved or overwritten.

Parameters

- **ADCx:** ADC instance
- **Overrun:** This parameter can be one of the following values:
  - LL_ADC_REG_OVR_DATA_PRESERVED
  - LL_ADC_REG_OVR_DATA_OVERWRITTEN

Return values

- **None:**

Notes

- Compatibility with devices without feature overrun: other devices without this feature have a behavior equivalent to data overwritten. The default setting of overrun is data preserved. Therefore, for compatibility with all devices, parameter overrun should be set to data overwritten.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.

Reference Manual to LL API cross reference:

- CFGR OVRMOD LL_ADC_REG_SetOverrun

LL_ADC_REG_GetOverrun

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_GetOverrun (ADC_TypeDef * ADCx)

Function description

Get ADC group regular behavior in case of overrun: data preserved or overwritten.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_REG_OVR_DATA_PRESERVED
  - LL_ADC_REG_OVR_DATA_OVERWRITTEN

Reference Manual to LL API cross reference:

- CFGR OVRMOD LL_ADC_REG_GetOverrun

LL_ADC_INJ_SetTriggerSource

Function name

__STATIC_INLINE void LL_ADC_INJ_SetTriggerSource (ADC_TypeDef * ADCx, uint32_t TriggerSource)

Function description

Set ADC group injected conversion trigger source: internal (SW start) or from external peripheral (timer event, external interrupt line).

Parameters

- **ADCx:** ADC instance
- **TriggerSource:** This parameter can be one of the following values:
  - LL_ADC_INJ_TRIG_SOFTWARE
  - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2
  - LL_ADC_INJ_TRIG_EXT_TIM1_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM2_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH3
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM6_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM8_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2
  - LL_ADC_INJ_TRIG_EXT_TIM15_TRGO
  - LL_ADC_INJ_TRIG_EXT_EXTI_LINE15

Return values

- **None:**

Notes

- On this STM32 serie, setting trigger source to external trigger also set trigger polarity to rising edge (default setting for compatibility with some ADC on other STM32 families having this setting set by HW default value). In case of need to modify trigger edge, use function LL_ADC_INJ_SetTriggerEdge().
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must not be disabled. Can be enabled with or without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- JSQR JEXTSEL LL_ADC_INJ_SetTriggerSource
- JSQR JEXTEN LL_ADC_INJ_SetTriggerSource

`LL_ADC_INJ_GetTriggerSource`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetTriggerSource (ADC_TypeDef * ADCx)

Function description

Get ADC group injected conversion trigger source: internal (SW start) or from external peripheral (timer event, external interrupt line).

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_INJ_TRIG_SOFTWARE
  - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2
  - LL_ADC_INJ_TRIG_EXT_TIM1_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM2_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH3
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM6_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM8_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2
  - LL_ADC_INJ_TRIG_EXT_TIM15_TRGO
  - LL_ADC_INJ_TRIG_EXT_EXTI_LINE15

Notes

- To determine whether group injected trigger source is internal (SW start) or external, without detail of which peripheral is selected as external trigger, (equivalent to "if(LL_ADC_INJ_GetTriggerSource(ADC1) == LL_ADC_INJ_TRIG_SOFTWARE)") use function LL_ADC_INJ_IsTriggerSourceSWStart.
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:

- JSQR JEXTSEL LL_ADC_INJ_GetTriggerSource
- JSQR JEXTEN LL_ADC_INJ_GetTriggerSource

LL_ADC_INJ_IsTriggerSourceSWStart

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_IsTriggerSourceSWStart (ADC_TypeDef * ADCx)

Function description

Get ADC group injected conversion trigger source internal (SW start) or external.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** "0" if trigger source external trigger Value "1" if trigger source SW start.

Notes

- In case of group injected trigger source set to external trigger, to determine which peripheral is selected as external trigger, use function LL_ADC_INJ_GetTriggerSource.

Reference Manual to LL API cross reference:

- JSQR JEXTEN LL_ADC_INJ_IsTriggerSourceSWStart

`LL_ADC_INJ_SetTriggerEdge`

Function name

__STATIC_INLINE void LL_ADC_INJ_SetTriggerEdge (ADC_TypeDef * ADCx, uint32_t ExternalTriggerEdge)

Function description

Set ADC group injected conversion trigger polarity.

Parameters

- **ADCx:** ADC instance
- **ExternalTriggerEdge:** This parameter can be one of the following values:
  - LL_ADC_INJ_TRIG_EXT_RISING
  - LL_ADC_INJ_TRIG_EXT_FALLING
  - LL_ADC_INJ_TRIG_EXT_RISINGFALLING

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must not be disabled. Can be enabled with or without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- JSQR JEXTEN LL_ADC_INJ_SetTriggerEdge

`LL_ADC_INJ_GetTriggerEdge`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetTriggerEdge (ADC_TypeDef * ADCx)

Function description

Get ADC group injected conversion trigger polarity.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_INJ_TRIG_EXT_RISING
  - LL_ADC_INJ_TRIG_EXT_FALLING
  - LL_ADC_INJ_TRIG_EXT_RISINGFALLING

Reference Manual to LL API cross reference:

- JSQR JEXTEN LL_ADC_INJ_GetTriggerEdge

`LL_ADC_INJ_SetSequencerLength`

Function name

__STATIC_INLINE void LL_ADC_INJ_SetSequencerLength (ADC_TypeDef * ADCx, uint32_t SequencerNbRanks)

Function description

Set ADC group injected sequencer length and scan direction.

Parameters

- **ADCx:** ADC instance
- **SequencerNbRanks:** This parameter can be one of the following values:
  - LL_ADC_INJ_SEQ_SCAN_DISABLE
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS

Return values

- **None:**

Notes

- This function performs configuration of: Sequence length: Number of ranks in the scan sequence.Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n).
- Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must not be disabled. Can be enabled with or without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- JSQR JL LL_ADC_INJ_SetSequencerLength

LL_ADC_INJ_GetSequencerLength

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetSequencerLength (ADC_TypeDef * ADCx)

Function description

Get ADC group injected sequencer length and scan direction.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_INJ_SEQ_SCAN_DISABLE
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS

Notes

- This function retrieves: Sequence length: Number of ranks in the scan sequence.Sequence direction: Unless specified in parameters, sequencer scan direction is forward (from rank 1 to rank n).
- Sequencer disabled is equivalent to sequencer of 1 rank: ADC conversion on only 1 channel.

Reference Manual to LL API cross reference:

- JSQR JL LL_ADC_INJ_GetSequencerLength

LL_ADC_INJ_SetSequencerDiscont

Function name

__STATIC_INLINE void LL_ADC_INJ_SetSequencerDiscont (ADC_TypeDef * ADCx, uint32_t SeqDiscont)

Function description

Set ADC group injected sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.

Parameters

- **ADCx:** ADC instance
- **SeqDiscont:** This parameter can be one of the following values:
  - LL_ADC_INJ_SEQ_DISCONT_DISABLE
  - LL_ADC_INJ_SEQ_DISCONT_1RANK

Return values

- **None:**

Notes

- It is not possible to enable both ADC group injected auto-injected mode and sequencer discontinuous mode.

Reference Manual to LL API cross reference:

- CFGR JDISCEN LL_ADC_INJ_SetSequencerDiscont

LL_ADC_INJ_GetSequencerDiscont

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetSequencerDiscont (ADC_TypeDef * ADCx)

Function description

Get ADC group injected sequencer discontinuous mode: sequence subdivided and scan conversions interrupted every selected number of ranks.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_INJ_SEQ_DISCONT_DISABLE
  - LL_ADC_INJ_SEQ_DISCONT_1RANK

Reference Manual to LL API cross reference:

- CFGR JDISCEN LL_ADC_INJ_GetSequencerDiscont

LL_ADC_INJ_SetSequencerRanks

Function name

__STATIC_INLINE void LL_ADC_INJ_SetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank, uint32_t Channel)

Function description

Set ADC group injected sequence: channel on the selected sequence rank.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4
- **Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).

Return values

- **None:**

Notes

- Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability.
- On this STM32 serie, to measure internal channels (VrefInt, TempSensor, ...), measurement paths to internal channels must be enabled separately. This can be done using function LL_ADC_SetCommonPathInternalCh().
- On STM32L4, some fast channels are available: fast analog inputs coming from GPIO pads (ADC_IN1..5).
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must not be disabled. Can be enabled with or without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- JSQR JSQ1 LL_ADC_INJ_SetSequencerRanks
- JSQR JSQ2 LL_ADC_INJ_SetSequencerRanks
- JSQR JSQ3 LL_ADC_INJ_SetSequencerRanks
- JSQR JSQ4 LL_ADC_INJ_SetSequencerRanks

`LL_ADC_INJ_GetSequencerRanks`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetSequencerRanks (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group injected sequence: channel on the selected sequence rank.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- (1, 2, 3, 4) For ADC channel read back from ADC register, comparison with internal channel parameter to be done using helper macro __LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL().

Notes

- Depending on devices and packages, some channels may not be available. Refer to device datasheet for channels availability.
- Usage of the returned channel number: To reinject this channel into another function LL_ADC_xxx: the returned channel number is only partly formatted on definition of literals LL_ADC_CHANNEL_x. Therefore, it has to be compared with parts of literals LL_ADC_CHANNEL_x or using helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB(). Then the selected literal LL_ADC_CHANNEL_x can be used as parameter for another function.To get the channel number in decimal format: process the returned value with the helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB().

Reference Manual to LL API cross reference:

- JSQR JSQ1 LL_ADC_INJ_GetSequencerRanks
- JSQR JSQ2 LL_ADC_INJ_GetSequencerRanks
- JSQR JSQ3 LL_ADC_INJ_GetSequencerRanks
- JSQR JSQ4 LL_ADC_INJ_GetSequencerRanks

`LL_ADC_INJ_SetTrigAuto`

Function name

__STATIC_INLINE void LL_ADC_INJ_SetTrigAuto (ADC_TypeDef * ADCx, uint32_t TrigAuto)

Function description

Set ADC group injected conversion trigger: independent or from ADC group regular.

Parameters

- **ADCx:** ADC instance
- **TrigAuto:** This parameter can be one of the following values:
  - LL_ADC_INJ_TRIG_INDEPENDENT
  - LL_ADC_INJ_TRIG_FROM_GRP_REGULAR

Return values

- **None:**

Notes

- This mode can be used to extend number of data registers updated after one ADC conversion trigger and with data permanently kept (not erased by successive conversions of scan of ADC sequencer ranks), up to 5 data registers: 1 data register on ADC group regular, 4 data registers on ADC group injected.
- If ADC group injected injected trigger source is set to an external trigger, this feature must be must be set to independent trigger. ADC group injected automatic trigger is compliant only with group injected trigger source set to SW start, without any further action on ADC group injected conversion start or stop: in this case, ADC group injected is controlled only from ADC group regular.
- It is not possible to enable both ADC group injected auto-injected mode and sequencer discontinuous mode.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR JAUTO LL_ADC_INJ_SetTrigAuto

`LL_ADC_INJ_GetTrigAuto`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetTrigAuto (ADC_TypeDef * ADCx)

Function description

Get ADC group injected conversion trigger: independent or from ADC group regular.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_INJ_TRIG_INDEPENDENT
  - LL_ADC_INJ_TRIG_FROM_GRP_REGULAR

Reference Manual to LL API cross reference:

- CFGR JAUTO LL_ADC_INJ_GetTrigAuto

`LL_ADC_INJ_SetQueueMode`

Function name

__STATIC_INLINE void LL_ADC_INJ_SetQueueMode (ADC_TypeDef * ADCx, uint32_t QueueMode)

Function description

Set ADC group injected contexts queue mode.

Parameters

- **ADCx:** ADC instance
- **QueueMode:** This parameter can be one of the following values:
  - LL_ADC_INJ_QUEUE_DISABLE
  - LL_ADC_INJ_QUEUE_2CONTEXTS_LAST_ACTIVE
  - LL_ADC_INJ_QUEUE_2CONTEXTS_END_EMPTY

Return values

- **None:**

Notes

- A context is a setting of group injected sequencer: group injected triggersequencer lengthsequencer ranks If contexts queue is disabled:only 1 sequence can be configured and is active perpetually. If contexts queue is enabled:up to 2 contexts can be queued and are checked in and out as a FIFO stack (first-in, first-out).If a new context is set when queues is full, error is triggered by interruption "Injected Queue Overflow".Two behaviors are possible when all contexts have been processed: the contexts queue can maintain the last context active perpetually or can be empty and injected group triggers are disabled.Triggers can be only external (not internal SW start)Caution: The sequence must be fully configured in one time (one write of register JSQR makes a check-in of a new context into the queue). Therefore functions to set separately injected trigger and sequencer channels cannot be used, register JSQR must be set using function LL_ADC_INJ_ConfigQueueContext().
- This parameter can be modified only when no conversion is on going on either groups regular or injected.
- A modification of the context mode (bit JQDIS) causes the contexts queue to be flushed and the register JSQR is cleared.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR JQM LL_ADC_INJ_SetQueueMode
- CFGR JQDIS LL_ADC_INJ_SetQueueMode

`LL_ADC_INJ_GetQueueMode`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_GetQueueMode (ADC_TypeDef * ADCx)

Function description

Get ADC group injected context queue mode.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_INJ_QUEUE_DISABLE
  - LL_ADC_INJ_QUEUE_2CONTEXTS_LAST_ACTIVE
  - LL_ADC_INJ_QUEUE_2CONTEXTS_END_EMPTY

Reference Manual to LL API cross reference:

- CFGR JQM LL_ADC_INJ_GetQueueMode
- CFGR JQDIS LL_ADC_INJ_GetQueueMode

`LL_ADC_INJ_ConfigQueueContext`

Function name

__STATIC_INLINE void LL_ADC_INJ_ConfigQueueContext (ADC_TypeDef * ADCx, uint32_t TriggerSource, uint32_t ExternalTriggerEdge, uint32_t SequencerNbRanks, uint32_t Rank1_Channel, uint32_t Rank2_Channel, uint32_t Rank3_Channel, uint32_t Rank4_Channel)

Function description

Set one context on ADC group injected that will be checked in contexts queue.

Parameters

- **ADCx:** ADC instance
- **TriggerSource:** This parameter can be one of the following values:
  - LL_ADC_INJ_TRIG_SOFTWARE
  - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2
  - LL_ADC_INJ_TRIG_EXT_TIM1_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM2_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH3
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM6_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM8_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2
  - LL_ADC_INJ_TRIG_EXT_TIM15_TRGO
  - LL_ADC_INJ_TRIG_EXT_EXTI_LINE15
- **ExternalTriggerEdge:** This parameter can be one of the following values:
  - LL_ADC_INJ_TRIG_EXT_RISING
  - LL_ADC_INJ_TRIG_EXT_FALLING
  - LL_ADC_INJ_TRIG_EXT_RISINGFALLING

  Note: This parameter is discarded in case of SW start: parameter "TriggerSource" set to "LL_ADC_INJ_TRIG_SOFTWARE".
- **SequencerNbRanks:** This parameter can be one of the following values:
  - LL_ADC_INJ_SEQ_SCAN_DISABLE
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS
  - LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS
- **Rank1_Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16

  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- **Rank2_Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.

- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- **Rank3_Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- **Rank4_Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)

  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.

- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).

Return values

- **None:**

Notes

- A context is a setting of group injected sequencer: group injected triggersequencer lengthsequencer ranks This function is intended to be used when contexts queue is enabled, because the sequence must be fully configured in one time (functions to set separately injected trigger and sequencer channels cannot be used): Refer to function LL_ADC_INJ_SetQueueMode().
- In the contexts queue, only the active context can be read. The parameters of this function can be read using functions: LL_ADC_INJ_GetTriggerSource() LL_ADC_INJ_GetTriggerEdge() LL_ADC_INJ_GetSequencerRanks()
- On this STM32 serie, to measure internal channels (VrefInt, TempSensor, ...), measurement paths to internal channels must be enabled separately. This can be done using function LL_ADC_SetCommonPathInternalCh().
- On STM32L4, some fast channels are available: fast analog inputs coming from GPIO pads (ADC_IN1..5).
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must not be disabled. Can be enabled with or without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- JSQR JEXTSEL LL_ADC_INJ_ConfigQueueContext
- JSQR JEXTEN LL_ADC_INJ_ConfigQueueContext
- JSQR JL LL_ADC_INJ_ConfigQueueContext
- JSQR JSQ1 LL_ADC_INJ_ConfigQueueContext
- JSQR JSQ2 LL_ADC_INJ_ConfigQueueContext
- JSQR JSQ3 LL_ADC_INJ_ConfigQueueContext
- JSQR JSQ4 LL_ADC_INJ_ConfigQueueContext

`LL_ADC_SetChannelSamplingTime`

Function name

__STATIC_INLINE void LL_ADC_SetChannelSamplingTime (ADC_TypeDef * ADCx, uint32_t Channel, uint32_t SamplingTime)

Function description

Set sampling time of the selected ADC channel Unit: ADC clock cycles.

Parameters

- **ADCx:** ADC instance
- **Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).
- **SamplingTime:** This parameter can be one of the following values:
  - LL_ADC_SAMPLINGTIME_2CYCLES_5 (1)
  - LL_ADC_SAMPLINGTIME_6CYCLES_5
  - LL_ADC_SAMPLINGTIME_12CYCLES_5
  - LL_ADC_SAMPLINGTIME_24CYCLES_5
  - LL_ADC_SAMPLINGTIME_47CYCLES_5
  - LL_ADC_SAMPLINGTIME_92CYCLES_5
  - LL_ADC_SAMPLINGTIME_247CYCLES_5
  - LL_ADC_SAMPLINGTIME_640CYCLES_5

(1) On some devices, ADC sampling time 2.5 ADC clock cycles can be replaced by 3.5 ADC clock cycles. Refer to function LL_ADC_SetSamplingTimeCommonConfig().

Return values

- **None:**

Notes

- On this device, sampling time is on channel scope: independently of channel mapped on ADC group regular or injected.
- In case of internal channel (VrefInt, TempSensor, ...) to be converted: sampling time constraints must be respected (sampling time can be adjusted in function of ADC clock frequency and sampling time setting). Refer to device datasheet for timings values (parameters TS_vrefint, TS_temp, ...).
- Conversion time is the addition of sampling time and processing time. On this STM32 serie, ADC processing time is: 12.5 ADC clock cycles at ADC resolution 12 bits10.5 ADC clock cycles at ADC resolution 10 bits8.5 ADC clock cycles at ADC resolution 8 bits6.5 ADC clock cycles at ADC resolution 6 bits
- In case of ADC conversion of internal channel (VrefInt, temperature sensor, ...), a sampling time minimum value is required. Refer to device datasheet.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- SMPR1 SMP0 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP1 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP2 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP3 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP4 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP5 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP6 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP7 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP8 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP9 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP10 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP11 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP12 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP13 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP14 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP15 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP16 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP17 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP18 LL_ADC_SetChannelSamplingTime

LL_ADC_GetChannelSamplingTime

Function name

__STATIC_INLINE uint32_t LL_ADC_GetChannelSamplingTime (ADC_TypeDef * ADCx, uint32_t Channel)

Function description

Get sampling time of the selected ADC channel Unit: ADC clock cycles.

Parameters

- **ADCx:** ADC instance
- **Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

  (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.
- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3.
- (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.
- (7) On STM32L4, fast channel (0.188 us for 12-bit resolution (ADC conversion rate up to 5.33 Ms/s)). Other channels are slow channels (0.238 us for 12-bit resolution (ADC conversion rate up to 4.21 Ms/s)).

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_SAMPLINGTIME_2CYCLES_5 (1)
  - LL_ADC_SAMPLINGTIME_6CYCLES_5
  - LL_ADC_SAMPLINGTIME_12CYCLES_5
  - LL_ADC_SAMPLINGTIME_24CYCLES_5
  - LL_ADC_SAMPLINGTIME_47CYCLES_5
  - LL_ADC_SAMPLINGTIME_92CYCLES_5
  - LL_ADC_SAMPLINGTIME_247CYCLES_5
  - LL_ADC_SAMPLINGTIME_640CYCLES_5

  (1) On some devices, ADC sampling time 2.5 ADC clock cycles can be replaced by 3.5 ADC clock cycles. Refer to function LL_ADC_SetSamplingTimeCommonConfig().

Notes

- On this device, sampling time is on channel scope: independently of channel mapped on ADC group regular or injected.
- Conversion time is the addition of sampling time and processing time. On this STM32 serie, ADC processing time is: 12.5 ADC clock cycles at ADC resolution 12 bits10.5 ADC clock cycles at ADC resolution 10 bits8.5 ADC clock cycles at ADC resolution 8 bits6.5 ADC clock cycles at ADC resolution 6 bits

Reference Manual to LL API cross reference:

- SMPR1 SMP0 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP1 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP2 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP3 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP4 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP5 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP6 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP7 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP8 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP9 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP10 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP11 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP12 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP13 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP14 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP15 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP16 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP17 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP18 LL_ADC_GetChannelSamplingTime

LL_ADC_SetChannelSingleDiff

Function name

__STATIC_INLINE void LL_ADC_SetChannelSingleDiff (ADC_TypeDef * ADCx, uint32_t Channel, uint32_t SingleDiff)

Function description

Set mode single-ended or differential input of the selected ADC channel.

Parameters

- **ADCx:** ADC instance
- **Channel:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_1
  - LL_ADC_CHANNEL_2
  - LL_ADC_CHANNEL_3
  - LL_ADC_CHANNEL_4
  - LL_ADC_CHANNEL_5
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
- **SingleDiff:** This parameter can be a combination of the following values:
  - LL_ADC_SINGLE_ENDED
  - LL_ADC_DIFFERENTIAL_ENDED

Return values

- **None:**

Notes

- Channel ending is on channel scope: independently of channel mapped on ADC group regular or injected. In differential mode: Differential measurement is carried out between the selected channel 'i' (positive input) and channel 'i+1' (negative input). Only channel 'i' has to be configured, channel 'i+1' is configured automatically.
- Refer to Reference Manual to ensure the selected channel is available in differential mode. For example, internal channels (VrefInt, TempSensor, ...) are not available in differential mode.
- When configuring a channel 'i' in differential mode, the channel 'i+1' is not usable separately.
- On STM32L4, channels 16, 17, 18 of ADC1, ADC2, ADC3 (if available) are internally fixed to single-ended inputs configuration.
- For ADC channels configured in differential mode, both inputs should be biased at (Vref+)/2 +/-200mV. (Vref+ is the analog voltage reference)
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled.
- One or several values can be selected. Example: (LL_ADC_CHANNEL_4 | LL_ADC_CHANNEL_12 | ...)

Reference Manual to LL API cross reference:

- DIFSEL DIFSEL LL_ADC_SetChannelSingleDiff

LL_ADC_GetChannelSingleDiff

Function name

__STATIC_INLINE uint32_t LL_ADC_GetChannelSingleDiff (ADC_TypeDef * ADCx, uint32_t Channel)

Function description

Get mode single-ended or differential input of the selected ADC channel.

Parameters

- **ADCx:** ADC instance
- **Channel:** This parameter can be a combination of the following values:
  - LL_ADC_CHANNEL_1
  - LL_ADC_CHANNEL_2
  - LL_ADC_CHANNEL_3
  - LL_ADC_CHANNEL_4
  - LL_ADC_CHANNEL_5
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15

Return values

- **0:** channel in single-ended mode, else: channel in differential mode

Notes

- When configuring a channel 'i' in differential mode, the channel 'i+1' is not usable separately. Therefore, to ensure a channel is configured in single-ended mode, the configuration of channel itself and the channel 'i-1' must be read back (to ensure that the selected channel channel has not been configured in differential mode by the previous channel).
- Refer to Reference Manual to ensure the selected channel is available in differential mode. For example, internal channels (VrefInt, TempSensor, ...) are not available in differential mode.
- When configuring a channel 'i' in differential mode, the channel 'i+1' is not usable separately.
- On STM32L4, channels 16, 17, 18 of ADC1, ADC2, ADC3 (if available) are internally fixed to single-ended inputs configuration.
- One or several values can be selected. In this case, the value returned is null if all channels are in single ended-mode. Example: (LL_ADC_CHANNEL_4 | LL_ADC_CHANNEL_12 | ...)

Reference Manual to LL API cross reference:

- DIFSEL DIFSEL LL_ADC_GetChannelSingleDiff

LL_ADC_SetAnalogWDMonitChannels

Function name

__STATIC_INLINE void LL_ADC_SetAnalogWDMonitChannels (ADC_TypeDef * ADCx, uint32_t AWDy, uint32_t AWDChannelGroup)

Function description

Set ADC analog watchdog monitored channels: a single channel, multiple channels or all channels, on ADC groups regular and-or injected.

Parameters

- **ADCx:** ADC instance
- **AWDy:** This parameter can be one of the following values:
  - LL_ADC_AWD1
  - LL_ADC_AWD2
  - LL_ADC_AWD3
- **AWDChannelGroup:** This parameter can be one of the following values:
  - LL_ADC_AWD_DISABLE
  - LL_ADC_AWD_ALL_CHANNELS_REG (0)
  - LL_ADC_AWD_ALL_CHANNELS_INJ (0)
  - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
  - LL_ADC_AWD_CHANNEL_0_REG (0)
  - LL_ADC_AWD_CHANNEL_0_INJ (0)
  - LL_ADC_AWD_CHANNEL_0_REG_INJ
  - LL_ADC_AWD_CHANNEL_1_REG (0)
  - LL_ADC_AWD_CHANNEL_1_INJ (0)
  - LL_ADC_AWD_CHANNEL_1_REG_INJ
  - LL_ADC_AWD_CHANNEL_2_REG (0)
  - LL_ADC_AWD_CHANNEL_2_INJ (0)
  - LL_ADC_AWD_CHANNEL_2_REG_INJ
  - LL_ADC_AWD_CHANNEL_3_REG (0)
  - LL_ADC_AWD_CHANNEL_3_INJ (0)
  - LL_ADC_AWD_CHANNEL_3_REG_INJ
  - LL_ADC_AWD_CHANNEL_4_REG (0)
  - LL_ADC_AWD_CHANNEL_4_INJ (0)
  - LL_ADC_AWD_CHANNEL_4_REG_INJ
  - LL_ADC_AWD_CHANNEL_5_REG (0)
  - LL_ADC_AWD_CHANNEL_5_INJ (0)
  - LL_ADC_AWD_CHANNEL_5_REG_INJ
  - LL_ADC_AWD_CHANNEL_6_REG (0)
  - LL_ADC_AWD_CHANNEL_6_INJ (0)
  - LL_ADC_AWD_CHANNEL_6_REG_INJ
  - LL_ADC_AWD_CHANNEL_7_REG (0)
  - LL_ADC_AWD_CHANNEL_7_INJ (0)
  - LL_ADC_AWD_CHANNEL_7_REG_INJ
  - LL_ADC_AWD_CHANNEL_8_REG (0)
  - LL_ADC_AWD_CHANNEL_8_INJ (0)
  - LL_ADC_AWD_CHANNEL_8_REG_INJ
  - LL_ADC_AWD_CHANNEL_9_REG (0)
  - LL_ADC_AWD_CHANNEL_9_INJ (0)
  - LL_ADC_AWD_CHANNEL_9_REG_INJ
  - LL_ADC_AWD_CHANNEL_10_REG (0)
  - LL_ADC_AWD_CHANNEL_10_INJ (0)
  - LL_ADC_AWD_CHANNEL_10_REG_INJ
  - LL_ADC_AWD_CHANNEL_11_REG (0)
  - LL_ADC_AWD_CHANNEL_11_INJ (0)
  - LL_ADC_AWD_CHANNEL_11_REG_INJ
  - LL_ADC_AWD_CHANNEL_12_REG (0)
  - LL_ADC_AWD_CHANNEL_12_INJ (0)

- LL_ADC_AWD_CHANNEL_12_REG_INJ
- LL_ADC_AWD_CHANNEL_13_REG (0)
- LL_ADC_AWD_CHANNEL_13_INJ (0)
- LL_ADC_AWD_CHANNEL_13_REG_INJ
- LL_ADC_AWD_CHANNEL_14_REG (0)
- LL_ADC_AWD_CHANNEL_14_INJ (0)
- LL_ADC_AWD_CHANNEL_14_REG_INJ
- LL_ADC_AWD_CHANNEL_15_REG (0)
- LL_ADC_AWD_CHANNEL_15_INJ (0)
- LL_ADC_AWD_CHANNEL_15_REG_INJ
- LL_ADC_AWD_CHANNEL_16_REG (0)
- LL_ADC_AWD_CHANNEL_16_INJ (0)
- LL_ADC_AWD_CHANNEL_16_REG_INJ
- LL_ADC_AWD_CHANNEL_17_REG (0)
- LL_ADC_AWD_CHANNEL_17_INJ (0)
- LL_ADC_AWD_CHANNEL_17_REG_INJ
- LL_ADC_AWD_CHANNEL_18_REG (0)
- LL_ADC_AWD_CHANNEL_18_INJ (0)
- LL_ADC_AWD_CHANNEL_18_REG_INJ
- LL_ADC_AWD_CH_VREFINT_REG (0)(1)
- LL_ADC_AWD_CH_VREFINT_INJ (0)(1)
- LL_ADC_AWD_CH_VREFINT_REG_INJ (1)
- LL_ADC_AWD_CH_TEMPSENSOR_REG (0)(4)
- LL_ADC_AWD_CH_TEMPSENSOR_INJ (0)(4)
- LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ (4)
- LL_ADC_AWD_CH_VBAT_REG (0)(4)
- LL_ADC_AWD_CH_VBAT_INJ (0)(4)
- LL_ADC_AWD_CH_VBAT_REG_INJ (4)
- LL_ADC_AWD_CH_DAC1CH1_REG (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH1_INJ (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH1_REG_INJ (2)(5)
- LL_ADC_AWD_CH_DAC1CH2_REG (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH2_INJ (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH2_REG_INJ (2)(5)
- LL_ADC_AWD_CH_DAC1CH1_ADC2_REG (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC2_INJ (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC2_REG_INJ (2)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC2_REG (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC2_INJ (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC2_REG_INJ (2)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC3_REG (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC3_INJ (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC3_REG_INJ (3)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC3_REG (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC3_INJ (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC3_REG_INJ (3)(6)

(0) On STM32L4, parameter available only on analog watchdog number: AWD1.

- (1) On STM32L4, parameter available only on ADC instance: ADC1.
- (2) On STM32L4, parameter available only on ADC instance: ADC2.

- (3) On STM32L4, parameter available only on ADC instance: ADC3.
- (4) On STM32L4, parameter available only on ADC instances: ADC1, ADC3. (5) On STM32L4, parameter available on devices with only 1 ADC instance.
- (6) On STM32L4, parameter available on devices with several ADC instances.

Return values

- **None:**

Notes

- Once monitored channels are selected, analog watchdog is enabled.
- In case of need to define a single channel to monitor with analog watchdog from sequencer channel definition, use helper macro __LL_ADC_ANALOGWD_CHANNEL_GROUP().
- On this STM32 serie, there are 2 kinds of analog watchdog instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels.groups monitored: ADC groups regular and-or injected.resolution: resolution is not limited (corresponds to ADC resolution configured). AWD flexible (instances AWD2, AWD3): channels monitored: flexible on channels monitored, selection is channel wise, from from 1 to all channels. Specificity of this analog watchdog: Multiple channels can be selected. For example: (LL_ADC_AWD_CHANNEL4_REG_INJ | LL_ADC_AWD_CHANNEL5_REG_INJ | ...)groups monitored: not selection possible (monitoring on both groups regular and injected). Channels selected are monitored on groups regular and injected: LL_ADC_AWD_CHANNELxx_REG_INJ (do not use parameters LL_ADC_AWD_CHANNELxx_REG and LL_ADC_AWD_CHANNELxx_INJ)resolution: resolution is limited to 8 bits: if ADC resolution is 12 bits the 4 LSB are ignored, if ADC resolution is 10 bits the 2 LSB are ignored.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR AWD1CH LL_ADC_SetAnalogWDMonitChannels
- CFGR AWD1SGL LL_ADC_SetAnalogWDMonitChannels
- CFGR AWD1EN LL_ADC_SetAnalogWDMonitChannels
- CFGR JAWD1EN LL_ADC_SetAnalogWDMonitChannels
- AWD2CR AWD2CH LL_ADC_SetAnalogWDMonitChannels
- AWD3CR AWD3CH LL_ADC_SetAnalogWDMonitChannels

LL_ADC_GetAnalogWDMonitChannels

Function name

__STATIC_INLINE uint32_t LL_ADC_GetAnalogWDMonitChannels (ADC_TypeDef * ADCx, uint32_t AWDy)

Function description

Get ADC analog watchdog monitored channel.

Parameters

- **ADCx:** ADC instance
- **AWDy:** This parameter can be one of the following values:
  - LL_ADC_AWD1
  - LL_ADC_AWD2 (1)
  - LL_ADC_AWD3 (1)

  (1) On this AWD number, monitored channel can be retrieved if only 1 channel is programmed (or none or all channels). This function cannot retrieve monitored channel if multiple channels are programmed simultaneously by bitfield.

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_AWD_DISABLE
  - LL_ADC_AWD_ALL_CHANNELS_REG (0)
  - LL_ADC_AWD_ALL_CHANNELS_INJ (0)
  - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
  - LL_ADC_AWD_CHANNEL_0_REG (0)
  - LL_ADC_AWD_CHANNEL_0_INJ (0)
  - LL_ADC_AWD_CHANNEL_0_REG_INJ
  - LL_ADC_AWD_CHANNEL_1_REG (0)
  - LL_ADC_AWD_CHANNEL_1_INJ (0)
  - LL_ADC_AWD_CHANNEL_1_REG_INJ
  - LL_ADC_AWD_CHANNEL_2_REG (0)
  - LL_ADC_AWD_CHANNEL_2_INJ (0)
  - LL_ADC_AWD_CHANNEL_2_REG_INJ
  - LL_ADC_AWD_CHANNEL_3_REG (0)
  - LL_ADC_AWD_CHANNEL_3_INJ (0)
  - LL_ADC_AWD_CHANNEL_3_REG_INJ
  - LL_ADC_AWD_CHANNEL_4_REG (0)
  - LL_ADC_AWD_CHANNEL_4_INJ (0)
  - LL_ADC_AWD_CHANNEL_4_REG_INJ
  - LL_ADC_AWD_CHANNEL_5_REG (0)
  - LL_ADC_AWD_CHANNEL_5_INJ (0)
  - LL_ADC_AWD_CHANNEL_5_REG_INJ
  - LL_ADC_AWD_CHANNEL_6_REG (0)
  - LL_ADC_AWD_CHANNEL_6_INJ (0)
  - LL_ADC_AWD_CHANNEL_6_REG_INJ
  - LL_ADC_AWD_CHANNEL_7_REG (0)
  - LL_ADC_AWD_CHANNEL_7_INJ (0)
  - LL_ADC_AWD_CHANNEL_7_REG_INJ
  - LL_ADC_AWD_CHANNEL_8_REG (0)
  - LL_ADC_AWD_CHANNEL_8_INJ (0)
  - LL_ADC_AWD_CHANNEL_8_REG_INJ
  - LL_ADC_AWD_CHANNEL_9_REG (0)
  - LL_ADC_AWD_CHANNEL_9_INJ (0)
  - LL_ADC_AWD_CHANNEL_9_REG_INJ
  - LL_ADC_AWD_CHANNEL_10_REG (0)
  - LL_ADC_AWD_CHANNEL_10_INJ (0)
  - LL_ADC_AWD_CHANNEL_10_REG_INJ
  - LL_ADC_AWD_CHANNEL_11_REG (0)
  - LL_ADC_AWD_CHANNEL_11_INJ (0)
  - LL_ADC_AWD_CHANNEL_11_REG_INJ
  - LL_ADC_AWD_CHANNEL_12_REG (0)
  - LL_ADC_AWD_CHANNEL_12_INJ (0)
  - LL_ADC_AWD_CHANNEL_12_REG_INJ
  - LL_ADC_AWD_CHANNEL_13_REG (0)
  - LL_ADC_AWD_CHANNEL_13_INJ (0)
  - LL_ADC_AWD_CHANNEL_13_REG_INJ
  - LL_ADC_AWD_CHANNEL_14_REG (0)

- LL_ADC_AWD_CHANNEL_14_INJ (0)
- LL_ADC_AWD_CHANNEL_14_REG_INJ
- LL_ADC_AWD_CHANNEL_15_REG (0)
- LL_ADC_AWD_CHANNEL_15_INJ (0)
- LL_ADC_AWD_CHANNEL_15_REG_INJ
- LL_ADC_AWD_CHANNEL_16_REG (0)
- LL_ADC_AWD_CHANNEL_16_INJ (0)
- LL_ADC_AWD_CHANNEL_16_REG_INJ
- LL_ADC_AWD_CHANNEL_17_REG (0)
- LL_ADC_AWD_CHANNEL_17_INJ (0)
- LL_ADC_AWD_CHANNEL_17_REG_INJ
- LL_ADC_AWD_CHANNEL_18_REG (0)
- LL_ADC_AWD_CHANNEL_18_INJ (0)
- LL_ADC_AWD_CHANNEL_18_REG_INJ

(0) On STM32L4, parameter available only on analog watchdog number: AWD1.

Notes

- Usage of the returned channel number: To reinject this channel into another function LL_ADC_xxx: the returned channel number is only partly formatted on definition of literals LL_ADC_CHANNEL_x. Therefore, it has to be compared with parts of literals LL_ADC_CHANNEL_x or using helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB(). Then the selected literal LL_ADC_CHANNEL_x can be used as parameter for another function.To get the channel number in decimal format: process the returned value with the helper macro __LL_ADC_CHANNEL_TO_DECIMAL_NB(). Applicable only when the analog watchdog is set to monitor one channel.
- On this STM32 serie, there are 2 kinds of analog watchdog instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels.groups monitored: ADC groups regular and-or injected.resolution: resolution is not limited (corresponds to ADC resolution configured). AWD flexible (instances AWD2, AWD3): channels monitored: flexible on channels monitored, selection is channel wise, from from 1 to all channels. Specificity of this analog watchdog: Multiple channels can be selected. For example: (LL_ADC_AWD_CHANNEL4_REG_INJ | LL_ADC_AWD_CHANNEL5_REG_INJ | ...)groups monitored: not selection possible (monitoring on both groups regular and injected). Channels selected are monitored on groups regular and injected: LL_ADC_AWD_CHANNELxx_REG_INJ (do not use parameters LL_ADC_AWD_CHANNELxx_REG and LL_ADC_AWD_CHANNELxx_INJ)resolution: resolution is limited to 8 bits: if ADC resolution is 12 bits the 4 LSB are ignored, if ADC resolution is 10 bits the 2 LSB are ignored.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR AWD1CH LL_ADC_GetAnalogWDMonitChannels
- CFGR AWD1SGL LL_ADC_GetAnalogWDMonitChannels
- CFGR AWD1EN LL_ADC_GetAnalogWDMonitChannels
- CFGR JAWD1EN LL_ADC_GetAnalogWDMonitChannels
- AWD2CR AWD2CH LL_ADC_GetAnalogWDMonitChannels
- AWD3CR AWD3CH LL_ADC_GetAnalogWDMonitChannels

`LL_ADC_ConfigAnalogWDThresholds`

Function name

__STATIC_INLINE void LL_ADC_ConfigAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDy, uint32_t AWDThresholdHighValue, uint32_t AWDThresholdLowValue)

Function description

Set ADC analog watchdog thresholds value of both thresholds high and low.

Parameters

- **ADCx:** ADC instance
- **AWDy:** This parameter can be one of the following values:
  - LL_ADC_AWD1
  - LL_ADC_AWD2
  - LL_ADC_AWD3
- **AWDThresholdHighValue:** Value between Min_Data=0x000 and Max_Data=0xFFF
- **AWDThresholdLowValue:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Notes

- If value of only one threshold high or low must be set, use function LL_ADC_SetAnalogWDThresholds().
- In case of ADC resolution different of 12 bits, analog watchdog thresholds data require a specific shift. Use helper macro __LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION().
- On this STM32 serie, there are 2 kinds of analog watchdog instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels.groups monitored: ADC groups regular and-or injected.resolution: resolution is not limited (corresponds to ADC resolution configured). AWD flexible (instances AWD2, AWD3): channels monitored: flexible on channels monitored, selection is channel wise, from from 1 to all channels. Specificity of this analog watchdog: Multiple channels can be selected. For example: (LL_ADC_AWD_CHANNEL4_REG_INJ | LL_ADC_AWD_CHANNEL5_REG_INJ | ...)groups monitored: not selection possible (monitoring on both groups regular and injected). Channels selected are monitored on groups regular and injected: LL_ADC_AWD_CHANNELxx_REG_INJ (do not use parameters LL_ADC_AWD_CHANNELxx_REG and LL_ADC_AWD_CHANNELxx_INJ)resolution: resolution is limited to 8 bits: if ADC resolution is 12 bits the 4 LSB are ignored, if ADC resolution is 10 bits the 2 LSB are ignored.
- If ADC oversampling is enabled, ADC analog watchdog thresholds are impacted: the comparison of analog watchdog thresholds is done on oversampling final computation (after ratio and shift application): ADC data register bitfield [15:4] (12 most significant bits).
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- TR1 HT1 LL_ADC_ConfigAnalogWDThresholds
- TR2 HT2 LL_ADC_ConfigAnalogWDThresholds
- TR3 HT3 LL_ADC_ConfigAnalogWDThresholds
- TR1 LT1 LL_ADC_ConfigAnalogWDThresholds
- TR2 LT2 LL_ADC_ConfigAnalogWDThresholds
- TR3 LT3 LL_ADC_ConfigAnalogWDThresholds

LL_ADC_SetAnalogWDThresholds

Function name

__STATIC_INLINE void LL_ADC_SetAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDy, uint32_t AWDThresholdsHighLow, uint32_t AWDThresholdValue)

Function description

Set ADC analog watchdog threshold value of threshold high or low.

Parameters

- **ADCx:** ADC instance
- **AWDy:** This parameter can be one of the following values:
  - LL_ADC_AWD1
  - LL_ADC_AWD2
  - LL_ADC_AWD3
- **AWDThresholdsHighLow:** This parameter can be one of the following values:
  - LL_ADC_AWD_THRESHOLD_HIGH
  - LL_ADC_AWD_THRESHOLD_LOW
- **AWDThresholdValue:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Notes

- If values of both thresholds high or low must be set, use function LL_ADC_ConfigAnalogWDThresholds().
- In case of ADC resolution different of 12 bits, analog watchdog thresholds data require a specific shift. Use helper macro __LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION().
- On this STM32 serie, there are 2 kinds of analog watchdog instance: AWD standard (instance AWD1): channels monitored: can monitor 1 channel or all channels.groups monitored: ADC groups regular and-or injected.resolution: resolution is not limited (corresponds to ADC resolution configured). AWD flexible (instances AWD2, AWD3): channels monitored: flexible on channels monitored, selection is channel wise, from from 1 to all channels. Specificity of this analog watchdog: Multiple channels can be selected. For example: (LL_ADC_AWD_CHANNEL4_REG_INJ | LL_ADC_AWD_CHANNEL5_REG_INJ | ...)groups monitored: not selection possible (monitoring on both groups regular and injected). Channels selected are monitored on groups regular and injected: LL_ADC_AWD_CHANNELxx_REG_INJ (do not use parameters LL_ADC_AWD_CHANNELxx_REG and LL_ADC_AWD_CHANNELxx_INJ)resolution: resolution is limited to 8 bits: if ADC resolution is 12 bits the 4 LSB are ignored, if ADC resolution is 10 bits the 2 LSB are ignored.
- If ADC oversampling is enabled, ADC analog watchdog thresholds are impacted: the comparison of analog watchdog thresholds is done on oversampling final computation (after ratio and shift application): ADC data register bitfield [15:4] (12 most significant bits).
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either ADC groups regular or injected.

Reference Manual to LL API cross reference:

- TR1 HT1 LL_ADC_SetAnalogWDThresholds
- TR2 HT2 LL_ADC_SetAnalogWDThresholds
- TR3 HT3 LL_ADC_SetAnalogWDThresholds
- TR1 LT1 LL_ADC_SetAnalogWDThresholds
- TR2 LT2 LL_ADC_SetAnalogWDThresholds
- TR3 LT3 LL_ADC_SetAnalogWDThresholds

LL_ADC_GetAnalogWDThresholds

Function name

__STATIC_INLINE uint32_t LL_ADC_GetAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDy, uint32_t AWDThresholdsHighLow)

Function description

Get ADC analog watchdog threshold value of threshold high, threshold low or raw data with ADC thresholds high and low concatenated.

Parameters

- **ADCx:** ADC instance
- **AWDy:** This parameter can be one of the following values:
  - LL_ADC_AWD1
  - LL_ADC_AWD2
  - LL_ADC_AWD3
- **AWDThresholdsHighLow:** This parameter can be one of the following values:
  - LL_ADC_AWD_THRESHOLD_HIGH
  - LL_ADC_AWD_THRESHOLD_LOW
  - LL_ADC_AWD_THRESHOLDS_HIGH_LOW

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0xFFF

Notes

- If raw data with ADC thresholds high and low is retrieved, the data of each threshold high or low can be isolated using helper macro: __LL_ADC_ANALOGWD_THRESHOLDS_HIGH_LOW().
- In case of ADC resolution different of 12 bits, analog watchdog thresholds data require a specific shift. Use helper macro __LL_ADC_ANALOGWD_GET_THRESHOLD_RESOLUTION().

Reference Manual to LL API cross reference:

- TR1 HT1 LL_ADC_GetAnalogWDThresholds
- TR2 HT2 LL_ADC_GetAnalogWDThresholds
- TR3 HT3 LL_ADC_GetAnalogWDThresholds
- TR1 LT1 LL_ADC_GetAnalogWDThresholds
- TR2 LT2 LL_ADC_GetAnalogWDThresholds
- TR3 LT3 LL_ADC_GetAnalogWDThresholds

`LL_ADC_SetOverSamplingScope`

Function name

__STATIC_INLINE void LL_ADC_SetOverSamplingScope (ADC_TypeDef * ADCx, uint32_t OvsScope)

Function description

Set ADC oversampling scope: ADC groups regular and-or injected (availability of ADC group injected depends on STM32 families).

Parameters

- **ADCx:** ADC instance
- **OvsScope:** This parameter can be one of the following values:
  - LL_ADC_OVS_DISABLE
  - LL_ADC_OVS_GRP_REGULAR_CONTINUED
  - LL_ADC_OVS_GRP_REGULAR_RESUMED
  - LL_ADC_OVS_GRP_INJECTED
  - LL_ADC_OVS_GRP_INJ_REG_RESUMED

Return values

- **None:**

Notes

- If both groups regular and injected are selected, specify behavior of ADC group injected interrupting group regular: when ADC group injected is triggered, the oversampling on ADC group regular is either temporary stopped and continued, or resumed from start (oversampler buffer reset).
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR2 ROVSE LL_ADC_SetOverSamplingScope
- CFGR2 JOVSE LL_ADC_SetOverSamplingScope
- CFGR2 ROVSM LL_ADC_SetOverSamplingScope

LL_ADC_GetOverSamplingScope

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOverSamplingScope (ADC_TypeDef * ADCx)

Function description

Get ADC oversampling scope: ADC groups regular and-or injected (availability of ADC group injected depends on STM32 families).

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_OVS_DISABLE
  - LL_ADC_OVS_GRP_REGULAR_CONTINUED
  - LL_ADC_OVS_GRP_REGULAR_RESUMED
  - LL_ADC_OVS_GRP_INJECTED
  - LL_ADC_OVS_GRP_INJ_REG_RESUMED

Notes

- If both groups regular and injected are selected, specify behavior of ADC group injected interrupting group regular: when ADC group injected is triggered, the oversampling on ADC group regular is either temporary stopped and continued, or resumed from start (oversampler buffer reset).

Reference Manual to LL API cross reference:

- CFGR2 ROVSE LL_ADC_GetOverSamplingScope
- CFGR2 JOVSE LL_ADC_GetOverSamplingScope
- CFGR2 ROVSM LL_ADC_GetOverSamplingScope

LL_ADC_SetOverSamplingDiscont

Function name

__STATIC_INLINE void LL_ADC_SetOverSamplingDiscont (ADC_TypeDef * ADCx, uint32_t OverSamplingDiscont)

Function description

Set ADC oversampling discontinuous mode (triggered mode) on the selected ADC group.

Parameters

- **ADCx:** ADC instance
- **OverSamplingDiscont:** This parameter can be one of the following values:
  - LL_ADC_OVS_REG_CONT
  - LL_ADC_OVS_REG_DISCONT

Return values

- **None:**

Notes

- Number of oversampled conversions are done either in: continuous mode (all conversions of oversampling ratio are done from 1 trigger)discontinuous mode (each conversion of oversampling ratio needs a trigger)
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on group regular.
- On this STM32 serie, oversampling discontinuous mode (triggered mode) can be used only when oversampling is set on group regular only and in resumed mode.

Reference Manual to LL API cross reference:

- CFGR2 TROVS LL_ADC_SetOverSamplingDiscont

`LL_ADC_GetOverSamplingDiscont`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOverSamplingDiscont (ADC_TypeDef * ADCx)

Function description

Get ADC oversampling discontinuous mode (triggered mode) on the selected ADC group.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_OVS_REG_CONT
  - LL_ADC_OVS_REG_DISCONT

Notes

- Number of oversampled conversions are done either in: continuous mode (all conversions of oversampling ratio are done from 1 trigger)discontinuous mode (each conversion of oversampling ratio needs a trigger)

Reference Manual to LL API cross reference:

- CFGR2 TROVS LL_ADC_GetOverSamplingDiscont

`LL_ADC_ConfigOverSamplingRatioShift`

Function name

__STATIC_INLINE void LL_ADC_ConfigOverSamplingRatioShift (ADC_TypeDef * ADCx, uint32_t Ratio, uint32_t Shift)

Function description

Set ADC oversampling (impacting both ADC groups regular and injected)

Parameters

- **ADCx:** ADC instance
- **Ratio:** This parameter can be one of the following values:
  - LL_ADC_OVS_RATIO_2
  - LL_ADC_OVS_RATIO_4
  - LL_ADC_OVS_RATIO_8
  - LL_ADC_OVS_RATIO_16
  - LL_ADC_OVS_RATIO_32
  - LL_ADC_OVS_RATIO_64
  - LL_ADC_OVS_RATIO_128
  - LL_ADC_OVS_RATIO_256
- **Shift:** This parameter can be one of the following values:
  - LL_ADC_OVS_SHIFT_NONE
  - LL_ADC_OVS_SHIFT_RIGHT_1
  - LL_ADC_OVS_SHIFT_RIGHT_2
  - LL_ADC_OVS_SHIFT_RIGHT_3
  - LL_ADC_OVS_SHIFT_RIGHT_4
  - LL_ADC_OVS_SHIFT_RIGHT_5
  - LL_ADC_OVS_SHIFT_RIGHT_6
  - LL_ADC_OVS_SHIFT_RIGHT_7
  - LL_ADC_OVS_SHIFT_RIGHT_8

Return values

- **None:**

Notes

- This function set the 2 items of oversampling configuration: ratioshift
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be disabled or enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CFGR2 OVSS LL_ADC_ConfigOverSamplingRatioShift
- CFGR2 OVSR LL_ADC_ConfigOverSamplingRatioShift

LL_ADC_GetOverSamplingRatio

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOverSamplingRatio (ADC_TypeDef * ADCx)

Function description

Get ADC oversampling ratio (impacting both ADC groups regular and injected)

Parameters

- **ADCx:** ADC instance

Return values

- **Ratio:** This parameter can be one of the following values:
  - LL_ADC_OVS_RATIO_2
  - LL_ADC_OVS_RATIO_4
  - LL_ADC_OVS_RATIO_8
  - LL_ADC_OVS_RATIO_16
  - LL_ADC_OVS_RATIO_32
  - LL_ADC_OVS_RATIO_64
  - LL_ADC_OVS_RATIO_128
  - LL_ADC_OVS_RATIO_256

Reference Manual to LL API cross reference:

- CFGR2 OVSR LL_ADC_GetOverSamplingRatio

`LL_ADC_GetOverSamplingShift`

Function name

__STATIC_INLINE uint32_t LL_ADC_GetOverSamplingShift (ADC_TypeDef * ADCx)

Function description

Get ADC oversampling shift (impacting both ADC groups regular and injected)

Parameters

- **ADCx:** ADC instance

Return values

- **Shift:** This parameter can be one of the following values:
  - LL_ADC_OVS_SHIFT_NONE
  - LL_ADC_OVS_SHIFT_RIGHT_1
  - LL_ADC_OVS_SHIFT_RIGHT_2
  - LL_ADC_OVS_SHIFT_RIGHT_3
  - LL_ADC_OVS_SHIFT_RIGHT_4
  - LL_ADC_OVS_SHIFT_RIGHT_5
  - LL_ADC_OVS_SHIFT_RIGHT_6
  - LL_ADC_OVS_SHIFT_RIGHT_7
  - LL_ADC_OVS_SHIFT_RIGHT_8

Reference Manual to LL API cross reference:

- CFGR2 OVSS LL_ADC_GetOverSamplingShift

`LL_ADC_REG_SetTrigSource`

Function name

__STATIC_INLINE void LL_ADC_REG_SetTrigSource (ADC_TypeDef * ADCx, uint32_t TriggerSource)

Function description

`LL_ADC_INJ_SetTrigSource`

Function name

__STATIC_INLINE void LL_ADC_INJ_SetTrigSource (ADC_TypeDef * ADCx, uint32_t TriggerSource)

Function description

`LL_ADC_EnableDeepPowerDown`

Function name

__STATIC_INLINE void LL_ADC_EnableDeepPowerDown (ADC_TypeDef * ADCx)

Function description

Put ADC instance in deep power down state.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- In case of ADC calibration necessary: When ADC is in deep-power-down state, the internal analog calibration is lost. After exiting from deep power down, calibration must be relaunched or calibration factor (preliminarily saved) must be set back into calibration register.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled.

Reference Manual to LL API cross reference:

- CR DEEPPWD LL_ADC_EnableDeepPowerDown

`LL_ADC_DisableDeepPowerDown`

Function name

__STATIC_INLINE void LL_ADC_DisableDeepPowerDown (ADC_TypeDef * ADCx)

Function description

Disable ADC deep power down mode.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- In case of ADC calibration necessary: When ADC is in deep-power-down state, the internal analog calibration is lost. After exiting from deep power down, calibration must be relaunched or calibration factor (preliminarily saved) must be set back into calibration register.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled.

Reference Manual to LL API cross reference:

- CR DEEPPWD LL_ADC_DisableDeepPowerDown

`LL_ADC_IsDeepPowerDownEnabled`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsDeepPowerDownEnabled (ADC_TypeDef * ADCx)

Function description

Get the selected ADC instance deep power down state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** deep power down is disabled, 1: deep power down is enabled.

Reference Manual to LL API cross reference:

- CR DEEPPWD LL_ADC_IsDeepPowerDownEnabled

`LL_ADC_EnableInternalRegulator`

Function name

__STATIC_INLINE void LL_ADC_EnableInternalRegulator (ADC_TypeDef * ADCx)

Function description

Enable ADC instance internal voltage regulator.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, after ADC internal voltage regulator enable, a delay for ADC internal voltage regulator stabilization is required before performing a ADC calibration or ADC enable. Refer to device datasheet, parameter tADCVREG_STUP. Refer to literal LL_ADC_DELAY_INTERNAL_REGUL_STAB_US.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled.

Reference Manual to LL API cross reference:

- CR ADVREGEN LL_ADC_EnableInternalRegulator

`LL_ADC_DisableInternalRegulator`

Function name

__STATIC_INLINE void LL_ADC_DisableInternalRegulator (ADC_TypeDef * ADCx)

Function description

Disable ADC internal voltage regulator.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled.

Reference Manual to LL API cross reference:

- CR ADVREGEN LL_ADC_DisableInternalRegulator

`LL_ADC_IsInternalRegulatorEnabled`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsInternalRegulatorEnabled (ADC_TypeDef * ADCx)

Function description

Get the selected ADC instance internal voltage regulator state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** internal regulator is disabled, 1: internal regulator is enabled.

Reference Manual to LL API cross reference:

- CR ADVREGEN LL_ADC_IsInternalRegulatorEnabled

`LL_ADC_Enable`

Function name

__STATIC_INLINE void LL_ADC_Enable (ADC_TypeDef * ADCx)

Function description

Enable the selected ADC instance.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, after ADC enable, a delay for ADC internal analog stabilization is required before performing a ADC conversion start. Refer to device datasheet, parameter tSTAB.
- On this STM32 serie, flag LL_ADC_FLAG_ADRDY is raised when the ADC is enabled and when conversion clock is active. (not only core clock: this ADC has a dual clock domain)
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled and ADC internal voltage regulator enabled.

Reference Manual to LL API cross reference:

- CR ADEN LL_ADC_Enable

`LL_ADC_Disable`

Function name

__STATIC_INLINE void LL_ADC_Disable (ADC_TypeDef * ADCx)

Function description

Disable the selected ADC instance.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be not disabled. Must be enabled without conversion on going on either groups regular or injected.

Reference Manual to LL API cross reference:

- CR ADDIS LL_ADC_Disable

`LL_ADC_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabled (ADC_TypeDef * ADCx)

Function description

Get the selected ADC instance enable state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** ADC is disabled, 1: ADC is enabled.

Notes

- On this STM32 serie, flag LL_ADC_FLAG_ADRDY is raised when the ADC is enabled and when conversion clock is active. (not only core clock: this ADC has a dual clock domain)

Reference Manual to LL API cross reference:

- CR ADEN LL_ADC_IsEnabled

`LL_ADC_IsDisableOngoing`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsDisableOngoing (ADC_TypeDef * ADCx)

Function description

Get the selected ADC instance disable state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** no ADC disable command on going.

Reference Manual to LL API cross reference:

- CR ADDIS LL_ADC_IsDisableOngoing

`LL_ADC_StartCalibration`

Function name

__STATIC_INLINE void LL_ADC_StartCalibration (ADC_TypeDef * ADCx, uint32_t SingleDiff)

Function description

Start ADC calibration in the mode single-ended or differential (for devices with differential mode available).

Parameters

- **ADCx:** ADC instance
- **SingleDiff:** This parameter can be one of the following values:
  - LL_ADC_SINGLE_ENDED
  - LL_ADC_DIFFERENTIAL_ENDED

Return values

- **None:**

Notes

- On this STM32 serie, a minimum number of ADC clock cycles are required between ADC end of calibration and ADC enable. Refer to literal LL_ADC_DELAY_CALIB_ENABLE_ADC_CYCLES.
- For devices with differential mode available: Calibration of offset is specific to each of single-ended and differential modes (calibration run must be performed for each of these differential modes, if used afterwards and if the application requires their calibration).
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be ADC disabled.

Reference Manual to LL API cross reference:

- CR ADCAL LL_ADC_StartCalibration
- CR ADCALDIF LL_ADC_StartCalibration

`LL_ADC_IsCalibrationOnGoing`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsCalibrationOnGoing (ADC_TypeDef * ADCx)

Function description

Get ADC calibration state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** calibration complete, 1: calibration in progress.

Reference Manual to LL API cross reference:

- CR ADCAL LL_ADC_IsCalibrationOnGoing

`LL_ADC_REG_StartConversion`

Function name

__STATIC_INLINE void LL_ADC_REG_StartConversion (ADC_TypeDef * ADCx)

Function description

Start ADC group regular conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, this function is relevant for both internal trigger (SW start) and external trigger: If ADC trigger has been set to software start, ADC conversion starts immediately.If ADC trigger has been set to external trigger, ADC conversion will start at next trigger event (on the selected trigger edge) following the ADC start conversion command.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be enabled without conversion on going on group regular, without conversion stop command on going on group regular, without ADC disable command on going.

Reference Manual to LL API cross reference:

- CR ADSTART LL_ADC_REG_StartConversion

`LL_ADC_REG_StopConversion`

Function name

__STATIC_INLINE void LL_ADC_REG_StopConversion (ADC_TypeDef * ADCx)

Function description

Stop ADC group regular conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be enabled with conversion on going on group regular, without ADC disable command on going.

Reference Manual to LL API cross reference:

- CR ADSTP LL_ADC_REG_StopConversion

`LL_ADC_REG_IsConversionOngoing`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_IsConversionOngoing (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** no conversion is on going on ADC group regular.

Reference Manual to LL API cross reference:

- CR ADSTART LL_ADC_REG_IsConversionOngoing

`LL_ADC_REG_IsStopConversionOngoing`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_IsStopConversionOngoing (ADC_TypeDef * ADCx)

Function description

Get ADC group regular command of conversion stop state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** no command of conversion stop is on going on ADC group regular.

Reference Manual to LL API cross reference:

- CR ADSTP LL_ADC_REG_IsStopConversionOngoing

`LL_ADC_REG_ReadConversionData32`

Function name

__STATIC_INLINE uint32_t LL_ADC_REG_ReadConversionData32 (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data, range fit for all ADC configurations: all ADC resolutions and all oversampling increased data width (for devices with feature oversampling).

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- DR RDATA LL_ADC_REG_ReadConversionData32

`LL_ADC_REG_ReadConversionData12`

Function name

__STATIC_INLINE uint16_t LL_ADC_REG_ReadConversionData12 (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data, range fit for ADC resolution 12 bits.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0xFFF

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32.

Reference Manual to LL API cross reference:

- DR RDATA LL_ADC_REG_ReadConversionData12

`LL_ADC_REG_ReadConversionData10`

Function name

__STATIC_INLINE uint16_t LL_ADC_REG_ReadConversionData10 (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data, range fit for ADC resolution 10 bits.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0x3FF

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32.

Reference Manual to LL API cross reference:

- DR RDATA LL_ADC_REG_ReadConversionData10

`LL_ADC_REG_ReadConversionData8`

Function name

__STATIC_INLINE uint8_t LL_ADC_REG_ReadConversionData8 (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data, range fit for ADC resolution 8 bits.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32.

Reference Manual to LL API cross reference:

- DR RDATA LL_ADC_REG_ReadConversionData8

`LL_ADC_REG_ReadConversionData6`

Function name

__STATIC_INLINE uint8_t LL_ADC_REG_ReadConversionData6 (ADC_TypeDef * ADCx)

Function description

Get ADC group regular conversion data, range fit for ADC resolution 6 bits.

Parameters

- **ADCx:** ADC instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x3F

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_REG_ReadConversionData32.

Reference Manual to LL API cross reference:

- DR RDATA LL_ADC_REG_ReadConversionData6

`LL_ADC_INJ_StartConversion`

Function name

__STATIC_INLINE void LL_ADC_INJ_StartConversion (ADC_TypeDef * ADCx)

Function description

Start ADC group injected conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, this function is relevant for both internal trigger (SW start) and external trigger: If ADC trigger has been set to software start, ADC conversion starts immediately.If ADC trigger has been set to external trigger, ADC conversion will start at next trigger event (on the selected trigger edge) following the ADC start conversion command.
- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be enabled without conversion on going on group injected, without conversion stop command on going on group injected, without ADC disable command on going.

Reference Manual to LL API cross reference:

- CR JADSTART LL_ADC_INJ_StartConversion

`LL_ADC_INJ_StopConversion`

Function name

__STATIC_INLINE void LL_ADC_INJ_StopConversion (ADC_TypeDef * ADCx)

Function description

Stop ADC group injected conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, setting of this feature is conditioned to ADC state: ADC must be enabled with conversion on going on group injected, without ADC disable command on going.

Reference Manual to LL API cross reference:

- CR JADSTP LL_ADC_INJ_StopConversion

`LL_ADC_INJ_IsConversionOngoing`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_IsConversionOngoing (ADC_TypeDef * ADCx)

Function description

Get ADC group injected conversion state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** no conversion is on going on ADC group injected.

Reference Manual to LL API cross reference:

- CR JADSTART LL_ADC_INJ_IsConversionOngoing

`LL_ADC_INJ_IsStopConversionOngoing`

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_IsStopConversionOngoing (ADC_TypeDef * ADCx)

Function description

Get ADC group injected command of conversion stop state.

Parameters

- **ADCx:** ADC instance

Return values

- **0:** no command of conversion stop is on going on ADC group injected.

Reference Manual to LL API cross reference:

- CR JADSTP LL_ADC_INJ_IsStopConversionOngoing

LL_ADC_INJ_ReadConversionData32

Function name

__STATIC_INLINE uint32_t LL_ADC_INJ_ReadConversionData32 (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group injected conversion data, range fit for all ADC configurations: all ADC resolutions and all oversampling increased data width (for devices with feature oversampling).

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4

Return values

- **Value:** between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- JDR1 JDATA LL_ADC_INJ_ReadConversionData32
- JDR2 JDATA LL_ADC_INJ_ReadConversionData32
- JDR3 JDATA LL_ADC_INJ_ReadConversionData32
- JDR4 JDATA LL_ADC_INJ_ReadConversionData32

LL_ADC_INJ_ReadConversionData12

Function name

__STATIC_INLINE uint16_t LL_ADC_INJ_ReadConversionData12 (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group injected conversion data, range fit for ADC resolution 12 bits.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0xFFF

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.

Reference Manual to LL API cross reference:

- JDR1 JDATA LL_ADC_INJ_ReadConversionData12
- JDR2 JDATA LL_ADC_INJ_ReadConversionData12
- JDR3 JDATA LL_ADC_INJ_ReadConversionData12
- JDR4 JDATA LL_ADC_INJ_ReadConversionData12

LL_ADC_INJ_ReadConversionData10

Function name

__STATIC_INLINE uint16_t LL_ADC_INJ_ReadConversionData10 (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group injected conversion data, range fit for ADC resolution 10 bits.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0x3FF

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.

Reference Manual to LL API cross reference:

- JDR1 JDATA LL_ADC_INJ_ReadConversionData10
- JDR2 JDATA LL_ADC_INJ_ReadConversionData10
- JDR3 JDATA LL_ADC_INJ_ReadConversionData10
- JDR4 JDATA LL_ADC_INJ_ReadConversionData10

LL_ADC_INJ_ReadConversionData8

Function name

__STATIC_INLINE uint8_t LL_ADC_INJ_ReadConversionData8 (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group injected conversion data, range fit for ADC resolution 8 bits.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.

Reference Manual to LL API cross reference:

- JDR1 JDATA LL_ADC_INJ_ReadConversionData8
- JDR2 JDATA LL_ADC_INJ_ReadConversionData8
- JDR3 JDATA LL_ADC_INJ_ReadConversionData8
- JDR4 JDATA LL_ADC_INJ_ReadConversionData8

LL_ADC_INJ_ReadConversionData6

Function name

__STATIC_INLINE uint8_t LL_ADC_INJ_ReadConversionData6 (ADC_TypeDef * ADCx, uint32_t Rank)

Function description

Get ADC group injected conversion data, range fit for ADC resolution 6 bits.

Parameters

- **ADCx:** ADC instance
- **Rank:** This parameter can be one of the following values:
  - LL_ADC_INJ_RANK_1
  - LL_ADC_INJ_RANK_2
  - LL_ADC_INJ_RANK_3
  - LL_ADC_INJ_RANK_4

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x3F

Notes

- For devices with feature oversampling: Oversampling can increase data width, function for extended range may be needed: LL_ADC_INJ_ReadConversionData32.

Reference Manual to LL API cross reference:

- JDR1 JDATA LL_ADC_INJ_ReadConversionData6
- JDR2 JDATA LL_ADC_INJ_ReadConversionData6
- JDR3 JDATA LL_ADC_INJ_ReadConversionData6
- JDR4 JDATA LL_ADC_INJ_ReadConversionData6

LL_ADC_IsActiveFlag_ADRDY

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_ADRDY (ADC_TypeDef * ADCx)

Function description

Get flag ADC ready.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Notes

- On this STM32 serie, flag LL_ADC_FLAG_ADRDY is raised when the ADC is enabled and when conversion clock is active. (not only core clock: this ADC has a dual clock domain)

Reference Manual to LL API cross reference:

- ISR ADRDY LL_ADC_IsActiveFlag_ADRDY

`LL_ADC_IsActiveFlag_EOC`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_EOC (ADC_TypeDef * ADCx)

Function description

Get flag ADC group regular end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR EOC LL_ADC_IsActiveFlag_EOC

`LL_ADC_IsActiveFlag_EOS`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_EOS (ADC_TypeDef * ADCx)

Function description

Get flag ADC group regular end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR EOS LL_ADC_IsActiveFlag_EOS

`LL_ADC_IsActiveFlag_OVR`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_OVR (ADC_TypeDef * ADCx)

Function description

Get flag ADC group regular overrun.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR OVR LL_ADC_IsActiveFlag_OVR

`LL_ADC_IsActiveFlag_EOSMP`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_EOSMP (ADC_TypeDef * ADCx)

Function description

Get flag ADC group regular end of sampling phase.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR EOSMP LL_ADC_IsActiveFlag_EOSMP

`LL_ADC_IsActiveFlag_JEOC`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_JEOC (ADC_TypeDef * ADCx)

Function description

Get flag ADC group injected end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR JEOC LL_ADC_IsActiveFlag_JEOC

`LL_ADC_IsActiveFlag_JEOS`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_JEOS (ADC_TypeDef * ADCx)

Function description

Get flag ADC group injected end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR JEOS LL_ADC_IsActiveFlag_JEOS

`LL_ADC_IsActiveFlag_JQOVF`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_JQOVF (ADC_TypeDef * ADCx)

Function description

Get flag ADC group injected contexts queue overflow.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR JQOVF LL_ADC_IsActiveFlag_JQOVF

`LL_ADC_IsActiveFlag_AWD1`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_AWD1 (ADC_TypeDef * ADCx)

Function description

Get flag ADC analog watchdog 1 flag.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR AWD1 LL_ADC_IsActiveFlag_AWD1

`LL_ADC_IsActiveFlag_AWD2`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_AWD2 (ADC_TypeDef * ADCx)

Function description

Get flag ADC analog watchdog 2.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR AWD2 LL_ADC_IsActiveFlag_AWD2

`LL_ADC_IsActiveFlag_AWD3`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_AWD3 (ADC_TypeDef * ADCx)

Function description

Get flag ADC analog watchdog 3.

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR AWD3 LL_ADC_IsActiveFlag_AWD3

`LL_ADC_ClearFlag_ADRDY`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_ADRDY (ADC_TypeDef * ADCx)

Function description

Clear flag ADC ready.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Notes

- On this STM32 serie, flag LL_ADC_FLAG_ADRDY is raised when the ADC is enabled and when conversion clock is active. (not only core clock: this ADC has a dual clock domain)

Reference Manual to LL API cross reference:

- ISR ADRDY LL_ADC_ClearFlag_ADRDY

`LL_ADC_ClearFlag_EOC`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_EOC (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group regular end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR EOC LL_ADC_ClearFlag_EOC

`LL_ADC_ClearFlag_EOS`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_EOS (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group regular end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR EOS LL_ADC_ClearFlag_EOS

`LL_ADC_ClearFlag_OVR`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_OVR (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group regular overrun.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR OVR LL_ADC_ClearFlag_OVR

`LL_ADC_ClearFlag_EOSMP`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_EOSMP (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group regular end of sampling phase.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR EOSMP LL_ADC_ClearFlag_EOSMP

`LL_ADC_ClearFlag_JEOC`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_JEOC (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group injected end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR JEOC LL_ADC_ClearFlag_JEOC

`LL_ADC_ClearFlag_JEOS`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_JEOS (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group injected end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR JEOS LL_ADC_ClearFlag_JEOS

`LL_ADC_ClearFlag_JQOVF`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_JQOVF (ADC_TypeDef * ADCx)

Function description

Clear flag ADC group injected contexts queue overflow.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR JQOVF LL_ADC_ClearFlag_JQOVF

`LL_ADC_ClearFlag_AWD1`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_AWD1 (ADC_TypeDef * ADCx)

Function description

Clear flag ADC analog watchdog 1.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR AWD1 LL_ADC_ClearFlag_AWD1

`LL_ADC_ClearFlag_AWD2`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_AWD2 (ADC_TypeDef * ADCx)

Function description

Clear flag ADC analog watchdog 2.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR AWD2 LL_ADC_ClearFlag_AWD2

`LL_ADC_ClearFlag_AWD3`

Function name

__STATIC_INLINE void LL_ADC_ClearFlag_AWD3 (ADC_TypeDef * ADCx)

Function description

Clear flag ADC analog watchdog 3.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR AWD3 LL_ADC_ClearFlag_AWD3

`LL_ADC_EnableIT_ADRDY`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_ADRDY (ADC_TypeDef * ADCx)

Function description

Enable ADC ready.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ADRDYIE LL_ADC_EnableIT_ADRDY

`LL_ADC_EnableIT_EOC`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_EOC (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC group regular end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EOCIE LL_ADC_EnableIT_EOC

`LL_ADC_EnableIT_EOS`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_EOS (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC group regular end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EOSIE LL_ADC_EnableIT_EOS

`LL_ADC_EnableIT_OVR`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_OVR (ADC_TypeDef * ADCx)

Function description

Enable ADC group regular interruption overrun.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER OVRIE LL_ADC_EnableIT_OVR

`LL_ADC_EnableIT_EOSMP`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_EOSMP (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC group regular end of sampling.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EOSMPIE LL_ADC_EnableIT_EOSMP

`LL_ADC_EnableIT_JEOC`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_JEOC (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC group injected end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER JEOCIE LL_ADC_EnableIT_JEOC

`LL_ADC_EnableIT_JEOS`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_JEOS (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC group injected end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER JEOSIE LL_ADC_EnableIT_JEOS

`LL_ADC_EnableIT_JQOVF`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_JQOVF (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC group injected context queue overflow.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER JQOVFIE LL_ADC_EnableIT_JQOVF

`LL_ADC_EnableIT_AWD1`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_AWD1 (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC analog watchdog 1.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER AWD1IE LL_ADC_EnableIT_AWD1

`LL_ADC_EnableIT_AWD2`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_AWD2 (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC analog watchdog 2.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER AWD2IE LL_ADC_EnableIT_AWD2

`LL_ADC_EnableIT_AWD3`

Function name

__STATIC_INLINE void LL_ADC_EnableIT_AWD3 (ADC_TypeDef * ADCx)

Function description

Enable interruption ADC analog watchdog 3.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER AWD3IE LL_ADC_EnableIT_AWD3

`LL_ADC_DisableIT_ADRDY`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_ADRDY (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC ready.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ADRDYIE LL_ADC_DisableIT_ADRDY

`LL_ADC_DisableIT_EOC`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_EOC (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group regular end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EOCIE LL_ADC_DisableIT_EOC

`LL_ADC_DisableIT_EOS`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_EOS (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group regular end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EOSIE LL_ADC_DisableIT_EOS

`LL_ADC_DisableIT_OVR`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_OVR (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group regular overrun.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER OVRIE LL_ADC_DisableIT_OVR

`LL_ADC_DisableIT_EOSMP`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_EOSMP (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group regular end of sampling.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EOSMPIE LL_ADC_DisableIT_EOSMP

`LL_ADC_DisableIT_JEOC`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_JEOC (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group regular end of unitary conversion.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER JEOCIE LL_ADC_DisableIT_JEOC

`LL_ADC_DisableIT_JEOS`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_JEOS (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group injected end of sequence conversions.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER JEOSIE LL_ADC_DisableIT_JEOS

`LL_ADC_DisableIT_JQOVF`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_JQOVF (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC group injected context queue overflow.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER JQOVFIE LL_ADC_DisableIT_JQOVF

`LL_ADC_DisableIT_AWD1`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_AWD1 (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC analog watchdog 1.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER AWD1IE LL_ADC_DisableIT_AWD1

`LL_ADC_DisableIT_AWD2`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_AWD2 (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC analog watchdog 2.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER AWD2IE LL_ADC_DisableIT_AWD2

`LL_ADC_DisableIT_AWD3`

Function name

__STATIC_INLINE void LL_ADC_DisableIT_AWD3 (ADC_TypeDef * ADCx)

Function description

Disable interruption ADC analog watchdog 3.

Parameters

- **ADCx:** ADC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER AWD3IE LL_ADC_DisableIT_AWD3

`LL_ADC_IsEnabledIT_ADRDY`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_ADRDY (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC ready (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER ADRDYIE LL_ADC_IsEnabledIT_ADRDY

`LL_ADC_IsEnabledIT_EOC`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_EOC (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group regular end of unitary conversion (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER EOCIE LL_ADC_IsEnabledIT_EOC

`LL_ADC_IsEnabledIT_EOS`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_EOS (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group regular end of sequence conversions (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER EOSIE LL_ADC_IsEnabledIT_EOS

LL_ADC_IsEnabledIT_OVR

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_OVR (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group regular overrun (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER OVRIE LL_ADC_IsEnabledIT_OVR

LL_ADC_IsEnabledIT_EOSMP

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_EOSMP (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group regular end of sampling (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER EOSMPIE LL_ADC_IsEnabledIT_EOSMP

LL_ADC_IsEnabledIT_JEOC

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_JEOC (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group injected end of unitary conversion (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER JEOCIE LL_ADC_IsEnabledIT_JEOC

`LL_ADC_IsEnabledIT_JEOS`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_JEOS (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group injected end of sequence conversions (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER JEOSIE LL_ADC_IsEnabledIT_JEOS

`LL_ADC_IsEnabledIT_JQOVF`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_JQOVF (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC group injected context queue overflow interrupt state (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER JQOVFIE LL_ADC_IsEnabledIT_JQOVF

`LL_ADC_IsEnabledIT_AWD1`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_AWD1 (ADC_TypeDef * ADCx)

Function description

Get state of interruption ADC analog watchdog 1 (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER AWD1IE LL_ADC_IsEnabledIT_AWD1

`LL_ADC_IsEnabledIT_AWD2`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_AWD2 (ADC_TypeDef * ADCx)

Function description

Get state of interruption Get ADC analog watchdog 2 (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER AWD2IE LL_ADC_IsEnabledIT_AWD2

`LL_ADC_IsEnabledIT_AWD3`

Function name

__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_AWD3 (ADC_TypeDef * ADCx)

Function description

Get state of interruption Get ADC analog watchdog 3 (0: interrupt disabled, 1: interrupt enabled).

Parameters

- **ADCx:** ADC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER AWD3IE LL_ADC_IsEnabledIT_AWD3

`LL_ADC_CommonDeInit`

Function name

ErrorStatus LL_ADC_CommonDeInit (ADC_Common_TypeDef * ADCxy_COMMON)

Function description

De-initialize registers of all ADC instances belonging to the same ADC common instance to their default reset values.

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ADC common registers are de-initialized
  - ERROR: not applicable

Notes

- This function is performing a hard reset, using high level clock source RCC ADC reset. Caution: On this STM32 serie, if several ADC instances are available on the selected device, RCC ADC reset will reset all ADC instances belonging to the common ADC instance. To de-initialize only 1 ADC instance, use function LL_ADC_DeInit().

`LL_ADC_CommonInit`

Function name

ErrorStatus LL_ADC_CommonInit (ADC_Common_TypeDef * ADCxy_COMMON, LL_ADC_CommonInitTypeDef * ADC_CommonInitStruct)

Function description

Initialize some features of ADC common parameters (all ADC instances belonging to the same ADC common instance) and multimode (for devices with several ADC instances available).

Parameters

- **ADCxy_COMMON:** ADC common instance (can be set directly from CMSIS definition or by using helper macro __LL_ADC_COMMON_INSTANCE())
- **ADC_CommonInitStruct:** Pointer to a LL_ADC_CommonInitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ADC common registers are initialized
  - ERROR: ADC common registers are not initialized

Notes

- The setting of ADC common parameters is conditioned to ADC instances state: All ADC instances belonging to the same ADC common instance must be disabled.

`LL_ADC_CommonStructInit`

Function name

void LL_ADC_CommonStructInit (LL_ADC_CommonInitTypeDef * ADC_CommonInitStruct)

Function description

Set each LL_ADC_CommonInitTypeDef field to default value.

Parameters

- **ADC_CommonInitStruct:** Pointer to a LL_ADC_CommonInitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

`LL_ADC_DeInit`

Function name

ErrorStatus LL_ADC_DeInit (ADC_TypeDef * ADCx)

Function description

De-initialize registers of the selected ADC instance to their default reset values.

Parameters

- **ADCx:** ADC instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ADC registers are de-initialized
  - ERROR: ADC registers are not de-initialized

Notes

- To reset all ADC instances quickly (perform a hard reset), use function LL_ADC_CommonDeInit().
- If this functions returns error status, it means that ADC instance is in an unknown state. In this case, perform a hard reset using high level clock source RCC ADC reset. Caution: On this STM32 serie, if several ADC instances are available on the selected device, RCC ADC reset will reset all ADC instances belonging to the common ADC instance. Refer to function LL_ADC_CommonDeInit().

LL_ADC_Init

Function name

ErrorStatus LL_ADC_Init (ADC_TypeDef * ADCx, LL_ADC_InitTypeDef * ADC_InitStruct)

Function description

Initialize some features of ADC instance.

Parameters

- **ADCx:** ADC instance
- **ADC_InitStruct:** Pointer to a LL_ADC_REG_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ADC registers are initialized
  - ERROR: ADC registers are not initialized

Notes

- These parameters have an impact on ADC scope: ADC instance. Affects both group regular and group injected (availability of ADC group injected depends on STM32 families). Refer to corresponding unitary functions into Configuration of ADC hierarchical scope: ADC instance .
- The setting of these parameters by function LL_ADC_Init() is conditioned to ADC state: ADC instance must be disabled. This condition is applied to all ADC features, for efficiency and compatibility over all STM32 families. However, the different features can be set under different ADC state conditions (setting possible with ADC enabled without conversion on going, ADC enabled with conversion on going, ...) Each feature can be updated afterwards with a unitary function and potentially with ADC in a different state than disabled, refer to description of each function for setting conditioned to ADC state.
- After using this function, some other features must be configured using LL unitary functions. The minimum configuration remaining to be done is: Set ADC group regular or group injected sequencer: map channel on the selected sequencer rank. Refer to function LL_ADC_REG_SetSequencerRanks().Set ADC channel sampling time Refer to function LL_ADC_SetChannelSamplingTime();

LL_ADC_StructInit

Function name

void LL_ADC_StructInit (LL_ADC_InitTypeDef * ADC_InitStruct)

Function description

Set each LL_ADC_InitTypeDef field to default value.

Parameters

- **ADC_InitStruct:** Pointer to a LL_ADC_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

`LL_ADC_REG_Init`

Function name

ErrorStatus LL_ADC_REG_Init (ADC_TypeDef * ADCx, LL_ADC_REG_InitTypeDef * ADC_REG_InitStruct)

Function description

Initialize some features of ADC group regular.

Parameters

- **ADCx:** ADC instance
- **ADC_REG_InitStruct:** Pointer to a LL_ADC_REG_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ADC registers are initialized
  - ERROR: ADC registers are not initialized

Notes

- These parameters have an impact on ADC scope: ADC group regular. Refer to corresponding unitary functions into Configuration of ADC hierarchical scope: group regular (functions with prefix "REG").
- The setting of these parameters by function LL_ADC_Init() is conditioned to ADC state: ADC instance must be disabled. This condition is applied to all ADC features, for efficiency and compatibility over all STM32 families. However, the different features can be set under different ADC state conditions (setting possible with ADC enabled without conversion on going, ADC enabled with conversion on going, ...) Each feature can be updated afterwards with a unitary function and potentially with ADC in a different state than disabled, refer to description of each function for setting conditioned to ADC state.
- After using this function, other features must be configured using LL unitary functions. The minimum configuration remaining to be done is: Set ADC group regular or group injected sequencer: map channel on the selected sequencer rank. Refer to function LL_ADC_REG_SetSequencerRanks().Set ADC channel sampling time Refer to function LL_ADC_SetChannelSamplingTime();

`LL_ADC_REG_StructInit`

Function name

void LL_ADC_REG_StructInit (LL_ADC_REG_InitTypeDef * ADC_REG_InitStruct)

Function description

Set each LL_ADC_REG_InitTypeDef field to default value.

Parameters

- **ADC_REG_InitStruct:** Pointer to a LL_ADC_REG_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

`LL_ADC_INJ_Init`

Function name

ErrorStatus LL_ADC_INJ_Init (ADC_TypeDef * ADCx, LL_ADC_INJ_InitTypeDef * ADC_INJ_InitStruct)

Function description

Initialize some features of ADC group injected.

Parameters

- **ADCx:** ADC instance
- **ADC_INJ_InitStruct:** Pointer to a LL_ADC_INJ_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ADC registers are initialized
  - ERROR: ADC registers are not initialized

Notes

- These parameters have an impact on ADC scope: ADC group injected. Refer to corresponding unitary functions into Configuration of ADC hierarchical scope: group regular (functions with prefix "INJ").
- The setting of these parameters by function LL_ADC_Init() is conditioned to ADC state: ADC instance must be disabled. This condition is applied to all ADC features, for efficiency and compatibility over all STM32 families. However, the different features can be set under different ADC state conditions (setting possible with ADC enabled without conversion on going, ADC enabled with conversion on going, ...) Each feature can be updated afterwards with a unitary function and potentially with ADC in a different state than disabled, refer to description of each function for setting conditioned to ADC state.
- After using this function, other features must be configured using LL unitary functions. The minimum configuration remaining to be done is: Set ADC group injected sequencer: map channel on the selected sequencer rank. Refer to function LL_ADC_INJ_SetSequencerRanks().Set ADC channel sampling time Refer to function LL_ADC_SetChannelSamplingTime();

`LL_ADC_INJ_StructInit`

Function name

void LL_ADC_INJ_StructInit (LL_ADC_INJ_InitTypeDef * ADC_INJ_InitStruct)

Function description

Set each LL_ADC_INJ_InitTypeDef field to default value.

Parameters

- **ADC_INJ_InitStruct:** Pointer to a LL_ADC_INJ_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

80.3 ADC Firmware driver defines

The following section lists the various define and macros of the module.

80.3.1 ADC

ADC

Analog watchdog - Monitored channels

LL_ADC_AWD_DISABLE

ADC analog watchdog monitoring disabled

LL_ADC_AWD_ALL_CHANNELS_REG

ADC analog watchdog monitoring of all channels, converted by group regular only

LL_ADC_AWD_ALL_CHANNELS_INJ

ADC analog watchdog monitoring of all channels, converted by group injected only

LL_ADC_AWD_ALL_CHANNELS_REG_INJ

ADC analog watchdog monitoring of all channels, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_0_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN0, converted by group regular only

LL_ADC_AWD_CHANNEL_0_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN0, converted by group injected only

LL_ADC_AWD_CHANNEL_0_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN0, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_1_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN1, converted by group regular only

LL_ADC_AWD_CHANNEL_1_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN1, converted by group injected only

LL_ADC_AWD_CHANNEL_1_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN1, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_2_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN2, converted by group regular only

LL_ADC_AWD_CHANNEL_2_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN2, converted by group injected only

LL_ADC_AWD_CHANNEL_2_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN2, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_3_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN3, converted by group regular only

LL_ADC_AWD_CHANNEL_3_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN3, converted by group injected only

LL_ADC_AWD_CHANNEL_3_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN3, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_4_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN4, converted by group regular only

LL_ADC_AWD_CHANNEL_4_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN4, converted by group injected only

LL_ADC_AWD_CHANNEL_4_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN4, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_5_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN5, converted by group regular only

LL_ADC_AWD_CHANNEL_5_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN5, converted by group injected only

LL_ADC_AWD_CHANNEL_5_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN5, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_6_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN6, converted by group regular only

LL_ADC_AWD_CHANNEL_6_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN6, converted by group injected only

LL_ADC_AWD_CHANNEL_6_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN6, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_7_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN7, converted by group regular only

LL_ADC_AWD_CHANNEL_7_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN7, converted by group injected only

LL_ADC_AWD_CHANNEL_7_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN7, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_8_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN8, converted by group regular only

LL_ADC_AWD_CHANNEL_8_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN8, converted by group injected only

LL_ADC_AWD_CHANNEL_8_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN8, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_9_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN9, converted by group regular only

LL_ADC_AWD_CHANNEL_9_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN9, converted by group injected only

LL_ADC_AWD_CHANNEL_9_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN9, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_10_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN10, converted by group regular only

LL_ADC_AWD_CHANNEL_10_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN10, converted by group injected only

LL_ADC_AWD_CHANNEL_10_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN10, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_11_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN11, converted by group regular only

LL_ADC_AWD_CHANNEL_11_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN11, converted by group injected only

LL_ADC_AWD_CHANNEL_11_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN11, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_12_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN12, converted by group regular only

LL_ADC_AWD_CHANNEL_12_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN12, converted by group injected only

LL_ADC_AWD_CHANNEL_12_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN12, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_13_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN13, converted by group regular only

LL_ADC_AWD_CHANNEL_13_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN13, converted by group injected only

LL_ADC_AWD_CHANNEL_13_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN13, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_14_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN14, converted by group regular only

LL_ADC_AWD_CHANNEL_14_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN14, converted by group injected only

LL_ADC_AWD_CHANNEL_14_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN14, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_15_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN15, converted by group regular only

LL_ADC_AWD_CHANNEL_15_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN15, converted by group injected only

LL_ADC_AWD_CHANNEL_15_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN15, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_16_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN16, converted by group regular only

LL_ADC_AWD_CHANNEL_16_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN16, converted by group injected only

LL_ADC_AWD_CHANNEL_16_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN16, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_17_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN17, converted by group regular only

LL_ADC_AWD_CHANNEL_17_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN17, converted by group injected only

LL_ADC_AWD_CHANNEL_17_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN17, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_18_REG

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN18, converted by group regular only

LL_ADC_AWD_CHANNEL_18_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN18, converted by group injected only

LL_ADC_AWD_CHANNEL_18_REG_INJ

ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN18, converted by either group regular or injected

LL_ADC_AWD_CH_VREFINT_REG

ADC analog watchdog monitoring of ADC internal channel connected to VrefInt: Internal voltage reference, converted by group regular only

LL_ADC_AWD_CH_VREFINT_INJ

ADC analog watchdog monitoring of ADC internal channel connected to VrefInt: Internal voltage reference, converted by group injected only

LL_ADC_AWD_CH_VREFINT_REG_INJ

ADC analog watchdog monitoring of ADC internal channel connected to VrefInt: Internal voltage reference, converted by either group regular or injected

LL_ADC_AWD_CH_TEMPSENSOR_REG

ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by group regular only

LL_ADC_AWD_CH_TEMPSENSOR_INJ

ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by group injected only

LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ

ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by either group regular or injected

LL_ADC_AWD_CH_VBAT_REG

ADC analog watchdog monitoring of ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda, converted by group regular only

LL_ADC_AWD_CH_VBAT_INJ

ADC analog watchdog monitoring of ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda, converted by group injected only

LL_ADC_AWD_CH_VBAT_REG_INJ

ADC analog watchdog monitoring of ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda

LL_ADC_AWD_CH_DAC1CH1_REG

ADC analog watchdog monitoring of ADC internal channel connected to DAC1 channel 1, channel specific to ADC1, converted by group regular only

LL_ADC_AWD_CH_DAC1CH1_INJ

ADC analog watchdog monitoring of ADC internal channel connected to DAC1 channel 1, channel specific to ADC1, converted by group injected only

LL_ADC_AWD_CH_DAC1CH1_REG_INJ

ADC analog watchdog monitoring of ADC internal channel connected to DAC1 channel 1, channel specific to ADC1, converted by either group regular or injected

LL_ADC_AWD_CH_DAC1CH2_REG

ADC analog watchdog monitoring of ADC internal channel connected to DAC1 channel 2, channel specific to ADC1, converted by group regular only

LL_ADC_AWD_CH_DAC1CH2_INJ

ADC analog watchdog monitoring of ADC internal channel connected to DAC1 channel 2, channel specific to ADC1, converted by group injected only

LL_ADC_AWD_CH_DAC1CH2_REG_INJ

ADC analog watchdog monitoring of ADC internal channel connected to DAC1 channel 2, channel specific to ADC1, converted by either group regular or injected

Analog watchdog - Analog watchdog number

LL_ADC_AWD1

ADC analog watchdog number 1

LL_ADC_AWD2

ADC analog watchdog number 2

LL_ADC_AWD3

ADC analog watchdog number 3

Analog watchdog - Thresholds

LL_ADC_AWD_THRESHOLD_HIGH

ADC analog watchdog threshold high

LL_ADC_AWD_THRESHOLD_LOW

ADC analog watchdog threshold low

LL_ADC_AWD_THRESHOLDS_HIGH_LOW

ADC analog watchdog both thresholds high and low concatenated into the same data

ADC instance - Channel number

LL_ADC_CHANNEL_0

ADC external channel (channel connected to GPIO pin) ADCx_IN0

LL_ADC_CHANNEL_1

ADC external channel (channel connected to GPIO pin) ADCx_IN1

LL_ADC_CHANNEL_2

ADC external channel (channel connected to GPIO pin) ADCx_IN2

LL_ADC_CHANNEL_3

ADC external channel (channel connected to GPIO pin) ADCx_IN3

LL_ADC_CHANNEL_4

ADC external channel (channel connected to GPIO pin) ADCx_IN4

LL_ADC_CHANNEL_5

ADC external channel (channel connected to GPIO pin) ADCx_IN5

LL_ADC_CHANNEL_6

ADC external channel (channel connected to GPIO pin) ADCx_IN6

LL_ADC_CHANNEL_7

ADC external channel (channel connected to GPIO pin) ADCx_IN7

LL_ADC_CHANNEL_8

ADC external channel (channel connected to GPIO pin) ADCx_IN8

LL_ADC_CHANNEL_9

ADC external channel (channel connected to GPIO pin) ADCx_IN9

LL_ADC_CHANNEL_10

ADC external channel (channel connected to GPIO pin) ADCx_IN10

LL_ADC_CHANNEL_11

ADC external channel (channel connected to GPIO pin) ADCx_IN11

LL_ADC_CHANNEL_12

ADC external channel (channel connected to GPIO pin) ADCx_IN12

LL_ADC_CHANNEL_13

ADC external channel (channel connected to GPIO pin) ADCx_IN13

LL_ADC_CHANNEL_14

ADC external channel (channel connected to GPIO pin) ADCx_IN14

LL_ADC_CHANNEL_15

ADC external channel (channel connected to GPIO pin) ADCx_IN15

LL_ADC_CHANNEL_16

ADC external channel (channel connected to GPIO pin) ADCx_IN16

LL_ADC_CHANNEL_17

ADC external channel (channel connected to GPIO pin) ADCx_IN17

LL_ADC_CHANNEL_18

ADC external channel (channel connected to GPIO pin) ADCx_IN18

LL_ADC_CHANNEL_VREFINT

ADC internal channel connected to VrefInt: Internal voltage reference. On STM32L4, ADC channel available only on ADC instance: ADC1.

LL_ADC_CHANNEL_TEMPSENSOR

ADC internal channel connected to Temperature sensor. On STM32L4, ADC channel available only on ADC instances: ADC1, ADC3.

LL_ADC_CHANNEL_VBAT

ADC internal channel connected to Vbat/3: Vbat voltage through a divider ladder of factor 1/3 to have Vbat always below Vdda. On STM32L4, ADC channel available only on ADC instances: ADC1, ADC3.

LL_ADC_CHANNEL_DAC1CH1

ADC internal channel connected to DAC1 channel 1, channel specific to ADC1. This channel is shared with ADC internal channel connected to temperature sensor, selection is done using function

LL_ADC_CHANNEL_DAC1CH2

ADC internal channel connected to DAC1 channel 2, channel specific to ADC1. This channel is shared with ADC internal channel connected to Vbat, selection is done using function

Channel - Sampling time

LL_ADC_SAMPLINGTIME_2CYCLES_5

Sampling time 2.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_6CYCLES_5

Sampling time 6.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_12CYCLES_5

Sampling time 12.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_24CYCLES_5

Sampling time 24.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_47CYCLES_5

Sampling time 47.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_92CYCLES_5

Sampling time 92.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_247CYCLES_5

Sampling time 247.5 ADC clock cycles

LL_ADC_SAMPLINGTIME_640CYCLES_5

Sampling time 640.5 ADC clock cycles

Channel - Single or differential ending

LL_ADC_SINGLE_ENDED

ADC channel ending set to single ended (literal also used to set calibration mode)

LL_ADC_DIFFERENTIAL_ENDED

ADC channel ending set to differential (literal also used to set calibration mode)

LL_ADC_BOTH_SINGLE_DIFF_ENDED

ADC channel ending set to both single ended and differential (literal used only to set calibration factors)

ADC common - Clock source

LL_ADC_CLOCK_SYNC_PCLK_DIV1

ADC synchronous clock derived from AHB clock without prescaler

LL_ADC_CLOCK_SYNC_PCLK_DIV2

ADC synchronous clock derived from AHB clock with prescaler division by 2

LL_ADC_CLOCK_SYNC_PCLK_DIV4

ADC synchronous clock derived from AHB clock with prescaler division by 4

LL_ADC_CLOCK_ASYNC_DIV1

ADC asynchronous clock without prescaler

LL_ADC_CLOCK_ASYNC_DIV2

ADC asynchronous clock with prescaler division by 2

LL_ADC_CLOCK_ASYNC_DIV4

ADC asynchronous clock with prescaler division by 4

LL_ADC_CLOCK_ASYNC_DIV6

ADC asynchronous clock with prescaler division by 6

LL_ADC_CLOCK_ASYNC_DIV8

ADC asynchronous clock with prescaler division by 8

LL_ADC_CLOCK_ASYNC_DIV10

ADC asynchronous clock with prescaler division by 10

LL_ADC_CLOCK_ASYNC_DIV12

ADC asynchronous clock with prescaler division by 12

LL_ADC_CLOCK_ASYNC_DIV16

ADC asynchronous clock with prescaler division by 16

LL_ADC_CLOCK_ASYNC_DIV32

ADC asynchronous clock with prescaler division by 32

LL_ADC_CLOCK_ASYNC_DIV64

ADC asynchronous clock with prescaler division by 64

LL_ADC_CLOCK_ASYNC_DIV128

ADC asynchronous clock with prescaler division by 128

LL_ADC_CLOCK_ASYNC_DIV256

ADC asynchronous clock with prescaler division by 256

ADC common - Measurement path to internal channels

LL_ADC_PATH_INTERNAL_NONE

ADC measurement pathes all disabled

LL_ADC_PATH_INTERNAL_VREFINT

ADC measurement path to internal channel VrefInt

LL_ADC_PATH_INTERNAL_TEMPSENSOR

ADC measurement path to internal channel temperature sensor

LL_ADC_PATH_INTERNAL_VBAT

ADC measurement path to internal channel Vbat

ADC instance - Data alignment

LL_ADC_DATA_ALIGN_RIGHT

ADC conversion data alignment: right aligned (alignment on data register LSB bit 0)

LL_ADC_DATA_ALIGN_LEFT

ADC conversion data alignment: left aligned (aligment on data register MSB bit 15)

ADC flags

LL_ADC_FLAG_ADRDY

ADC flag ADC instance ready

LL_ADC_FLAG_EOC

ADC flag ADC group regular end of unitary conversion

LL_ADC_FLAG_EOS

ADC flag ADC group regular end of sequence conversions

LL_ADC_FLAG_OVR

ADC flag ADC group regular overrun

LL_ADC_FLAG_EOSMP

ADC flag ADC group regular end of sampling phase

LL_ADC_FLAG_JEOC

ADC flag ADC group injected end of unitary conversion

LL_ADC_FLAG_JEOS

ADC flag ADC group injected end of sequence conversions

LL_ADC_FLAG_JQOVF

ADC flag ADC group injected contexts queue overflow

LL_ADC_FLAG_AWD1

ADC flag ADC analog watchdog 1

LL_ADC_FLAG_AWD2

ADC flag ADC analog watchdog 2

LL_ADC_FLAG_AWD3

ADC flag ADC analog watchdog 3

ADC instance - Groups

LL_ADC_GROUP_REGULAR

ADC group regular (available on all STM32 devices)

LL_ADC_GROUP_INJECTED

ADC group injected (not available on all STM32 devices)

LL_ADC_GROUP_REGULAR_INJECTED

ADC both groups regular and injected

Definitions of ADC hardware constraints delays

LL_ADC_DELAY_INTERNAL_REGUL_STAB_US

Delay for ADC stabilization time (ADC voltage regulator start-up time)

LL_ADC_DELAY_VREFINT_STAB_US

Delay for internal voltage reference stabilization time

LL_ADC_DELAY_TEMPSENSOR_STAB_US

Delay for temperature sensor stabilization time

LL_ADC_DELAY_CALIB_ENABLE_ADC_CYCLES

Delay required between ADC end of calibration and ADC enable

ADC group injected - Context queue mode

LL_ADC_INJ_QUEUE_2CONTEXTS_LAST_ACTIVE

LL_ADC_INJ_QUEUE_2CONTEXTS_END_EMPTY

LL_ADC_INJ_QUEUE_DISABLE

ADC group injected - Sequencer discontinuous mode

LL_ADC_INJ_SEQ_DISCONT_DISABLE

ADC group injected sequencer discontinuous mode disable

LL_ADC_INJ_SEQ_DISCONT_1RANK

ADC group injected sequencer discontinuous mode enable with sequence interruption every rank

ADC group injected - Sequencer ranks

LL_ADC_INJ_RANK_1

ADC group injected sequencer rank 1

LL_ADC_INJ_RANK_2

ADC group injected sequencer rank 2

LL_ADC_INJ_RANK_3

ADC group injected sequencer rank 3

LL_ADC_INJ_RANK_4

ADC group injected sequencer rank 4

ADC group injected - Sequencer scan length

LL_ADC_INJ_SEQ_SCAN_DISABLE

ADC group injected sequencer disable (equivalent to sequencer of 1 rank: ADC conversion on only 1 channel)

LL_ADC_INJ_SEQ_SCAN_ENABLE_2RANKS

ADC group injected sequencer enable with 2 ranks in the sequence

LL_ADC_INJ_SEQ_SCAN_ENABLE_3RANKS

ADC group injected sequencer enable with 3 ranks in the sequence

LL_ADC_INJ_SEQ_SCAN_ENABLE_4RANKS

ADC group injected sequencer enable with 4 ranks in the sequence

ADC group injected - Trigger edge

LL_ADC_INJ_TRIG_EXT_RISING

ADC group injected conversion trigger polarity set to rising edge

LL_ADC_INJ_TRIG_EXT_FALLING

ADC group injected conversion trigger polarity set to falling edge

LL_ADC_INJ_TRIG_EXT_RISINGFALLING

ADC group injected conversion trigger polarity set to both rising and falling edges

ADC group injected - Trigger source

LL_ADC_INJ_TRIG_SOFTWARE

ADC group injected conversion trigger internal: SW start.. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM1_TRGO

ADC group injected conversion trigger from external peripheral: TIM1 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM1_TRGO2

ADC group injected conversion trigger from external peripheral: TIM1 TRGO2. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM1_CH4

ADC group injected conversion trigger from external peripheral: TIM1 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM2_TRGO

ADC group injected conversion trigger from external peripheral: TIM2 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM2_CH1

ADC group injected conversion trigger from external peripheral: TIM2 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM3_TRGO

ADC group injected conversion trigger from external peripheral: TIM3 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM3_CH1

ADC group injected conversion trigger from external peripheral: TIM3 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM3_CH3

ADC group injected conversion trigger from external peripheral: TIM3 channel 3 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM3_CH4

ADC group injected conversion trigger from external peripheral: TIM3 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM4_TRGO

ADC group injected conversion trigger from external peripheral: TIM4 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM6_TRGO

ADC group injected conversion trigger from external peripheral: TIM6 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM8_CH4

ADC group injected conversion trigger from external peripheral: TIM8 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM8_TRGO

ADC group injected conversion trigger from external peripheral: TIM8 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM8_TRGO2

ADC group injected conversion trigger from external peripheral: TIM8 TRGO2. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_TIM15_TRGO

ADC group injected conversion trigger from external peripheral: TIM15 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_INJ_TRIG_EXT_EXTI_LINE15

ADC group injected conversion trigger from external peripheral: external interrupt line 15. Trigger edge set to rising edge (default setting).

ADC group injected - Automatic trigger mode

LL_ADC_INJ_TRIG_INDEPENDENT

ADC group injected conversion trigger independent. Setting mandatory if ADC group injected injected trigger source is set to an external trigger.

LL_ADC_INJ_TRIG_FROM_GRP_REGULAR

ADC group injected conversion trigger from ADC group regular. Setting compliant only with group injected trigger source set to SW start, without any further action on ADC group injected conversion start or stop: in this case, ADC group injected is controlled only from ADC group regular.

ADC interruptions for configuration (interruption enable or disable)

LL_ADC_IT_ADRDY

ADC interruption ADC instance ready

LL_ADC_IT_EOC

ADC interruption ADC group regular end of unitary conversion

LL_ADC_IT_EOS

ADC interruption ADC group regular end of sequence conversions

LL_ADC_IT_OVR

ADC interruption ADC group regular overrun

LL_ADC_IT_EOSMP

ADC interruption ADC group regular end of sampling phase

LL_ADC_IT_JEOC

ADC interruption ADC group injected end of unitary conversion

LL_ADC_IT_JEOS

ADC interruption ADC group injected end of sequence conversions

LL_ADC_IT_JQOVF

ADC interruption ADC group injected contexts queue overflow

LL_ADC_IT_AWD1

ADC interruption ADC analog watchdog 1

LL_ADC_IT_AWD2

ADC interruption ADC analog watchdog 2

LL_ADC_IT_AWD3

ADC interruption ADC analog watchdog 3

ADC literals legacy naming

LL_ADC_REG_TRIG_SW_START

LL_ADC_REG_TRIG_EXT_TIM1_CC1

LL_ADC_REG_TRIG_EXT_TIM1_CC2

LL_ADC_REG_TRIG_EXT_TIM1_CC3

LL_ADC_REG_TRIG_EXT_TIM2_CC2

LL_ADC_REG_TRIG_EXT_TIM3_CC4

LL_ADC_REG_TRIG_EXT_TIM4_CC4

LL_ADC_INJ_TRIG_SW_START

LL_ADC_INJ_TRIG_EXT_TIM1_CC4

LL_ADC_INJ_TRIG_EXT_TIM2_CC1

LL_ADC_INJ_TRIG_EXT_TIM3_CC1

LL_ADC_INJ_TRIG_EXT_TIM3_CC3

LL_ADC_INJ_TRIG_EXT_TIM3_CC4

LL_ADC_INJ_TRIG_EXT_TIM8_CC4

LL_ADC_OVS_DATA_SHIFT_NONE

LL_ADC_OVS_DATA_SHIFT_1

LL_ADC_OVS_DATA_SHIFT_2

LL_ADC_OVS_DATA_SHIFT_3

LL_ADC_OVS_DATA_SHIFT_4

LL_ADC_OVS_DATA_SHIFT_5

LL_ADC_OVS_DATA_SHIFT_6

LL_ADC_OVS_DATA_SHIFT_7

LL_ADC_OVS_DATA_SHIFT_8

ADC instance - Low power mode

LL_ADC_LP_MODE_NONE

No ADC low power mode activated

LL_ADC_LP_AUTOWAIT

ADC low power mode auto delay: Dynamic low power mode, ADC conversions are performed only when necessary (when previous ADC conversion data is read). See description with function

ADC instance - Offset number

LL_ADC_OFFSET_1

ADC offset number 1: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

LL_ADC_OFFSET_2

ADC offset number 2: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

LL_ADC_OFFSET_3

ADC offset number 3: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

LL_ADC_OFFSET_4

ADC offset number 4: ADC channel and offset level to which the offset programmed will be applied (independently of channel mapped on ADC group regular or group injected)

ADC instance - Offset state

LL_ADC_OFFSET_DISABLE

ADC offset disabled (among ADC selected offset number 1, 2, 3 or 4)

LL_ADC_OFFSET_ENABLE

ADC offset enabled (among ADC selected offset number 1, 2, 3 or 4)

Oversampling - Discontinuous mode

LL_ADC_OVS_REG_CONT

ADC oversampling discontinuous mode: continuous mode (all conversions of oversampling ratio are done from 1 trigger)

LL_ADC_OVS_REG_DISCONT

ADC oversampling discontinuous mode: discontinuous mode (each conversion of oversampling ratio needs a trigger)

Oversampling - Ratio

LL_ADC_OVS_RATIO_2

ADC oversampling ratio of 2 (2 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_4

ADC oversampling ratio of 4 (4 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_8

ADC oversampling ratio of 8 (8 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_16

ADC oversampling ratio of 16 (16 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_32

ADC oversampling ratio of 32 (32 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_64

ADC oversampling ratio of 64 (64 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_128

ADC oversampling ratio of 128 (128 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

LL_ADC_OVS_RATIO_256

ADC oversampling ratio of 256 (256 ADC conversions are performed, sum of these conversions data is computed to result as the ADC oversampling conversion data (before potential shift)

Oversampling - Oversampling scope

LL_ADC_OVS_DISABLE

ADC oversampling disabled.

LL_ADC_OVS_GRP_REGULAR_CONTINUED

ADC oversampling on conversions of ADC group regular. If group injected interrupts group regular: when ADC group injected is triggered, the oversampling on ADC group regular is temporary stopped and continued afterwards.

LL_ADC_OVS_GRP_REGULAR_RESUMED

ADC oversampling on conversions of ADC group regular. If group injected interrupts group regular: when ADC group injected is triggered, the oversampling on ADC group regular is resumed from start (oversampler buffer reset).

LL_ADC_OVS_GRP_INJECTED

ADC oversampling on conversions of ADC group injected.

LL_ADC_OVS_GRP_INJ_REG_RESUMED

ADC oversampling on conversions of both ADC groups regular and injected. If group injected interrupting group regular: when ADC group injected is triggered, the oversampling on ADC group regular is resumed from start (oversampler buffer reset).

Oversampling - Data shift

LL_ADC_OVS_SHIFT_NONE

ADC oversampling no shift (sum of the ADC conversions data is not divided to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_1

ADC oversampling shift of 1 (sum of the ADC conversions data is divided by 2 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_2

ADC oversampling shift of 2 (sum of the ADC conversions data is divided by 4 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_3

ADC oversampling shift of 3 (sum of the ADC conversions data is divided by 8 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_4

ADC oversampling shift of 4 (sum of the ADC conversions data is divided by 16 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_5

ADC oversampling shift of 5 (sum of the ADC conversions data is divided by 32 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_6

ADC oversampling shift of 6 (sum of the ADC conversions data is divided by 64 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_7

ADC oversampling shift of 7 (sum of the ADC conversions data is divided by 128 to result as the ADC oversampling conversion data)

LL_ADC_OVS_SHIFT_RIGHT_8

ADC oversampling shift of 8 (sum of the ADC conversions data is divided by 256 to result as the ADC oversampling conversion data)

ADC registers compliant with specific purpose

LL_ADC_DMA_REG_REGULAR_DATA

ADC group regular - Continuous mode

LL_ADC_REG_CONV_SINGLE

ADC conversions are performed in single mode: one conversion per trigger

LL_ADC_REG_CONV_CONTINUOUS

ADC conversions are performed in continuous mode: after the first trigger, following conversions launched successively automatically

ADC group regular - DFSDM transfer of ADC conversion data

LL_ADC_REG_DFSDM_TRANSFER_NONE

ADC conversions are not transferred by DFSDM.

LL_ADC_REG_DFSDM_TRANSFER_ENABLE

ADC conversion data are transfered to DFSDM for post processing. The ADC conversion data format must be 16-bit signed and right aligned, refer to reference manual. DFSDM transfer cannot be used if DMA transfer is enabled.

ADC group regular - DMA transfer of ADC conversion data

LL_ADC_REG_DMA_TRANSFER_NONE

ADC conversions are not transferred by DMA

LL_ADC_REG_DMA_TRANSFER_LIMITED

ADC conversion data are transferred by DMA, in limited mode (one shot mode): DMA transfer requests are stopped when number of DMA data transfers (number of ADC conversions) is reached. This ADC mode is intended to be used with DMA mode non-circular.

LL_ADC_REG_DMA_TRANSFER_UNLIMITED

ADC conversion data are transferred by DMA, in unlimited mode: DMA transfer requests are unlimited, whatever number of DMA data transferred (number of ADC conversions). This ADC mode is intended to be used with DMA mode circular.

ADC group regular - Overrun behavior on conversion data

LL_ADC_REG_OVR_DATA_PRESERVED

ADC group regular behavior in case of overrun: data preserved

LL_ADC_REG_OVR_DATA_OVERWRITTEN

ADC group regular behavior in case of overrun: data overwritten

ADC group regular - Sequencer discontinuous mode

LL_ADC_REG_SEQ_DISCONT_DISABLE

ADC group regular sequencer discontinuous mode disable

LL_ADC_REG_SEQ_DISCONT_1RANK

ADC group regular sequencer discontinuous mode enable with sequence interruption every rank

LL_ADC_REG_SEQ_DISCONT_2RANKS

ADC group regular sequencer discontinuous mode enabled with sequence interruption every 2 ranks

LL_ADC_REG_SEQ_DISCONT_3RANKS

ADC group regular sequencer discontinuous mode enable with sequence interruption every 3 ranks

LL_ADC_REG_SEQ_DISCONT_4RANKS

ADC group regular sequencer discontinuous mode enable with sequence interruption every 4 ranks

LL_ADC_REG_SEQ_DISCONT_5RANKS

ADC group regular sequencer discontinuous mode enable with sequence interruption every 5 ranks

LL_ADC_REG_SEQ_DISCONT_6RANKS

ADC group regular sequencer discontinuous mode enable with sequence interruption every 6 ranks

LL_ADC_REG_SEQ_DISCONT_7RANKS

ADC group regular sequencer discontinuous mode enable with sequence interruption every 7 ranks

LL_ADC_REG_SEQ_DISCONT_8RANKS

ADC group regular sequencer discontinuous mode enable with sequence interruption every 8 ranks

ADC group regular - Sequencer ranks

LL_ADC_REG_RANK_1

ADC group regular sequencer rank 1

LL_ADC_REG_RANK_2

ADC group regular sequencer rank 2

LL_ADC_REG_RANK_3

ADC group regular sequencer rank 3

LL_ADC_REG_RANK_4

ADC group regular sequencer rank 4

LL_ADC_REG_RANK_5

ADC group regular sequencer rank 5

LL_ADC_REG_RANK_6

ADC group regular sequencer rank 6

LL_ADC_REG_RANK_7

ADC group regular sequencer rank 7

LL_ADC_REG_RANK_8

ADC group regular sequencer rank 8

LL_ADC_REG_RANK_9

ADC group regular sequencer rank 9

LL_ADC_REG_RANK_10

ADC group regular sequencer rank 10

LL_ADC_REG_RANK_11

ADC group regular sequencer rank 11

LL_ADC_REG_RANK_12

ADC group regular sequencer rank 12

LL_ADC_REG_RANK_13

ADC group regular sequencer rank 13

LL_ADC_REG_RANK_14

ADC group regular sequencer rank 14

LL_ADC_REG_RANK_15

ADC group regular sequencer rank 15

LL_ADC_REG_RANK_16

ADC group regular sequencer rank 16

ADC group regular - Sequencer scan length

LL_ADC_REG_SEQ_SCAN_DISABLE

ADC group regular sequencer disable (equivalent to sequencer of 1 rank: ADC conversion on only 1 channel)

LL_ADC_REG_SEQ_SCAN_ENABLE_2RANKS

ADC group regular sequencer enable with 2 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_3RANKS

ADC group regular sequencer enable with 3 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_4RANKS

ADC group regular sequencer enable with 4 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_5RANKS

ADC group regular sequencer enable with 5 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_6RANKS

ADC group regular sequencer enable with 6 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_7RANKS

ADC group regular sequencer enable with 7 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_8RANKS

ADC group regular sequencer enable with 8 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_9RANKS

ADC group regular sequencer enable with 9 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_10RANKS

ADC group regular sequencer enable with 10 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_11RANKS

ADC group regular sequencer enable with 11 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_12RANKS

ADC group regular sequencer enable with 12 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_13RANKS

ADC group regular sequencer enable with 13 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_14RANKS

ADC group regular sequencer enable with 14 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_15RANKS

ADC group regular sequencer enable with 15 ranks in the sequence

LL_ADC_REG_SEQ_SCAN_ENABLE_16RANKS

ADC group regular sequencer enable with 16 ranks in the sequence

ADC group regular - Trigger edge

LL_ADC_REG_TRIG_EXT_RISING

ADC group regular conversion trigger polarity set to rising edge

LL_ADC_REG_TRIG_EXT_FALLING

ADC group regular conversion trigger polarity set to falling edge

LL_ADC_REG_TRIG_EXT_RISINGFALLING

ADC group regular conversion trigger polarity set to both rising and falling edges

ADC group regular - Trigger source

LL_ADC_REG_TRIG_SOFTWARE

ADC group regular conversion trigger internal: SW start.

LL_ADC_REG_TRIG_EXT_TIM1_TRGO

ADC group regular conversion trigger from external peripheral: TIM1 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM1_TRGO2

ADC group regular conversion trigger from external peripheral: TIM1 TRGO2. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM1_CH1

ADC group regular conversion trigger from external peripheral: TIM1 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM1_CH2

ADC group regular conversion trigger from external peripheral: TIM1 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM1_CH3

ADC group regular conversion trigger from external peripheral: TIM1 channel 3 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM2_TRGO

ADC group regular conversion trigger from external peripheral: TIM2 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM2_CH2

ADC group regular conversion trigger from external peripheral: TIM2 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM3_TRGO

ADC group regular conversion trigger from external peripheral: TIM3 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM3_CH4

ADC group regular conversion trigger from external peripheral: TIM3 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM4_TRGO

ADC group regular conversion trigger from external peripheral: TIM4 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM4_CH4

ADC group regular conversion trigger from external peripheral: TIM4 channel 4 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM6_TRGO

ADC group regular conversion trigger from external peripheral: TIM6 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM8_TRGO

ADC group regular conversion trigger from external peripheral: TIM8 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM8_TRGO2

ADC group regular conversion trigger from external peripheral: TIM8 TRGO2. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_TIM15_TRGO

ADC group regular conversion trigger from external peripheral: TIM15 TRGO. Trigger edge set to rising edge (default setting).

LL_ADC_REG_TRIG_EXT_EXTI_LINE11

ADC group regular conversion trigger from external peripheral: external interrupt line 11. Trigger edge set to rising edge (default setting).

ADC instance - Resolution

LL_ADC_RESOLUTION_12B

ADC resolution 12 bits

LL_ADC_RESOLUTION_10B

ADC resolution 10 bits

LL_ADC_RESOLUTION_8B

ADC resolution 8 bits

LL_ADC_RESOLUTION_6B

ADC resolution 6 bits

ADC instance - ADC sampling time common configuration

LL_ADC_SAMPLINGTIME_COMMON_DEFAULT

ADC sampling time let to default settings.

LL_ADC_SAMPLINGTIME_COMMON_3C5_REPL_2C5

ADC additional sampling time 3.5 ADC clock cycles replacing 2.5 ADC clock cycles (this applies to all channels mapped with selection sampling time 2.5 ADC clock cycles, whatever channels mapped on ADC groups regular or injected).

ADC helper macro

__LL_ADC_CHANNEL_TO_DECIMAL_NB

Description:

- Helper macro to get ADC channel number in decimal format from literals LL_ADC_CHANNEL_x.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Value: between Min_Data=0 and Max_Data=18

Notes:

- Example: __LL_ADC_CHANNEL_TO_DECIMAL_NB(LL_ADC_CHANNEL_4) will return decimal number "4". The input can be a value from functions where a channel number is returned, either defined with number or with bitfield (only one bit must be set).

__LL_ADC_DECIMAL_NB_TO_CHANNEL

Description:

- Helper macro to get ADC channel in literal format LL_ADC_CHANNEL_x from number in decimal format.

Parameters:

- __DECIMAL_NB__: Value between Min_Data=0 and Max_Data=18

Return value:

- Returned: value can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Notes:

- Example: __LL_ADC_DECIMAL_NB_TO_CHANNEL(4) will return a data equivalent to "LL_ADC_CHANNEL_4".

__LL_ADC_IS_CHANNEL_INTERNAL

Description:

- Helper macro to determine whether the selected channel corresponds to literal definitions of driver.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Value: "0" if the channel corresponds to a parameter definition of a ADC external channel (channel connected to a GPIO pin). Value "1" if the channel corresponds to a parameter definition of a ADC internal channel.

Notes:

- The different literal definitions of ADC channels are: ADC internal channel: LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...ADC external channel (channel connected to a GPIO pin): LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ... The channel parameter must be a value defined from literal definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...), must not be a value from functions where a channel number is returned from ADC registers, because internal and external channels share the same channel number in ADC registers. The differentiation is made only with parameters definitions of driver.

__LL_ADC_CHANNEL_INTERNAL_TO_EXTERNAL

Description:

- Helper macro to convert a channel defined from parameter definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), to its equivalent parameter definition of a ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...).

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Returned: value can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1
  - LL_ADC_CHANNEL_2
  - LL_ADC_CHANNEL_3
  - LL_ADC_CHANNEL_4
  - LL_ADC_CHANNEL_5
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11

- LL_ADC_CHANNEL_12
- LL_ADC_CHANNEL_13
- LL_ADC_CHANNEL_14
- LL_ADC_CHANNEL_15
- LL_ADC_CHANNEL_16
- LL_ADC_CHANNEL_17
- LL_ADC_CHANNEL_18

Notes:

- The channel parameter can be, additionally to a value defined from parameter definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), a value defined from parameter definition of ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...) or a value from functions where a channel number is returned from ADC registers.

__LL_ADC_IS_CHANNEL_INTERNAL_AVAILABLE

Description:

- Helper macro to determine whether the internal channel selected is available on the ADC instance selected.

Parameters:

- __ADC_INSTANCE__: ADC instance
- __CHANNEL__: This parameter can be one of the following values:
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)

Return value:

- Value: "0" if the internal channel selected is not available on the ADC instance selected. Value "1" if the internal channel selected is available on the ADC instance selected.

Notes:

- The channel parameter must be a value defined from parameter definition of a ADC internal channel (LL_ADC_CHANNEL_VREFINT, LL_ADC_CHANNEL_TEMPSENSOR, ...), must not be a value defined from parameter definition of ADC external channel (LL_ADC_CHANNEL_1, LL_ADC_CHANNEL_2, ...) or a value from functions where a channel number is returned from ADC registers, because internal and external channels share the same channel number in ADC registers. The differentiation is made only with parameters definitions of driver.

__LL_ADC_ANALOGWD_CHANNEL_GROUP

Description:

- Helper macro to define ADC analog watchdog parameter: define a single channel to monitor with analog watchdog from sequencer channel and groups definition.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - LL_ADC_CHANNEL_0
  - LL_ADC_CHANNEL_1 (7)
  - LL_ADC_CHANNEL_2 (7)
  - LL_ADC_CHANNEL_3 (7)
  - LL_ADC_CHANNEL_4 (7)
  - LL_ADC_CHANNEL_5 (7)
  - LL_ADC_CHANNEL_6
  - LL_ADC_CHANNEL_7
  - LL_ADC_CHANNEL_8
  - LL_ADC_CHANNEL_9
  - LL_ADC_CHANNEL_10
  - LL_ADC_CHANNEL_11
  - LL_ADC_CHANNEL_12
  - LL_ADC_CHANNEL_13
  - LL_ADC_CHANNEL_14
  - LL_ADC_CHANNEL_15
  - LL_ADC_CHANNEL_16
  - LL_ADC_CHANNEL_17
  - LL_ADC_CHANNEL_18
  - LL_ADC_CHANNEL_VREFINT (1)
  - LL_ADC_CHANNEL_TEMPSENSOR (4)
  - LL_ADC_CHANNEL_VBAT (4)
  - LL_ADC_CHANNEL_DAC1CH1 (5)
  - LL_ADC_CHANNEL_DAC1CH2 (5)
  - LL_ADC_CHANNEL_DAC1CH1_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC2 (2)(6)
  - LL_ADC_CHANNEL_DAC1CH1_ADC3 (3)(6)
  - LL_ADC_CHANNEL_DAC1CH2_ADC3 (3)(6)
- __GROUP__: This parameter can be one of the following values:
  - LL_ADC_GROUP_REGULAR
  - LL_ADC_GROUP_INJECTED
  - LL_ADC_GROUP_REGULAR_INJECTED

Return value:

- Returned: value can be one of the following values:
  - LL_ADC_AWD_DISABLE
  - LL_ADC_AWD_ALL_CHANNELS_REG (0)
  - LL_ADC_AWD_ALL_CHANNELS_INJ (0)
  - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
  - LL_ADC_AWD_CHANNEL_0_REG (0)
  - LL_ADC_AWD_CHANNEL_0_INJ (0)
  - LL_ADC_AWD_CHANNEL_0_REG_INJ
  - LL_ADC_AWD_CHANNEL_1_REG (0)
  - LL_ADC_AWD_CHANNEL_1_INJ (0)

- LL_ADC_AWD_CHANNEL_1_REG_INJ
- LL_ADC_AWD_CHANNEL_2_REG (0)
- LL_ADC_AWD_CHANNEL_2_INJ (0)
- LL_ADC_AWD_CHANNEL_2_REG_INJ
- LL_ADC_AWD_CHANNEL_3_REG (0)
- LL_ADC_AWD_CHANNEL_3_INJ (0)
- LL_ADC_AWD_CHANNEL_3_REG_INJ
- LL_ADC_AWD_CHANNEL_4_REG (0)
- LL_ADC_AWD_CHANNEL_4_INJ (0)
- LL_ADC_AWD_CHANNEL_4_REG_INJ
- LL_ADC_AWD_CHANNEL_5_REG (0)
- LL_ADC_AWD_CHANNEL_5_INJ (0)
- LL_ADC_AWD_CHANNEL_5_REG_INJ
- LL_ADC_AWD_CHANNEL_6_REG (0)
- LL_ADC_AWD_CHANNEL_6_INJ (0)
- LL_ADC_AWD_CHANNEL_6_REG_INJ
- LL_ADC_AWD_CHANNEL_7_REG (0)
- LL_ADC_AWD_CHANNEL_7_INJ (0)
- LL_ADC_AWD_CHANNEL_7_REG_INJ
- LL_ADC_AWD_CHANNEL_8_REG (0)
- LL_ADC_AWD_CHANNEL_8_INJ (0)
- LL_ADC_AWD_CHANNEL_8_REG_INJ
- LL_ADC_AWD_CHANNEL_9_REG (0)
- LL_ADC_AWD_CHANNEL_9_INJ (0)
- LL_ADC_AWD_CHANNEL_9_REG_INJ
- LL_ADC_AWD_CHANNEL_10_REG (0)
- LL_ADC_AWD_CHANNEL_10_INJ (0)
- LL_ADC_AWD_CHANNEL_10_REG_INJ
- LL_ADC_AWD_CHANNEL_11_REG (0)
- LL_ADC_AWD_CHANNEL_11_INJ (0)
- LL_ADC_AWD_CHANNEL_11_REG_INJ
- LL_ADC_AWD_CHANNEL_12_REG (0)
- LL_ADC_AWD_CHANNEL_12_INJ (0)
- LL_ADC_AWD_CHANNEL_12_REG_INJ
- LL_ADC_AWD_CHANNEL_13_REG (0)
- LL_ADC_AWD_CHANNEL_13_INJ (0)
- LL_ADC_AWD_CHANNEL_13_REG_INJ
- LL_ADC_AWD_CHANNEL_14_REG (0)
- LL_ADC_AWD_CHANNEL_14_INJ (0)
- LL_ADC_AWD_CHANNEL_14_REG_INJ
- LL_ADC_AWD_CHANNEL_15_REG (0)
- LL_ADC_AWD_CHANNEL_15_INJ (0)
- LL_ADC_AWD_CHANNEL_15_REG_INJ
- LL_ADC_AWD_CHANNEL_16_REG (0)
- LL_ADC_AWD_CHANNEL_16_INJ (0)
- LL_ADC_AWD_CHANNEL_16_REG_INJ
- LL_ADC_AWD_CHANNEL_17_REG (0)
- LL_ADC_AWD_CHANNEL_17_INJ (0)
- LL_ADC_AWD_CHANNEL_17_REG_INJ

- LL_ADC_AWD_CHANNEL_18_REG (0)
- LL_ADC_AWD_CHANNEL_18_INJ (0)
- LL_ADC_AWD_CHANNEL_18_REG_INJ
- LL_ADC_AWD_CH_VREFINT_REG (0)(1)
- LL_ADC_AWD_CH_VREFINT_INJ (0)(1)
- LL_ADC_AWD_CH_VREFINT_REG_INJ (1)
- LL_ADC_AWD_CH_TEMPSENSOR_REG (0)(4)
- LL_ADC_AWD_CH_TEMPSENSOR_INJ (0)(4)
- LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ (4)
- LL_ADC_AWD_CH_VBAT_REG (0)(4)
- LL_ADC_AWD_CH_VBAT_INJ (0)(4)
- LL_ADC_AWD_CH_VBAT_REG_INJ (4)
- LL_ADC_AWD_CH_DAC1CH1_REG (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH1_INJ (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH1_REG_INJ (2)(5)
- LL_ADC_AWD_CH_DAC1CH2_REG (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH2_INJ (0)(2)(5)
- LL_ADC_AWD_CH_DAC1CH2_REG_INJ (2)(5)
- LL_ADC_AWD_CH_DAC1CH1_ADC2_REG (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC2_INJ (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC2_REG_INJ (2)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC2_REG (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC2_INJ (0)(2)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC2_REG_INJ (2)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC3_REG (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC3_INJ (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH1_ADC3_REG_INJ (3)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC3_REG (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC3_INJ (0)(3)(6)
- LL_ADC_AWD_CH_DAC1CH2_ADC3_REG_INJ (3)(6)

Notes:

- To be used with function LL_ADC_SetAnalogWDMonitChannels(). Example:
  LL_ADC_SetAnalogWDMonitChannels(ADC1, LL_ADC_AWD1,
  __LL_ADC_ANALOGWD_CHANNEL_GROUP(LL_ADC_CHANNEL4, LL_ADC_GROUP_REGULAR))

__LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION

Description:

- Helper macro to set the value of ADC analog watchdog threshold high or low in function of ADC resolution, when ADC resolution is different of 12 bits.

Parameters:

- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B
- __AWD_THRESHOLD__: Value between Min_Data=0x000 and Max_Data=0xFFF

Return value:

- Value: between Min_Data=0x000 and Max_Data=0xFFF

Notes:

- To be used with function LL_ADC_ConfigAnalogWDThresholds() or LL_ADC_SetAnalogWDThresholds(). Example, with a ADC resolution of 8 bits, to set the value of analog watchdog threshold high (on 8 bits): LL_ADC_SetAnalogWDThresholds (< ADCx param >, __LL_ADC_ANALOGWD_SET_THRESHOLD_RESOLUTION(LL_ADC_RESOLUTION_8B, <threshold_value_8_bits>));

__LL_ADC_ANALOGWD_GET_THRESHOLD_RESOLUTION

Description:

- Helper macro to get the value of ADC analog watchdog threshold high or low in function of ADC resolution, when ADC resolution is different of 12 bits.

Parameters:

- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B
- __AWD_THRESHOLD_12_BITS__: Value between Min_Data=0x000 and Max_Data=0xFFF

Return value:

- Value: between Min_Data=0x000 and Max_Data=0xFFF

Notes:

- To be used with function LL_ADC_GetAnalogWDThresholds(). Example, with a ADC resolution of 8 bits, to get the value of analog watchdog threshold high (on 8 bits): < threshold_value_6_bits > = __LL_ADC_ANALOGWD_GET_THRESHOLD_RESOLUTION (LL_ADC_RESOLUTION_8B, LL_ADC_GetAnalogWDThresholds(<ADCx param>, LL_ADC_AWD_THRESHOLD_HIGH));

__LL_ADC_ANALOGWD_THRESHOLDS_HIGH_LOW

Description:

- Helper macro to get the ADC analog watchdog threshold high or low from raw value containing both thresholds concatenated.

Parameters:

- __AWD_THRESHOLD_TYPE__: This parameter can be one of the following values:
  - LL_ADC_AWD_THRESHOLD_HIGH
  - LL_ADC_AWD_THRESHOLD_LOW
- __AWD_THRESHOLDS__: Value between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF

Return value:

- Value: between Min_Data=0x000 and Max_Data=0xFFF

Notes:

- To be used with function LL_ADC_GetAnalogWDThresholds(). Example, to get analog watchdog threshold high from the register raw value: __LL_ADC_ANALOGWD_THRESHOLDS_HIGH_LOW(LL_ADC_AWD_THRESHOLD_HIGH, <raw_value_with_both_thresholds>);

__LL_ADC_CALIB_FACTOR_SINGLE_DIFF

Description:

- Helper macro to set the ADC calibration value with both single ended and differential modes calibration factors concatenated.

Parameters:

- __CALIB_FACTOR_SINGLE_ENDED__: Value between Min_Data=0x00 and Max_Data=0x7F
- __CALIB_FACTOR_DIFFERENTIAL__: Value between Min_Data=0x00 and Max_Data=0x7F

Return value:

- Value: between Min_Data=0x00000000 and Max_Data=0xFFFFFFFF

Notes:

- To be used with function LL_ADC_SetCalibrationFactor(). Example, to set calibration factors single ended to 0x55 and differential ended to 0x2A: LL_ADC_SetCalibrationFactor(ADC1, __LL_ADC_CALIB_FACTOR_SINGLE_DIFF(0x55, 0x2A))

__LL_ADC_COMMON_INSTANCE

Description:

- Helper macro to select the ADC common instance to which is belonging the selected ADC instance.

Parameters:

- __ADCx__: ADC instance

Return value:

- ADC: common register instance

Notes:

- ADC common register instance can be used for: Set parameters common to several ADC instancesMultimode (for devices with several ADC instances) Refer to functions having argument "ADCxy_COMMON" as parameter.

__LL_ADC_IS_ENABLED_ALL_COMMON_INSTANCE

Description:

- Helper macro to check if all ADC instances sharing the same ADC common instance are disabled.

Parameters:

- __ADCXY_COMMON__: ADC common instance (can be set directly from CMSIS definition or by using helper macro

Return value:

- Value: "0" if all ADC instances sharing the same ADC common instance are disabled. Value "1" if at least one ADC instance sharing the same ADC common instance is enabled.

Notes:

- This check is required by functions with setting conditioned to ADC state: All ADC instances of the ADC common group must be disabled. Refer to functions having argument "ADCxy_COMMON" as parameter. On devices with only 1 ADC common instance, parameter of this macro is useless and can be ignored (parameter kept for compatibility with devices featuring several ADC common instances).

__LL_ADC_DIGITAL_SCALE

Description:

- Helper macro to define the ADC conversion data full-scale digital value corresponding to the selected ADC resolution.

Parameters:

- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return value:

- ADC: conversion data full-scale digital value (unit: digital value of ADC conversion data)

Notes:

- ADC conversion data full-scale corresponds to voltage range determined by analog voltage references Vref + and Vref- (refer to reference manual).

__LL_ADC_CONVERT_DATA_RESOLUTION

Description:

- Helper macro to convert the ADC conversion data from a resolution to another resolution.

Parameters:

- __DATA__: ADC conversion data to be converted
- __ADC_RESOLUTION_CURRENT__: Resolution of the data to be converted This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B
- __ADC_RESOLUTION_TARGET__: Resolution of the data after conversion This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return value:

- ADC: conversion data to the requested resolution

__LL_ADC_CALC_DATA_TO_VOLTAGE

Description:

- Helper macro to calculate the voltage (unit: mVolt) corresponding to a ADC conversion data (unit: digital value).

Parameters:

- __VREFANALOG_VOLTAGE__: Analog reference voltage (unit: mV)
- __ADC_DATA__: ADC conversion data (resolution 12 bits) (unit: digital value).
- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return value:

- ADC: conversion data equivalent voltage value (unit: mVolt)

Notes:

- Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE().

__LL_ADC_CALC_DATA_VOLTAGE

__LL_ADC_CALC_VREFANALOG_VOLTAGE

Description:

- Helper macro to calculate analog reference voltage (Vref+) (unit: mVolt) from ADC conversion data of internal voltage reference VrefInt.

Parameters:

- __VREFINT_ADC_DATA__: ADC conversion data (resolution 12 bits) of internal voltage reference VrefInt (unit: digital value).
- __ADC_RESOLUTION__: This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return value:

- Analog: reference voltage (unit: mV)

Notes:

- Computation is using VrefInt calibration value stored in system memory for each device during production. This voltage depends on user board environment: voltage level connected to pin Vref+. On devices with small package, the pin Vref+ is not present and internally bonded to pin Vdda. On this STM32 serie, calibration data of internal voltage reference VrefInt corresponds to a resolution of 12 bits, this is the recommended ADC resolution to convert voltage of internal voltage reference VrefInt. Otherwise, this macro performs the processing to scale ADC conversion data to 12 bits.

__LL_ADC_CALC_TEMPERATURE

Description:

- Helper macro to calculate the temperature (unit: degree Celsius) from ADC conversion data of internal temperature sensor.

Parameters:

- __VREFANALOG_VOLTAGE__: Analog reference voltage (unit: mV)
- __TEMPSENSOR_ADC_DATA__: ADC conversion data of internal temperature sensor (unit: digital value).
- __ADC_RESOLUTION__: ADC resolution at which internal temperature sensor voltage has been measured. This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return value:

- Temperature: (unit: degree Celsius)

Notes:

- Computation is using temperature sensor calibration values stored in system memory for each device during production. Calculation formula: Temperature = ((TS_ADC_DATA - TS_CAL1) * (TS_CAL2_TEMP - TS_CAL1_TEMP)) / (TS_CAL2 - TS_CAL1) + TS_CAL1_TEMP with TS_ADC_DATA = temperature sensor raw data measured by ADC Avg_Slope = (TS_CAL2 - TS_CAL1) / (TS_CAL2_TEMP - TS_CAL1_TEMP) TS_CAL1 = equivalent TS_ADC_DATA at temperature TEMP_DEGC_CAL1 (calibrated in factory) TS_CAL2 = equivalent TS_ADC_DATA at temperature TEMP_DEGC_CAL2 (calibrated in factory) Caution: Calculation relevancy under reserve that calibration parameters are correct (address and data). To calculate temperature using temperature sensor datasheet typical values (generic values less, therefore less accurate than calibrated values), use helper macro __LL_ADC_CALC_TEMPERATURE_TYP_PARAMS(). As calculation input, the analog reference voltage (Vref+) must be defined as it impacts the ADC LSB equivalent voltage. Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE(). On this STM32 serie, calibration data of temperature sensor corresponds to a resolution of 12 bits, this is the recommended ADC resolution to convert voltage of temperature sensor. Otherwise, this macro performs the processing to scale ADC conversion data to 12 bits.

__LL_ADC_CALC_TEMPERATURE_TYP_PARAMS

Description:

- Helper macro to calculate the temperature (unit: degree Celsius) from ADC conversion data of internal temperature sensor.

Parameters:

- __TEMPSENSOR_TYP_AVGSLOPE__: Device datasheet data: Temperature sensor slope typical value (unit: uV/DegCelsius). On STM32L4, refer to device datasheet parameter "Avg_Slope".
- __TEMPSENSOR_TYP_CALX_V__: Device datasheet data: Temperature sensor voltage typical value (at temperature and Vref+ defined in parameters below) (unit: mV). On STM32L4, refer to device datasheet parameter "V30" (corresponding to TS_CAL1).
- __TEMPSENSOR_CALX_TEMP__: Device datasheet data: Temperature at which temperature sensor voltage (see parameter above) is corresponding (unit: mV)
- __VREFANALOG_VOLTAGE__: Analog voltage reference (Vref+) voltage (unit: mV)
- __TEMPSENSOR_ADC_DATA__: ADC conversion data of internal temperature sensor (unit: digital value).
- __ADC_RESOLUTION__: ADC resolution at which internal temperature sensor voltage has been measured. This parameter can be one of the following values:
  - LL_ADC_RESOLUTION_12B
  - LL_ADC_RESOLUTION_10B
  - LL_ADC_RESOLUTION_8B
  - LL_ADC_RESOLUTION_6B

Return value:

- Temperature: (unit: degree Celsius)

Notes:

- Computation is using temperature sensor typical values (refer to device datasheet). Calculation formula: Temperature = (TS_TYP_CALx_VOLT(uV) - TS_ADC_DATA * Conversion_uV) / Avg_Slope + CALx_TEMP with TS_ADC_DATA = temperature sensor raw data measured by ADC (unit: digital value) Avg_Slope = temperature sensor slope (unit: uV/Degree Celsius) TS_TYP_CALx_VOLT = temperature sensor digital value at temperature CALx_TEMP (unit: mV) Caution: Calculation relevancy under reserve the temperature sensor of the current device has characteristics in line with datasheet typical values. If temperature sensor calibration values are available on on this device (presence of macro __LL_ADC_CALC_TEMPERATURE()), temperature calculation will be more accurate using helper macro __LL_ADC_CALC_TEMPERATURE(). As calculation input, the analog reference voltage (Vref+) must be defined as it impacts the ADC LSB equivalent voltage. Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE(). ADC measurement data must correspond to a resolution of 12 bits (full scale digital value 4095). If not the case, the data must be preliminarily rescaled to an equivalent resolution of 12 bits.

Common write and read registers Macros

LL_ADC_WriteReg

Description:

- Write a value in ADC register.

Parameters:

- __INSTANCE__: ADC Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_ADC_ReadReg

Description:

- Read a value in ADC register.

Parameters:

- __INSTANCE__: ADC Instance
- __REG__: Register to be read

Return value:

- Register: value

81 LL BUS Generic Driver

81.1 BUS Firmware driver API description

The following section lists the various functions of the BUS library.

81.1.1 Detailed description of functions

`LL_AHB1_GRP1_EnableClock`

Function name

__STATIC_INLINE void LL_AHB1_GRP1_EnableClock (uint32_t Periphs)

Function description

Enable AHB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1ENR DMA1EN LL_AHB1_GRP1_EnableClock
- AHB1ENR DMA2EN LL_AHB1_GRP1_EnableClock
- AHB1ENR DMAMUX1EN LL_AHB1_GRP1_EnableClock
- AHB1ENR FLASHEN LL_AHB1_GRP1_EnableClock
- AHB1ENR CRCEN LL_AHB1_GRP1_EnableClock
- AHB1ENR TSCEN LL_AHB1_GRP1_EnableClock
- AHB1ENR DMA2DEN LL_AHB1_GRP1_EnableClock
- AHB1ENR GFXMMUEN LL_AHB1_GRP1_EnableClock

`LL_AHB1_GRP1_IsEnabledClock`

Function name

__STATIC_INLINE uint32_t LL_AHB1_GRP1_IsEnabledClock (uint32_t Periphs)

Function description

Check if AHB1 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- AHB1ENR DMA1EN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DMA2EN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DMAMUX1EN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR FLASHEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR CRCEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR TSCEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR DMA2DEN LL_AHB1_GRP1_IsEnabledClock
- AHB1ENR GFXMMUEN LL_AHB1_GRP1_IsEnabledClock

LL_AHB1_GRP1_DisableClock

Function name

__STATIC_INLINE void LL_AHB1_GRP1_DisableClock (uint32_t Periphs)

Function description

Disable AHB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1ENR DMA1EN LL_AHB1_GRP1_DisableClock
- AHB1ENR DMA2EN LL_AHB1_GRP1_DisableClock
- AHB1ENR DMAMUX1EN LL_AHB1_GRP1_DisableClock
- AHB1ENR FLASHEN LL_AHB1_GRP1_DisableClock
- AHB1ENR CRCEN LL_AHB1_GRP1_DisableClock
- AHB1ENR TSCEN LL_AHB1_GRP1_DisableClock
- AHB1ENR DMA2DEN LL_AHB1_GRP1_DisableClock
- AHB1ENR GFXMMUEN LL_AHB1_GRP1_DisableClock

`LL_AHB1_GRP1_ForceReset`

Function name

__STATIC_INLINE void LL_AHB1_GRP1_ForceReset (uint32_t Periphs)

Function description

Force AHB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_ALL
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1RSTR DMA1RST LL_AHB1_GRP1_ForceReset
- AHB1RSTR DMA2RST LL_AHB1_GRP1_ForceReset
- AHB1RSTR DMAMUX1RST LL_AHB1_GRP1_ForceReset
- AHB1RSTR FLASHRST LL_AHB1_GRP1_ForceReset
- AHB1RSTR CRCRST LL_AHB1_GRP1_ForceReset
- AHB1RSTR TSCRST LL_AHB1_GRP1_ForceReset
- AHB1RSTR DMA2DRST LL_AHB1_GRP1_ForceReset
- AHB1RSTR GFXMMURST LL_AHB1_GRP1_ForceReset

`LL_AHB1_GRP1_ReleaseReset`

Function name

__STATIC_INLINE void LL_AHB1_GRP1_ReleaseReset (uint32_t Periphs)

Function description

Release AHB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_ALL
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1RSTR DMA1RST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR DMA2RST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR DMAMUX1RST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR FLASHRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR CRCRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR TSCRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR DMA2DRST LL_AHB1_GRP1_ReleaseReset
- AHB1RSTR GFXMMURST LL_AHB1_GRP1_ReleaseReset

`LL_AHB1_GRP1_EnableClockStopSleep`

Function name

__STATIC_INLINE void LL_AHB1_GRP1_EnableClockStopSleep (uint32_t Periphs)

Function description

Enable AHB1 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_SRAM1
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1SMENR DMA1SMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR DMA2SMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR DMAMUX1SMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR FLASHSMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR SRAM1SMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR CRCSMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR TSCSMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR DMA2DSMEN LL_AHB1_GRP1_EnableClockStopSleep
- AHB1SMENR GFXMMUSMEN LL_AHB1_GRP1_EnableClockStopSleep

`LL_AHB1_GRP1_DisableClockStopSleep`

Function name

__STATIC_INLINE void LL_AHB1_GRP1_DisableClockStopSleep (uint32_t Periphs)

Function description

Disable AHB1 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2
  - LL_AHB1_GRP1_PERIPH_DMAMUX1 (*)
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_SRAM1
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_TSC
  - LL_AHB1_GRP1_PERIPH_DMA2D (*)
  - LL_AHB1_GRP1_PERIPH_GFXMMU (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB1SMENR DMA1SMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR DMA2SMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR DMAMUX1SMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR FLASHSMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR SRAM1SMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR CRCSMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR TSCSMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR DMA2DSMEN LL_AHB1_GRP1_DisableClockStopSleep
- AHB1SMENR GFXMMUSMEN LL_AHB1_GRP1_DisableClockStopSleep

`LL_AHB2_GRP1_EnableClock`

Function name

__STATIC_INLINE void LL_AHB2_GRP1_EnableClock (uint32_t Periphs)

Function description

Enable AHB2 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2ENR GPIOAEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOBEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOCEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIODEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOEEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOFEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOGEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOHEN LL_AHB2_GRP1_EnableClock
- AHB2ENR GPIOIEN LL_AHB2_GRP1_EnableClock
- AHB2ENR OTGFSEN LL_AHB2_GRP1_EnableClock
- AHB2ENR ADCEN LL_AHB2_GRP1_EnableClock
- AHB2ENR DCMIEN LL_AHB2_GRP1_EnableClock
- AHB2ENR AESEN LL_AHB2_GRP1_EnableClock
- AHB2ENR HASHEN LL_AHB2_GRP1_EnableClock
- AHB2ENR RNGEN LL_AHB2_GRP1_EnableClock
- AHB2ENR OSPIMEN LL_AHB2_GRP1_EnableClock
- AHB2ENR SDMMC1EN LL_AHB2_GRP1_EnableClock

LL_AHB2_GRP1_IsEnabledClock

Function name

__STATIC_INLINE uint32_t LL_AHB2_GRP1_IsEnabledClock (uint32_t Periphs)

Function description

Check if AHB2 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- AHB2ENR GPIOAEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOBEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOCEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIODEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOEEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOFEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOGEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOHEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR GPIOIEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR OTGFSEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR ADCEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR DCMIEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR AESEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR HASHEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR RNGEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR OSPIMEN LL_AHB2_GRP1_IsEnabledClock
- AHB2ENR SDMMC1EN LL_AHB2_GRP1_IsEnabledClock

`LL_AHB2_GRP1_DisableClock`

Function name

__STATIC_INLINE void LL_AHB2_GRP1_DisableClock (uint32_t Periphs)

Function description

Disable AHB2 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2ENR GPIOAEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOBEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOCEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIODEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOEEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOFEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOGEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOHEN LL_AHB2_GRP1_DisableClock
- AHB2ENR GPIOIEN LL_AHB2_GRP1_DisableClock
- AHB2ENR OTGFSEN LL_AHB2_GRP1_DisableClock
- AHB2ENR ADCEN LL_AHB2_GRP1_DisableClock
- AHB2ENR DCMIEN LL_AHB2_GRP1_DisableClock
- AHB2ENR AESEN LL_AHB2_GRP1_DisableClock
- AHB2ENR HASHEN LL_AHB2_GRP1_DisableClock
- AHB2ENR RNGEN LL_AHB2_GRP1_DisableClock
- AHB2ENR OSPIMEN LL_AHB2_GRP1_DisableClock
- AHB2ENR SDMMC1EN LL_AHB2_GRP1_DisableClock

LL_AHB2_GRP1_ForceReset

Function name

__STATIC_INLINE void LL_AHB2_GRP1_ForceReset (uint32_t Periphs)

Function description

Force AHB2 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_ALL
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2RSTR GPIOARST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOBRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOCRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIODRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOERST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOFRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOGRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOHRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR GPIOIRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR OTGFSRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR ADCRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR DCMIRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR AESRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR HASHRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR RNGRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR OSPIMRST LL_AHB2_GRP1_ForceReset
- AHB2RSTR SDMMC1RST LL_AHB2_GRP1_ForceReset

`LL_AHB2_GRP1_ReleaseReset`

Function name

__STATIC_INLINE void LL_AHB2_GRP1_ReleaseReset (uint32_t Periphs)

Function description

Release AHB2 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_ALL
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2RSTR GPIOARST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOBRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOCRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIODRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOERST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOFRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOGRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOHRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR GPIOIRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR OTGFSRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR ADCRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR DCMIRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR AESRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR HASHRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR RNGRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR OSPIMRST LL_AHB2_GRP1_ReleaseReset
- AHB2RSTR SDMMC1RST LL_AHB2_GRP1_ReleaseReset

LL_AHB2_GRP1_EnableClockStopSleep

Function name

__STATIC_INLINE void LL_AHB2_GRP1_EnableClockStopSleep (uint32_t Periphs)

Function description

Enable AHB2 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_SRAM2
  - LL_AHB2_GRP1_PERIPH_SRAM3 (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2SMENR GPIOASMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOBSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOCSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIODSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOESMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOFSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOGSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOHSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR GPIOISMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR SRAM2SMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR SRAM3SMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR OTGFSSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR ADCSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR DCMISMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR AESSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR HASHSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR RNGSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR OSPIMSMEN LL_AHB2_GRP1_EnableClockStopSleep
- AHB2SMENR SDMMC1SMEN LL_AHB2_GRP1_EnableClockStopSleep

`LL_AHB2_GRP1_DisableClockStopSleep`

Function name

__STATIC_INLINE void LL_AHB2_GRP1_DisableClockStopSleep (uint32_t Periphs)

Function description

Disable AHB2 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_GPIOA
  - LL_AHB2_GRP1_PERIPH_GPIOB
  - LL_AHB2_GRP1_PERIPH_GPIOC
  - LL_AHB2_GRP1_PERIPH_GPIOD (*)
  - LL_AHB2_GRP1_PERIPH_GPIOE (*)
  - LL_AHB2_GRP1_PERIPH_GPIOF (*)
  - LL_AHB2_GRP1_PERIPH_GPIOG (*)
  - LL_AHB2_GRP1_PERIPH_GPIOH
  - LL_AHB2_GRP1_PERIPH_GPIOI (*)
  - LL_AHB2_GRP1_PERIPH_SRAM2
  - LL_AHB2_GRP1_PERIPH_SRAM3 (*)
  - LL_AHB2_GRP1_PERIPH_OTGFS (*)
  - LL_AHB2_GRP1_PERIPH_ADC
  - LL_AHB2_GRP1_PERIPH_DCMI (*)
  - LL_AHB2_GRP1_PERIPH_AES (*)
  - LL_AHB2_GRP1_PERIPH_HASH (*)
  - LL_AHB2_GRP1_PERIPH_RNG
  - LL_AHB2_GRP1_PERIPH_OSPIM (*)
  - LL_AHB2_GRP1_PERIPH_SDMMC1 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB2SMENR GPIOASMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOBSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOCSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIODSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOESMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOFSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOGSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOHSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR GPIOISMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR SRAM2SMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR SRAM3SMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR OTGFSSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR ADCSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR DCMISMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR AESSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR HASHSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR RNGSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR OSPIMSMEN LL_AHB2_GRP1_DisableClockStopSleep
- AHB2SMENR SDMMC1SMEN LL_AHB2_GRP1_DisableClockStopSleep

`LL_AHB3_GRP1_EnableClock`

Function name

__STATIC_INLINE void LL_AHB3_GRP1_EnableClock (uint32_t Periphs)

Function description

Enable AHB3 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB3ENR FMCEN LL_AHB3_GRP1_EnableClock
- AHB3ENR QSPIEN LL_AHB3_GRP1_EnableClock
- AHB3ENR OSPI1EN LL_AHB3_GRP1_EnableClock
- AHB3ENR OSPI2EN LL_AHB3_GRP1_EnableClock

`LL_AHB3_GRP1_IsEnabledClock`

Function name

__STATIC_INLINE uint32_t LL_AHB3_GRP1_IsEnabledClock (uint32_t Periphs)

Function description

Check if AHB3 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- AHB3ENR FMCEN LL_AHB3_GRP1_IsEnabledClock
- AHB3ENR QSPIEN LL_AHB3_GRP1_IsEnabledClock
- AHB3ENR OSPI1EN LL_AHB3_GRP1_IsEnabledClock
- AHB3ENR OSPI2EN LL_AHB3_GRP1_IsEnabledClock

LL_AHB3_GRP1_DisableClock

Function name

__STATIC_INLINE void LL_AHB3_GRP1_DisableClock (uint32_t Periphs)

Function description

Disable AHB3 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB3ENR FMCEN LL_AHB3_GRP1_DisableClock
- AHB3ENR QSPIEN LL_AHB3_GRP1_DisableClock
- AHB3ENR OSPI1EN LL_AHB3_GRP1_DisableClock
- AHB3ENR OSPI2EN LL_AHB3_GRP1_DisableClock

LL_AHB3_GRP1_ForceReset

Function name

__STATIC_INLINE void LL_AHB3_GRP1_ForceReset (uint32_t Periphs)

Function description

Force AHB3 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB3_GRP1_PERIPH_ALL
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB3RSTR FMCRST LL_AHB3_GRP1_ForceReset
- AHB3RSTR QSPIRST LL_AHB3_GRP1_ForceReset
- AHB3RSTR OSPI1RST LL_AHB3_GRP1_ForceReset
- AHB3RSTR OSPI2RST LL_AHB3_GRP1_ForceReset

`LL_AHB3_GRP1_ReleaseReset`

Function name

__STATIC_INLINE void LL_AHB3_GRP1_ReleaseReset (uint32_t Periphs)

Function description

Release AHB3 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB2_GRP1_PERIPH_ALL
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB3RSTR FMCRST LL_AHB3_GRP1_ReleaseReset
- AHB3RSTR QSPIRST LL_AHB3_GRP1_ReleaseReset
- AHB3RSTR OSPI1RST LL_AHB3_GRP1_ReleaseReset
- AHB3RSTR OSPI2RST LL_AHB3_GRP1_ReleaseReset

`LL_AHB3_GRP1_EnableClockStopSleep`

Function name

__STATIC_INLINE void LL_AHB3_GRP1_EnableClockStopSleep (uint32_t Periphs)

Function description

Enable AHB3 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB3SMENR FMCSMEN LL_AHB3_GRP1_EnableClockStopSleep
- AHB3SMENR QSPISMEN LL_AHB3_GRP1_EnableClockStopSleep
- AHB3SMENR OSPI1SMEN LL_AHB3_GRP1_EnableClockStopSleep
- AHB3SMENR OSPI2SMEN LL_AHB3_GRP1_EnableClockStopSleep

`LL_AHB3_GRP1_DisableClockStopSleep`

Function name

__STATIC_INLINE void LL_AHB3_GRP1_DisableClockStopSleep (uint32_t Periphs)

Function description

Disable AHB3 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_AHB3_GRP1_PERIPH_FMC (*)
  - LL_AHB3_GRP1_PERIPH_QSPI (*)
  - LL_AHB3_GRP1_PERIPH_OSPI1 (*)
  - LL_AHB3_GRP1_PERIPH_OSPI2 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHB3SMENR FMCSMEN LL_AHB3_GRP1_DisableClockStopSleep
- AHB3SMENR QSPISMEN LL_AHB3_GRP1_DisableClockStopSleep
- AHB3SMENR OSPI1SMEN LL_AHB3_GRP1_DisableClockStopSleep
- AHB3SMENR OSPI2SMEN LL_AHB3_GRP1_DisableClockStopSleep
-

`LL_APB1_GRP1_EnableClock`

Function name

__STATIC_INLINE void LL_APB1_GRP1_EnableClock (uint32_t Periphs)

Function description

Enable APB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_RTCAPB (*)
  - LL_APB1_GRP1_PERIPH_WWDG
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1ENR1 TIM2EN LL_APB1_GRP1_EnableClock
- APB1ENR1 TIM3EN LL_APB1_GRP1_EnableClock
- APB1ENR1 TIM4EN LL_APB1_GRP1_EnableClock
- APB1ENR1 TIM5EN LL_APB1_GRP1_EnableClock
- APB1ENR1 TIM6EN LL_APB1_GRP1_EnableClock
- APB1ENR1 TIM7EN LL_APB1_GRP1_EnableClock
- APB1ENR1 LCDEN LL_APB1_GRP1_EnableClock
- APB1ENR1 RTCAPBEN LL_APB1_GRP1_EnableClock
- APB1ENR1 WWDGEN LL_APB1_GRP1_EnableClock
- APB1ENR1 SPI2EN LL_APB1_GRP1_EnableClock
- APB1ENR1 SPI3EN LL_APB1_GRP1_EnableClock
- APB1ENR1 USART2EN LL_APB1_GRP1_EnableClock
- APB1ENR1 USART3EN LL_APB1_GRP1_EnableClock
- APB1ENR1 UART4EN LL_APB1_GRP1_EnableClock
- APB1ENR1 UART5EN LL_APB1_GRP1_EnableClock
- APB1ENR1 I2C1EN LL_APB1_GRP1_EnableClock
- APB1ENR1 I2C2EN LL_APB1_GRP1_EnableClock
- APB1ENR1 I2C3EN LL_APB1_GRP1_EnableClock
- APB1ENR1 CRSEN LL_APB1_GRP1_EnableClock
- APB1ENR1 CAN1EN LL_APB1_GRP1_EnableClock
- APB1ENR1 USBFSEN LL_APB1_GRP1_EnableClock
- APB1ENR1 CAN2EN LL_APB1_GRP1_EnableClock
- APB1ENR1 PWREN LL_APB1_GRP1_EnableClock
- APB1ENR1 DAC1EN LL_APB1_GRP1_EnableClock
- APB1ENR1 OPAMPEN LL_APB1_GRP1_EnableClock
- APB1ENR1 LPTIM1EN LL_APB1_GRP1_EnableClock

`LL_APB1_GRP2_EnableClock`

Function name

__STATIC_INLINE void LL_APB1_GRP2_EnableClock (uint32_t Periphs)

Function description

Enable APB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1ENR2 LPUART1EN LL_APB1_GRP2_EnableClock
- APB1ENR2 I2C4EN LL_APB1_GRP2_EnableClock
- APB1ENR2 SWPMI1EN LL_APB1_GRP2_EnableClock
- APB1ENR2 LPTIM2EN LL_APB1_GRP2_EnableClock

`LL_APB1_GRP1_IsEnabledClock`

Function name

__STATIC_INLINE uint32_t LL_APB1_GRP1_IsEnabledClock (uint32_t Periphs)

Function description

Check if APB1 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_RTCAPB (*)
  - LL_APB1_GRP1_PERIPH_WWDG
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- APB1ENR1 TIM2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 TIM3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 TIM4EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 TIM5EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 TIM6EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 TIM7EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 LCDEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 RTCAPBEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 WWDGEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 SPI2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 SPI3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 USART2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 USART3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 UART4EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 UART5EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 I2C1EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 I2C2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 I2C3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 CRSEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 CAN1EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 USBFSEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 CAN2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 PWREN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 DAC1EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 OPAMPEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR1 LPTIM1EN LL_APB1_GRP1_IsEnabledClock

`LL_APB1_GRP2_IsEnabledClock`

Function name

__STATIC_INLINE uint32_t LL_APB1_GRP2_IsEnabledClock (uint32_t Periphs)

Function description

Check if APB1 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- APB1ENR2 LPUART1EN LL_APB1_GRP2_IsEnabledClock
- APB1ENR2 I2C4EN LL_APB1_GRP2_IsEnabledClock
- APB1ENR2 SWPMI1EN LL_APB1_GRP2_IsEnabledClock
- APB1ENR2 LPTIM2EN LL_APB1_GRP2_IsEnabledClock

LL_APB1_GRP1_DisableClock

Function name

__STATIC_INLINE void LL_APB1_GRP1_DisableClock (uint32_t Periphs)

Function description

Disable APB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_RTCAPB (*)
  - LL_APB1_GRP1_PERIPH_WWDG
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1ENR1 TIM2EN LL_APB1_GRP1_DisableClock
- APB1ENR1 TIM3EN LL_APB1_GRP1_DisableClock
- APB1ENR1 TIM4EN LL_APB1_GRP1_DisableClock
- APB1ENR1 TIM5EN LL_APB1_GRP1_DisableClock
- APB1ENR1 TIM6EN LL_APB1_GRP1_DisableClock
- APB1ENR1 TIM7EN LL_APB1_GRP1_DisableClock
- APB1ENR1 LCDEN LL_APB1_GRP1_DisableClock
- APB1ENR1 RTCAPBEN LL_APB1_GRP1_DisableClock
- APB1ENR1 WWDGEN LL_APB1_GRP1_DisableClock
- APB1ENR1 SPI2EN LL_APB1_GRP1_DisableClock
- APB1ENR1 SPI3EN LL_APB1_GRP1_DisableClock
- APB1ENR1 USART2EN LL_APB1_GRP1_DisableClock
- APB1ENR1 USART3EN LL_APB1_GRP1_DisableClock
- APB1ENR1 UART4EN LL_APB1_GRP1_DisableClock
- APB1ENR1 UART5EN LL_APB1_GRP1_DisableClock
- APB1ENR1 I2C1EN LL_APB1_GRP1_DisableClock
- APB1ENR1 I2C2EN LL_APB1_GRP1_DisableClock
- APB1ENR1 I2C3EN LL_APB1_GRP1_DisableClock
- APB1ENR1 CRSEN LL_APB1_GRP1_DisableClock
- APB1ENR1 CAN1EN LL_APB1_GRP1_DisableClock
- APB1ENR1 USBFSEN LL_APB1_GRP1_DisableClock
- APB1ENR1 CAN2EN LL_APB1_GRP1_DisableClock
- APB1ENR1 PWREN LL_APB1_GRP1_DisableClock
- APB1ENR1 DAC1EN LL_APB1_GRP1_DisableClock
- APB1ENR1 OPAMPEN LL_APB1_GRP1_DisableClock
- APB1ENR1 LPTIM1EN LL_APB1_GRP1_DisableClock

`LL_APB1_GRP2_DisableClock`

Function name

__STATIC_INLINE void LL_APB1_GRP2_DisableClock (uint32_t Periphs)

Function description

Disable APB1 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1ENR2 LPUART1EN LL_APB1_GRP2_DisableClock
- APB1ENR2 I2C4EN LL_APB1_GRP2_DisableClock
- APB1ENR2 SWPMI1EN LL_APB1_GRP2_DisableClock
- APB1ENR2 LPTIM2EN LL_APB1_GRP2_DisableClock

`LL_APB1_GRP1_ForceReset`

Function name

__STATIC_INLINE void LL_APB1_GRP1_ForceReset (uint32_t Periphs)

Function description

Force APB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_ALL
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1RSTR1 TIM2RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 TIM3RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 TIM4RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 TIM5RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 TIM6RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 TIM7RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 LCDRST LL_APB1_GRP1_ForceReset
- APB1RSTR1 SPI2RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 SPI3RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 USART2RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 USART3RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 UART4RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 UART5RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 I2C1RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 I2C2RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 I2C3RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 CRSRST LL_APB1_GRP1_ForceReset
- APB1RSTR1 CAN1RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 USBFSRST LL_APB1_GRP1_ForceReset
- APB1RSTR1 CAN2RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 PWRRST LL_APB1_GRP1_ForceReset
- APB1RSTR1 DAC1RST LL_APB1_GRP1_ForceReset
- APB1RSTR1 OPAMPRST LL_APB1_GRP1_ForceReset
- APB1RSTR1 LPTIM1RST LL_APB1_GRP1_ForceReset

`LL_APB1_GRP2_ForceReset`

Function name

__STATIC_INLINE void LL_APB1_GRP2_ForceReset (uint32_t Periphs)

Function description

Force APB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_ALL
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1RSTR2 LPUART1RST LL_APB1_GRP2_ForceReset
- APB1RSTR2 I2C4RST LL_APB1_GRP2_ForceReset
- APB1RSTR2 SWPMI1RST LL_APB1_GRP2_ForceReset
- APB1RSTR2 LPTIM2RST LL_APB1_GRP2_ForceReset

`LL_APB1_GRP1_ReleaseReset`

Function name

__STATIC_INLINE void LL_APB1_GRP1_ReleaseReset (uint32_t Periphs)

Function description

Release APB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_ALL
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1RSTR1 TIM2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 TIM3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 TIM4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 TIM5RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 TIM6RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 TIM7RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 LCDRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 SPI2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 SPI3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 USART2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 USART3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 UART4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 UART5RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 I2C1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 I2C2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 I2C3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 CRSRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 CAN1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 USBFSRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 CAN2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 PWRRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 DAC1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 OPAMPRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR1 LPTIM1RST LL_APB1_GRP1_ReleaseReset

`LL_APB1_GRP2_ReleaseReset`

Function name

__STATIC_INLINE void LL_APB1_GRP2_ReleaseReset (uint32_t Periphs)

Function description

Release APB1 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_ALL
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1RSTR2 LPUART1RST LL_APB1_GRP2_ReleaseReset
- APB1RSTR2 I2C4RST LL_APB1_GRP2_ReleaseReset
- APB1RSTR2 SWPMI1RST LL_APB1_GRP2_ReleaseReset
- APB1RSTR2 LPTIM2RST LL_APB1_GRP2_ReleaseReset

`LL_APB1_GRP1_EnableClockStopSleep`

Function name

__STATIC_INLINE void LL_APB1_GRP1_EnableClockStopSleep (uint32_t Periphs)

Function description

Enable APB1 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_RTCAPB (*)
  - LL_APB1_GRP1_PERIPH_WWDG
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1SMENR1 TIM2SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 TIM3SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 TIM4SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 TIM5SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 TIM6SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 TIM7SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 LCDSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 RTCAPBSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 WWDGSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 SPI2SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 SPI3SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 USART2SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 USART3SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 UART4SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 UART5SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 I2C1SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 I2C2SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 I2C3SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 CRSSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 CAN1SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 USBFSSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 CAN2SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 PWRSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 DAC1SMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 OPAMPSMEN LL_APB1_GRP1_EnableClockStopSleep
- APB1SMENR1 LPTIM1SMEN LL_APB1_GRP1_EnableClockStopSleep

`LL_APB1_GRP2_EnableClockStopSleep`

Function name

__STATIC_INLINE void LL_APB1_GRP2_EnableClockStopSleep (uint32_t Periphs)

Function description

Enable APB1 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1SMENR2 LPUART1SMEN LL_APB1_GRP2_EnableClockStopSleep
- APB1SMENR2 I2C4SMEN LL_APB1_GRP2_EnableClockStopSleep
- APB1SMENR2 SWPMI1SMEN LL_APB1_GRP2_EnableClockStopSleep
- APB1SMENR2 LPTIM2SMEN LL_APB1_GRP2_EnableClockStopSleep

`LL_APB1_GRP1_DisableClockStopSleep`

Function name

__STATIC_INLINE void LL_APB1_GRP1_DisableClockStopSleep (uint32_t Periphs)

Function description

Disable APB1 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP1_PERIPH_TIM2
  - LL_APB1_GRP1_PERIPH_TIM3 (*)
  - LL_APB1_GRP1_PERIPH_TIM4 (*)
  - LL_APB1_GRP1_PERIPH_TIM5 (*)
  - LL_APB1_GRP1_PERIPH_TIM6
  - LL_APB1_GRP1_PERIPH_TIM7
  - LL_APB1_GRP1_PERIPH_LCD (*)
  - LL_APB1_GRP1_PERIPH_RTCAPB (*)
  - LL_APB1_GRP1_PERIPH_WWDG
  - LL_APB1_GRP1_PERIPH_SPI2 (*)
  - LL_APB1_GRP1_PERIPH_SPI3
  - LL_APB1_GRP1_PERIPH_USART2
  - LL_APB1_GRP1_PERIPH_USART3 (*)
  - LL_APB1_GRP1_PERIPH_UART4 (*)
  - LL_APB1_GRP1_PERIPH_UART5 (*)
  - LL_APB1_GRP1_PERIPH_I2C1
  - LL_APB1_GRP1_PERIPH_I2C2 (*)
  - LL_APB1_GRP1_PERIPH_I2C3
  - LL_APB1_GRP1_PERIPH_CRS (*)
  - LL_APB1_GRP1_PERIPH_CAN1
  - LL_APB1_GRP1_PERIPH_CAN2 (*)
  - LL_APB1_GRP1_PERIPH_USB (*)
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_OPAMP
  - LL_APB1_GRP1_PERIPH_LPTIM1

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1SMENR1 TIM2SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 TIM3SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 TIM4SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 TIM5SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 TIM6SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 TIM7SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 LCDSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 RTCAPBSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 WWDGSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 SPI2SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 SPI3SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 USART2SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 USART3SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 UART4SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 UART5SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 I2C1SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 I2C2SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 I2C3SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 CRSSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 CAN1SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 USBFSSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 CAN2SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 PWRSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 DAC1SMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 OPAMPSMEN LL_APB1_GRP1_DisableClockStopSleep
- APB1SMENR1 LPTIM1SMEN LL_APB1_GRP1_DisableClockStopSleep

`LL_APB1_GRP2_DisableClockStopSleep`

Function name

__STATIC_INLINE void LL_APB1_GRP2_DisableClockStopSleep (uint32_t Periphs)

Function description

Disable APB1 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB1_GRP2_PERIPH_LPUART1
  - LL_APB1_GRP2_PERIPH_I2C4 (*)
  - LL_APB1_GRP2_PERIPH_SWPMI1 (*)
  - LL_APB1_GRP2_PERIPH_LPTIM2

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1SMENR2 LPUART1SMEN LL_APB1_GRP2_DisableClockStopSleep
- APB1SMENR2 I2C4SMEN LL_APB1_GRP2_DisableClockStopSleep
- APB1SMENR2 SWPMI1SMEN LL_APB1_GRP2_DisableClockStopSleep
- APB1SMENR2 LPTIM2SMEN LL_APB1_GRP2_DisableClockStopSleep

`LL_APB2_GRP1_EnableClock`

Function name

__STATIC_INLINE void LL_APB2_GRP1_EnableClock (uint32_t Periphs)

Function description

Enable APB2 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_FW
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB2ENR SYSCFGEN LL_APB2_GRP1_EnableClock
- APB2ENR FWEN LL_APB2_GRP1_EnableClock
- APB2ENR SDMMC1EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM1EN LL_APB2_GRP1_EnableClock
- APB2ENR SPI1EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM8EN LL_APB2_GRP1_EnableClock
- APB2ENR USART1EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM15EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM16EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM17EN LL_APB2_GRP1_EnableClock
- APB2ENR SAI1EN LL_APB2_GRP1_EnableClock
- APB2ENR SAI2EN LL_APB2_GRP1_EnableClock
- APB2ENR DFSDM1EN LL_APB2_GRP1_EnableClock
- APB2ENR LTDCEN LL_APB2_GRP1_EnableClock
- APB2ENR DSIEN LL_APB2_GRP1_EnableClock

`LL_APB2_GRP1_IsEnabledClock`

Function name

__STATIC_INLINE uint32_t LL_APB2_GRP1_IsEnabledClock (uint32_t Periphs)

Function description

Check if APB2 peripheral clock is enabled or not.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_FW
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- APB2ENR SYSCFGEN LL_APB2_GRP1_IsEnabledClock
- APB2ENR FWEN LL_APB2_GRP1_IsEnabledClock
- APB2ENR SDMMC1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR SPI1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM8EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR USART1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM15EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM16EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM17EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR SAI1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR SAI2EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR DFSDM1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR LTDCEN LL_APB2_GRP1_IsEnabledClock
- APB2ENR DSIEN LL_APB2_GRP1_IsEnabledClock

`LL_APB2_GRP1_DisableClock`

Function name

__STATIC_INLINE void LL_APB2_GRP1_DisableClock (uint32_t Periphs)

Function description

Disable APB2 peripherals clock.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB2ENR SYSCFGEN LL_APB2_GRP1_DisableClock
- APB2ENR SDMMC1EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM1EN LL_APB2_GRP1_DisableClock
- APB2ENR SPI1EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM8EN LL_APB2_GRP1_DisableClock
- APB2ENR USART1EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM15EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM16EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM17EN LL_APB2_GRP1_DisableClock
- APB2ENR SAI1EN LL_APB2_GRP1_DisableClock
- APB2ENR SAI2EN LL_APB2_GRP1_DisableClock
- APB2ENR DFSDM1EN LL_APB2_GRP1_DisableClock
- APB2ENR LTDCEN LL_APB2_GRP1_DisableClock
- APB2ENR DSIEN LL_APB2_GRP1_DisableClock

`LL_APB2_GRP1_ForceReset`

Function name

__STATIC_INLINE void LL_APB2_GRP1_ForceReset (uint32_t Periphs)

Function description

Force APB2 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_ALL
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB2RSTR SYSCFGRST LL_APB2_GRP1_ForceReset
- APB2RSTR SDMMC1RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM1RST LL_APB2_GRP1_ForceReset
- APB2RSTR SPI1RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM8RST LL_APB2_GRP1_ForceReset
- APB2RSTR USART1RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM15RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM16RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM17RST LL_APB2_GRP1_ForceReset
- APB2RSTR SAI1RST LL_APB2_GRP1_ForceReset
- APB2RSTR SAI2RST LL_APB2_GRP1_ForceReset
- APB2RSTR DFSDM1RST LL_APB2_GRP1_ForceReset
- APB2RSTR LTDCRST LL_APB2_GRP1_ForceReset
- APB2RSTR DSIRST LL_APB2_GRP1_ForceReset

`LL_APB2_GRP1_ReleaseReset`

Function name

__STATIC_INLINE void LL_APB2_GRP1_ReleaseReset (uint32_t Periphs)

Function description

Release APB2 peripherals reset.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_ALL
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB2RSTR SYSCFGRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SDMMC1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SPI1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM8RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR USART1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM15RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM16RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM17RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SAI1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SAI2RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR DFSDM1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR LTDCRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR DSIRST LL_APB2_GRP1_ReleaseReset

`LL_APB2_GRP1_EnableClockStopSleep`

Function name

__STATIC_INLINE void LL_APB2_GRP1_EnableClockStopSleep (uint32_t Periphs)

Function description

Enable APB2 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB2SMENR SYSCFGSMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR SDMMC1SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR TIM1SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR SPI1SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR TIM8SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR USART1SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR TIM15SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR TIM16SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR TIM17SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR SAI1SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR SAI2SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR DFSDM1SMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR LTDCSMEN LL_APB2_GRP1_EnableClockStopSleep
- APB2SMENR DSISMEN LL_APB2_GRP1_EnableClockStopSleep

`LL_APB2_GRP1_DisableClockStopSleep`

Function name

__STATIC_INLINE void LL_APB2_GRP1_DisableClockStopSleep (uint32_t Periphs)

Function description

Disable APB2 peripheral clocks in Sleep and Stop modes.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_SDMMC1 (*)
  - LL_APB2_GRP1_PERIPH_TIM1
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_TIM8 (*)
  - LL_APB2_GRP1_PERIPH_USART1
  - LL_APB2_GRP1_PERIPH_TIM15
  - LL_APB2_GRP1_PERIPH_TIM16
  - LL_APB2_GRP1_PERIPH_TIM17 (*)
  - LL_APB2_GRP1_PERIPH_SAI1
  - LL_APB2_GRP1_PERIPH_SAI2 (*)
  - LL_APB2_GRP1_PERIPH_DFSDM1 (*)
  - LL_APB2_GRP1_PERIPH_LTDC (*)
  - LL_APB2_GRP1_PERIPH_DSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB2SMENR SYSCFGSMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR SDMMC1SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR TIM1SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR SPI1SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR TIM8SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR USART1SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR TIM15SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR TIM16SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR TIM17SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR SAI1SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR SAI2SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR DFSDM1SMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR LTDCSMEN LL_APB2_GRP1_DisableClockStopSleep
- APB2SMENR DSISMEN LL_APB2_GRP1_DisableClockStopSleep

81.2 BUS Firmware driver defines

The following section lists the various define and macros of the module.

81.2.1 BUS

BUS

AHB1 GRP1 PERIPH

LL_AHB1_GRP1_PERIPH_ALL

LL_AHB1_GRP1_PERIPH_DMA1

LL_AHB1_GRP1_PERIPH_DMA2

LL_AHB1_GRP1_PERIPH_DMAMUX1

LL_AHB1_GRP1_PERIPH_FLASH

LL_AHB1_GRP1_PERIPH_CRC

LL_AHB1_GRP1_PERIPH_TSC

LL_AHB1_GRP1_PERIPH_DMA2D

LL_AHB1_GRP1_PERIPH_GFXMMU

LL_AHB1_GRP1_PERIPH_SRAM1

AHB2 GRP1 PERIPH

LL_AHB2_GRP1_PERIPH_ALL

LL_AHB2_GRP1_PERIPH_GPIOA

LL_AHB2_GRP1_PERIPH_GPIOB

LL_AHB2_GRP1_PERIPH_GPIOC

LL_AHB2_GRP1_PERIPH_GPIOD

LL_AHB2_GRP1_PERIPH_GPIOE

LL_AHB2_GRP1_PERIPH_GPIOF

LL_AHB2_GRP1_PERIPH_GPIOG

LL_AHB2_GRP1_PERIPH_GPIOH

LL_AHB2_GRP1_PERIPH_GPIOI

LL_AHB2_GRP1_PERIPH_OTGFS

LL_AHB2_GRP1_PERIPH_ADC

LL_AHB2_GRP1_PERIPH_DCMI

LL_AHB2_GRP1_PERIPH_AES

LL_AHB2_GRP1_PERIPH_HASH

LL_AHB2_GRP1_PERIPH_RNG

LL_AHB2_GRP1_PERIPH_OSPIM

LL_AHB2_GRP1_PERIPH_SDMMC1

LL_AHB2_GRP1_PERIPH_SRAM2

LL_AHB2_GRP1_PERIPH_SRAM3

AHB3 GRP1 PERIPH

LL_AHB3_GRP1_PERIPH_ALL

LL_AHB3_GRP1_PERIPH_FMC

LL_AHB3_GRP1_PERIPH_OSPI1

LL_AHB3_GRP1_PERIPH_OSPI2

APB1 GRP1 PERIPH

LL_APB1_GRP1_PERIPH_ALL

LL_APB1_GRP1_PERIPH_TIM2

LL_APB1_GRP1_PERIPH_TIM3

LL_APB1_GRP1_PERIPH_TIM4

LL_APB1_GRP1_PERIPH_TIM5

LL_APB1_GRP1_PERIPH_TIM6

LL_APB1_GRP1_PERIPH_TIM7

LL_APB1_GRP1_PERIPH_RTCAPB

LL_APB1_GRP1_PERIPH_WWDG

LL_APB1_GRP1_PERIPH_SPI2

LL_APB1_GRP1_PERIPH_SPI3

LL_APB1_GRP1_PERIPH_USART2

LL_APB1_GRP1_PERIPH_USART3

LL_APB1_GRP1_PERIPH_UART4

LL_APB1_GRP1_PERIPH_UART5

LL_APB1_GRP1_PERIPH_I2C1

LL_APB1_GRP1_PERIPH_I2C2

LL_APB1_GRP1_PERIPH_I2C3

LL_APB1_GRP1_PERIPH_CRS

LL_APB1_GRP1_PERIPH_CAN1

LL_APB1_GRP1_PERIPH_PWR

LL_APB1_GRP1_PERIPH_DAC1

LL_APB1_GRP1_PERIPH_OPAMP

LL_APB1_GRP1_PERIPH_LPTIM1

APB1 GRP2 PERIPH

LL_APB1_GRP2_PERIPH_ALL

LL_APB1_GRP2_PERIPH_LPUART1

LL_APB1_GRP2_PERIPH_I2C4

LL_APB1_GRP2_PERIPH_LPTIM2

APB2 GRP1 PERIPH

LL_APB2_GRP1_PERIPH_ALL

LL_APB2_GRP1_PERIPH_SYSCFG

LL_APB2_GRP1_PERIPH_FW

LL_APB2_GRP1_PERIPH_TIM1

LL_APB2_GRP1_PERIPH_SPI1

LL_APB2_GRP1_PERIPH_TIM8

LL_APB2_GRP1_PERIPH_USART1

LL_APB2_GRP1_PERIPH_TIM15

LL_APB2_GRP1_PERIPH_TIM16

LL_APB2_GRP1_PERIPH_TIM17

LL_APB2_GRP1_PERIPH_SAI1

LL_APB2_GRP1_PERIPH_SAI2

LL_APB2_GRP1_PERIPH_DFSDM1

LL_APB2_GRP1_PERIPH_LTDC

LL_APB2_GRP1_PERIPH_DSI

82 LL COMP Generic Driver

82.1 COMP Firmware driver registers structures

82.1.1 LL_COMP_InitTypeDef

LL_COMP_InitTypeDef is defined in the stm32l4xx_ll_comp.h

Data Fields

- ***uint32_t PowerMode***
- ***uint32_t InputPlus***
- ***uint32_t InputMinus***
- ***uint32_t InputHysteresis***
- ***uint32_t OutputPolarity***
- ***uint32_t OutputBlankingSource***

Field Documentation

- ***uint32_t LL_COMP_InitTypeDef::PowerMode***

  Set comparator operating mode to adjust power and speed. This parameter can be a value of ***COMP_LL_EC_POWERMODE***This feature can be modified afterwards using unitary function **LL_COMP_SetPowerMode()**.
- ***uint32_t LL_COMP_InitTypeDef::InputPlus***

  Set comparator input plus (non-inverting input). This parameter can be a value of ***COMP_LL_EC_INPUT_PLUS***This feature can be modified afterwards using unitary function **LL_COMP_SetInputPlus()**.
- ***uint32_t LL_COMP_InitTypeDef::InputMinus***

  Set comparator input minus (inverting input). This parameter can be a value of ***COMP_LL_EC_INPUT_MINUS***This feature can be modified afterwards using unitary function **LL_COMP_SetInputMinus()**.
- ***uint32_t LL_COMP_InitTypeDef::InputHysteresis***

  Set comparator hysteresis mode of the input minus. This parameter can be a value of ***COMP_LL_EC_INPUT_HYSTERESIS***This feature can be modified afterwards using unitary function **LL_COMP_SetInputHysteresis()**.
- ***uint32_t LL_COMP_InitTypeDef::OutputPolarity***

  Set comparator output polarity. This parameter can be a value of ***COMP_LL_EC_OUTPUT_POLARITY***This feature can be modified afterwards using unitary function **LL_COMP_SetOutputPolarity()**.
- ***uint32_t LL_COMP_InitTypeDef::OutputBlankingSource***

  Set comparator blanking source. This parameter can be a value of ***COMP_LL_EC_OUTPUT_BLANKING_SOURCE***This feature can be modified afterwards using unitary function **LL_COMP_SetOutputBlankingSource()**.

82.2 COMP Firmware driver API description

The following section lists the various functions of the COMP library.

82.2.1 Detailed description of functions

`LL_COMP_SetCommonWindowMode`

Function name

__STATIC_INLINE void LL_COMP_SetCommonWindowMode (COMP_Common_TypeDef * COMPxy_COMMON, uint32_t WindowMode)

Function description

Set window mode of a pair of comparators instances (2 consecutive COMP instances odd and even COMP<x> and COMP<x+1>).

Parameters

- **COMPxy_COMMON:** Comparator common instance (can be set directly from CMSIS definition or by using helper macro __LL_COMP_COMMON_INSTANCE())
- **WindowMode:** This parameter can be one of the following values:
  - LL_COMP_WINDOWMODE_DISABLE
  - LL_COMP_WINDOWMODE_COMP1_INPUT_PLUS_COMMON

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR WINMODE LL_COMP_SetCommonWindowMode

LL_COMP_GetCommonWindowMode

Function name

__STATIC_INLINE uint32_t LL_COMP_GetCommonWindowMode (COMP_Common_TypeDef * COMPxy_COMMON)

Function description

Get window mode of a pair of comparators instances (2 consecutive COMP instances odd and even COMP<x> and COMP<x+1>).

Parameters

- **COMPxy_COMMON:** Comparator common instance (can be set directly from CMSIS definition or by using helper macro __LL_COMP_COMMON_INSTANCE())

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_WINDOWMODE_DISABLE
  - LL_COMP_WINDOWMODE_COMP1_INPUT_PLUS_COMMON

Reference Manual to LL API cross reference:

- CSR WINMODE LL_COMP_GetCommonWindowMode

LL_COMP_SetPowerMode

Function name

__STATIC_INLINE void LL_COMP_SetPowerMode (COMP_TypeDef * COMPx, uint32_t PowerMode)

Function description

Set comparator instance operating mode to adjust power and speed.

Parameters

- **COMPx:** Comparator instance
- **PowerMode:** This parameter can be one of the following values:
  - LL_COMP_POWERMODE_HIGHSPEED
  - LL_COMP_POWERMODE_MEDIUMSPEED
  - LL_COMP_POWERMODE_ULTRALOWPOWER

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR PWRMODE LL_COMP_SetPowerMode

`LL_COMP_GetPowerMode`

Function name

__STATIC_INLINE uint32_t LL_COMP_GetPowerMode (COMP_TypeDef * COMPx)

Function description

Get comparator instance operating mode to adjust power and speed.

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_POWERMODE_HIGHSPEED
  - LL_COMP_POWERMODE_MEDIUMSPEED
  - LL_COMP_POWERMODE_ULTRALOWPOWER

Reference Manual to LL API cross reference:

- CSR PWRMODE LL_COMP_GetPowerMode

`LL_COMP_ConfigInputs`

Function name

__STATIC_INLINE void LL_COMP_ConfigInputs (COMP_TypeDef * COMPx, uint32_t InputMinus, uint32_t InputPlus)

Function description

Set comparator inputs minus (inverting) and plus (non-inverting).

Parameters

- **COMPx:** Comparator instance
- **InputMinus:** This parameter can be one of the following values:
  - LL_COMP_INPUT_MINUS_1_4VREFINT
  - LL_COMP_INPUT_MINUS_1_2VREFINT
  - LL_COMP_INPUT_MINUS_3_4VREFINT
  - LL_COMP_INPUT_MINUS_VREFINT
  - LL_COMP_INPUT_MINUS_DAC1_CH1
  - LL_COMP_INPUT_MINUS_DAC1_CH2 (*)
  - LL_COMP_INPUT_MINUS_IO1
  - LL_COMP_INPUT_MINUS_IO2
  - LL_COMP_INPUT_MINUS_IO3 (*)
  - LL_COMP_INPUT_MINUS_IO4 (*)
  - LL_COMP_INPUT_MINUS_IO5 (*)

  (*) Parameter not available on all devices.
- **InputPlus:** This parameter can be one of the following values:
  - LL_COMP_INPUT_PLUS_IO1
  - LL_COMP_INPUT_PLUS_IO2
  - LL_COMP_INPUT_PLUS_IO3 (*)

  (*) Parameter not available on all devices.

Return values

- **None:**

Notes

- In case of comparator input selected to be connected to IO: GPIO pins are specific to each comparator instance. Refer to description of parameters or to reference manual.
- On this STM32 serie, scaler bridge is configurable: to optimize power consumption, this function enables the voltage scaler bridge only when required (when selecting comparator input based on VrefInt: VrefInt or subdivision of VrefInt). For scaler bridge power consumption values, refer to device datasheet, parameter "IDDA(SCALER)".Voltage scaler requires a delay for voltage stabilization. Refer to device datasheet, parameter "tSTART_SCALER".Scaler bridge is common for all comparator instances, therefore if at least one of the comparator instance is requiring the scaler bridge, it remains enabled.

Reference Manual to LL API cross reference:

- CSR INMSEL LL_COMP_ConfigInputs
- CSR INPSEL LL_COMP_ConfigInputs
- CSR BRGEN LL_COMP_ConfigInputs
- CSR SCALEN LL_COMP_ConfigInputs

LL_COMP_SetInputPlus

Function name

__STATIC_INLINE void LL_COMP_SetInputPlus (COMP_TypeDef * COMPx, uint32_t InputPlus)

Function description

Set comparator input plus (non-inverting).

Parameters

- **COMPx:** Comparator instance
- **InputPlus:** This parameter can be one of the following values:
  - LL_COMP_INPUT_PLUS_IO1
  - LL_COMP_INPUT_PLUS_IO2
  - LL_COMP_INPUT_PLUS_IO3 (*)

  (*) Parameter not available on all devices.

Return values

- **None:**

Notes

- In case of comparator input selected to be connected to IO: GPIO pins are specific to each comparator instance. Refer to description of parameters or to reference manual.

Reference Manual to LL API cross reference:

- CSR INPSEL LL_COMP_SetInputPlus

LL_COMP_GetInputPlus

Function name

__STATIC_INLINE uint32_t LL_COMP_GetInputPlus (COMP_TypeDef * COMPx)

Function description

Get comparator input plus (non-inverting).

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_INPUT_PLUS_IO1
  - LL_COMP_INPUT_PLUS_IO2
  - LL_COMP_INPUT_PLUS_IO3 (*)

  (*) Parameter not available on all devices.

Notes

- In case of comparator input selected to be connected to IO: GPIO pins are specific to each comparator instance. Refer to description of parameters or to reference manual.

Reference Manual to LL API cross reference:

- CSR INPSEL LL_COMP_GetInputPlus

LL_COMP_SetInputMinus

Function name

__STATIC_INLINE void LL_COMP_SetInputMinus (COMP_TypeDef * COMPx, uint32_t InputMinus)

Function description

Set comparator input minus (inverting).

Parameters

- **COMPx:** Comparator instance
- **InputMinus:** This parameter can be one of the following values:
  - LL_COMP_INPUT_MINUS_1_4VREFINT
  - LL_COMP_INPUT_MINUS_1_2VREFINT
  - LL_COMP_INPUT_MINUS_3_4VREFINT
  - LL_COMP_INPUT_MINUS_VREFINT
  - LL_COMP_INPUT_MINUS_DAC1_CH1
  - LL_COMP_INPUT_MINUS_DAC1_CH2 (*)
  - LL_COMP_INPUT_MINUS_IO1
  - LL_COMP_INPUT_MINUS_IO2
  - LL_COMP_INPUT_MINUS_IO3 (*)
  - LL_COMP_INPUT_MINUS_IO4 (*)
  - LL_COMP_INPUT_MINUS_IO5 (*)

  (*) Parameter not available on all devices.

Return values

- **None:**

Notes

- In case of comparator input selected to be connected to IO: GPIO pins are specific to each comparator instance. Refer to description of parameters or to reference manual.
- On this STM32 serie, scaler bridge is configurable: to optimize power consumption, this function enables the voltage scaler bridge only when required (when selecting comparator input based on VrefInt: VrefInt or subdivision of VrefInt). For scaler bridge power consumption values, refer to device datasheet, parameter "IDDA(SCALER)".Voltage scaler requires a delay for voltage stabilization. Refer to device datasheet, parameter "tSTART_SCALER".Scaler bridge is common for all comparator instances, therefore if at least one of the comparator instance is requiring the scaler bridge, it remains enabled.

Reference Manual to LL API cross reference:

- CSR INMSEL LL_COMP_SetInputMinus
- CSR BRGEN LL_COMP_SetInputMinus
- CSR SCALEN LL_COMP_SetInputMinus

LL_COMP_GetInputMinus

Function name

__STATIC_INLINE uint32_t LL_COMP_GetInputMinus (COMP_TypeDef * COMPx)

Function description

Get comparator input minus (inverting).

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_INPUT_MINUS_1_4VREFINT
  - LL_COMP_INPUT_MINUS_1_2VREFINT
  - LL_COMP_INPUT_MINUS_3_4VREFINT
  - LL_COMP_INPUT_MINUS_VREFINT
  - LL_COMP_INPUT_MINUS_DAC1_CH1
  - LL_COMP_INPUT_MINUS_DAC1_CH2 (*)
  - LL_COMP_INPUT_MINUS_IO1
  - LL_COMP_INPUT_MINUS_IO2
  - LL_COMP_INPUT_MINUS_IO3 (*)
  - LL_COMP_INPUT_MINUS_IO4 (*)
  - LL_COMP_INPUT_MINUS_IO5 (*)

  (*) Parameter not available on all devices.

Notes

- In case of comparator input selected to be connected to IO: GPIO pins are specific to each comparator instance. Refer to description of parameters or to reference manual.

Reference Manual to LL API cross reference:

- CSR INMSEL LL_COMP_GetInputMinus
- CSR BRGEN LL_COMP_GetInputMinus
- CSR SCALEN LL_COMP_GetInputMinus

LL_COMP_SetInputHysteresis

Function name

__STATIC_INLINE void LL_COMP_SetInputHysteresis (COMP_TypeDef * COMPx, uint32_t InputHysteresis)

Function description

Set comparator instance hysteresis mode of the input minus (inverting input).

Parameters

- **COMPx:** Comparator instance
- **InputHysteresis:** This parameter can be one of the following values:
  - LL_COMP_HYSTERESIS_NONE
  - LL_COMP_HYSTERESIS_LOW
  - LL_COMP_HYSTERESIS_MEDIUM
  - LL_COMP_HYSTERESIS_HIGH

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR HYST LL_COMP_SetInputHysteresis

`LL_COMP_GetInputHysteresis`

Function name

__STATIC_INLINE uint32_t LL_COMP_GetInputHysteresis (COMP_TypeDef * COMPx)

Function description

Get comparator instance hysteresis mode of the minus (inverting) input.

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_HYSTERESIS_NONE
  - LL_COMP_HYSTERESIS_LOW
  - LL_COMP_HYSTERESIS_MEDIUM
  - LL_COMP_HYSTERESIS_HIGH

Reference Manual to LL API cross reference:

- CSR HYST LL_COMP_GetInputHysteresis

`LL_COMP_SetOutputPolarity`

Function name

__STATIC_INLINE void LL_COMP_SetOutputPolarity (COMP_TypeDef * COMPx, uint32_t OutputPolarity)

Function description

Set comparator instance output polarity.

Parameters

- **COMPx:** Comparator instance
- **OutputPolarity:** This parameter can be one of the following values:
  - LL_COMP_OUTPUTPOL_NONINVERTED
  - LL_COMP_OUTPUTPOL_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR POLARITY LL_COMP_SetOutputPolarity

`LL_COMP_GetOutputPolarity`

Function name

__STATIC_INLINE uint32_t LL_COMP_GetOutputPolarity (COMP_TypeDef * COMPx)

Function description

Get comparator instance output polarity.

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_OUTPUTPOL_NONINVERTED
  - LL_COMP_OUTPUTPOL_INVERTED

Reference Manual to LL API cross reference:

- CSR POLARITY LL_COMP_GetOutputPolarity

`LL_COMP_SetOutputBlankingSource`

Function name

__STATIC_INLINE void LL_COMP_SetOutputBlankingSource (COMP_TypeDef * COMPx, uint32_t BlankingSource)

Function description

Set comparator instance blanking source.

Parameters

- **COMPx:** Comparator instance
- **BlankingSource:** This parameter can be one of the following values:
  - LL_COMP_BLANKINGSRC_NONE
  - LL_COMP_BLANKINGSRC_TIM1_OC5_COMP1 (1)(2)
  - LL_COMP_BLANKINGSRC_TIM2_OC3_COMP1 (1)(2)
  - LL_COMP_BLANKINGSRC_TIM3_OC3_COMP1 (1)(2)
  - LL_COMP_BLANKINGSRC_TIM3_OC4_COMP2 (1)(3)
  - LL_COMP_BLANKINGSRC_TIM8_OC5_COMP2 (1)(3)
  - LL_COMP_BLANKINGSRC_TIM15_OC1_COMP2 (1)(3)

  (1) Parameter availability depending on timer availability on the selected device. (2) On STM32L4, parameter available only on comparator instance: COMP1. (3) On STM32L4, parameter available only on comparator instance: COMP2.

Return values

- **None:**

Notes

- Blanking source may be specific to each comparator instance. Refer to description of parameters or to reference manual.
- Availability of parameters of blanking source from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:

- CSR BLANKING LL_COMP_SetOutputBlankingSource

`LL_COMP_GetOutputBlankingSource`

Function name

__STATIC_INLINE uint32_t LL_COMP_GetOutputBlankingSource (COMP_TypeDef * COMPx)

Function description

Get comparator instance blanking source.

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_BLANKINGSRC_NONE
  - LL_COMP_BLANKINGSRC_TIM1_OC5_COMP1 (1)(2)
  - LL_COMP_BLANKINGSRC_TIM2_OC3_COMP1 (1)(2)
  - LL_COMP_BLANKINGSRC_TIM3_OC3_COMP1 (1)(2)
  - LL_COMP_BLANKINGSRC_TIM3_OC4_COMP2 (1)(3)
  - LL_COMP_BLANKINGSRC_TIM8_OC5_COMP2 (1)(3)
  - LL_COMP_BLANKINGSRC_TIM15_OC1_COMP2 (1)(3)

  (1) Parameter availability depending on timer availability on the selected device. (2) On STM32L4, parameter available only on comparator instance: COMP1. (3) On STM32L4, parameter available only on comparator instance: COMP2.

Notes

- Availability of parameters of blanking source from timer depends on timers availability on the selected device.
- Blanking source may be specific to each comparator instance. Refer to description of parameters or to reference manual.

Reference Manual to LL API cross reference:

- CSR BLANKING LL_COMP_GetOutputBlankingSource

`LL_COMP_SetInputNonInverting`

Function name

__STATIC_INLINE void LL_COMP_SetInputNonInverting (COMP_TypeDef * COMPx, uint32_t InputNonInverting)

Function description

`LL_COMP_GetInputNonInverting`

Function name

__STATIC_INLINE uint32_t LL_COMP_GetInputNonInverting (COMP_TypeDef * COMPx)

Function description

`LL_COMP_SetInputInverting`

Function name

__STATIC_INLINE void LL_COMP_SetInputInverting (COMP_TypeDef * COMPx, uint32_t InputInverting)

Function description

`LL_COMP_GetInputInverting`

Function name

__STATIC_INLINE uint32_t LL_COMP_GetInputInverting (COMP_TypeDef * COMPx)

Function description

`LL_COMP_Enable`

Function name

__STATIC_INLINE void LL_COMP_Enable (COMP_TypeDef * COMPx)

Function description

Enable comparator instance.

Parameters

- **COMPx:** Comparator instance

Return values

- **None:**

Notes

- After enable from off state, comparator requires a delay to reach reach propagation delay specification. Refer to device datasheet, parameter "tSTART".

Reference Manual to LL API cross reference:

- CSR EN LL_COMP_Enable

`LL_COMP_Disable`

Function name

__STATIC_INLINE void LL_COMP_Disable (COMP_TypeDef * COMPx)

Function description

Disable comparator instance.

Parameters

- **COMPx:** Comparator instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR EN LL_COMP_Disable

`LL_COMP_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_COMP_IsEnabled (COMP_TypeDef * COMPx)

Function description

Get comparator enable state (0: COMP is disabled, 1: COMP is enabled)

Parameters

- **COMPx:** Comparator instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR EN LL_COMP_IsEnabled

`LL_COMP_Lock`

Function name

__STATIC_INLINE void LL_COMP_Lock (COMP_TypeDef * COMPx)

Function description

Lock comparator instance.

Parameters

- **COMPx:** Comparator instance

Return values

- **None:**

Notes

- Once locked, comparator configuration can be accessed in read-only.
- The only way to unlock the comparator is a device hardware reset.

Reference Manual to LL API cross reference:

- CSR LOCK LL_COMP_Lock

`LL_COMP_IsLocked`

Function name

__STATIC_INLINE uint32_t LL_COMP_IsLocked (COMP_TypeDef * COMPx)

Function description

Get comparator lock state (0: COMP is unlocked, 1: COMP is locked).

Parameters

- **COMPx:** Comparator instance

Return values

- **State:** of bit (1 or 0).

Notes

- Once locked, comparator configuration can be accessed in read-only.
- The only way to unlock the comparator is a device hardware reset.

Reference Manual to LL API cross reference:

- CSR LOCK LL_COMP_IsLocked

`LL_COMP_ReadOutputLevel`

Function name

__STATIC_INLINE uint32_t LL_COMP_ReadOutputLevel (COMP_TypeDef * COMPx)

Function description

Read comparator instance output level.

Parameters

- **COMPx:** Comparator instance

Return values

- **Returned:** value can be one of the following values:
  - LL_COMP_OUTPUT_LEVEL_LOW
  - LL_COMP_OUTPUT_LEVEL_HIGH

Notes

- The comparator output level depends on the selected polarity (Refer to function LL_COMP_SetOutputPolarity()). If the comparator polarity is not inverted: Comparator output is low when the input plus is at a lower voltage than the input minusComparator output is high when the input plus is at a higher voltage than the input minus If the comparator polarity is inverted:Comparator output is high when the input plus is at a lower voltage than the input minusComparator output is low when the input plus is at a higher voltage than the input minus

Reference Manual to LL API cross reference:

- CSR VALUE LL_COMP_ReadOutputLevel

`LL_COMP_DeInit`

Function name

ErrorStatus LL_COMP_DeInit (COMP_TypeDef * COMPx)

Function description

De-initialize registers of the selected COMP instance to their default reset values.

Parameters

- **COMPx:** COMP instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: COMP registers are de-initialized
  - ERROR: COMP registers are not de-initialized

Notes

- If comparator is locked, de-initialization by software is not possible. The only way to unlock the comparator is a device hardware reset.

`LL_COMP_Init`

Function name

ErrorStatus LL_COMP_Init (COMP_TypeDef * COMPx, LL_COMP_InitTypeDef * COMP_InitStruct)

Function description

Initialize some features of COMP instance.

Parameters

- **COMPx:** COMP instance
- **COMP_InitStruct:** Pointer to a LL_COMP_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: COMP registers are initialized
  - ERROR: COMP registers are not initialized

Notes

- This function configures features of the selected COMP instance. Some features are also available at scope COMP common instance (common to several COMP instances). Refer to functions having argument "COMPxy_COMMON" as parameter.

`LL_COMP_StructInit`

Function name

void LL_COMP_StructInit (LL_COMP_InitTypeDef * COMP_InitStruct)

Function description

Set each LL_COMP_InitTypeDef field to default value.

Parameters

- **COMP_InitStruct:** Pointer to a LL_COMP_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

82.3 COMP Firmware driver defines

The following section lists the various define and macros of the module.

82.3.1 COMP

COMP

Comparator common modes - Window mode

LL_COMP_WINDOWMODE_DISABLE

Window mode disable: Comparators 1 and 2 are independent

LL_COMP_WINDOWMODE_COMP1_INPUT_PLUS_COMMON

Window mode enable: Comparators instances pair COMP1 and COMP2 have their input plus connected together. The common input is COMP1 input plus (COMP2 input plus is no more accessible).

Definitions of COMP hardware constraints delays

LL_COMP_DELAY_STARTUP_US

Delay for COMP startup time

LL_COMP_DELAY_VOLTAGE_SCALER_STAB_US

Delay for COMP voltage scaler stabilization time

Comparator input - Hysteresis

LL_COMP_HYSTERESIS_NONE

No hysteresis

LL_COMP_HYSTERESIS_LOW

Hysteresis level low

LL_COMP_HYSTERESIS_MEDIUM

Hysteresis level medium

LL_COMP_HYSTERESIS_HIGH

Hysteresis level high

Comparator inputs legacy literals name

LL_COMP_WINDOWMODE_ENABLE

LL_COMP_INVERTINGINPUT_1_4VREFINT

LL_COMP_INVERTINGINPUT_1_2VREFINT

LL_COMP_INVERTINGINPUT_3_4VREFINT

LL_COMP_INVERTINGINPUT_VREFINT

LL_COMP_INVERTINGINPUT_DAC1

LL_COMP_INVERTINGINPUT_DAC2

LL_COMP_INVERTINGINPUT_IO1

LL_COMP_INVERTINGINPUT_IO2

LL_COMP_NONINVERTINGINPUT_IO1

LL_COMP_NONINVERTINGINPUT_IO2

Comparator inputs - Input minus (input inverting) selection

LL_COMP_INPUT_MINUS_1_4VREFINT

Comparator input minus connected to 1/4 VrefInt

LL_COMP_INPUT_MINUS_1_2VREFINT

Comparator input minus connected to 1/2 VrefInt

LL_COMP_INPUT_MINUS_3_4VREFINT

Comparator input minus connected to 3/4 VrefInt

LL_COMP_INPUT_MINUS_VREFINT

Comparator input minus connected to VrefInt

LL_COMP_INPUT_MINUS_DAC1_CH1

Comparator input minus connected to DAC1 channel 1 (DAC_OUT1)

LL_COMP_INPUT_MINUS_DAC1_CH2

Comparator input minus connected to DAC1 channel 2 (DAC_OUT2)

LL_COMP_INPUT_MINUS_IO1

Comparator input minus connected to IO1 (pin PB1 for COMP1, pin PB3 for COMP2)

LL_COMP_INPUT_MINUS_IO2

Comparator input minus connected to IO2 (pin PC4 for COMP1, pin PB7 for COMP2)

Comparator inputs - Input plus (input non-inverting) selection

LL_COMP_INPUT_PLUS_IO1

Comparator input plus connected to IO1 (pin PC5 for COMP1, pin PB4 for COMP2)

LL_COMP_INPUT_PLUS_IO2

Comparator input plus connected to IO2 (pin PB2 for COMP1, pin PB6 for COMP2)

Comparator output - Blanking source

LL_COMP_BLANKINGSRC_NONE

Comparator output without blanking

LL_COMP_BLANKINGSRC_TIM1_OC5_COMP1

Comparator output blanking source TIM1 OC5 (specific to COMP instance: COMP1)

LL_COMP_BLANKINGSRC_TIM2_OC3_COMP1

Comparator output blanking source TIM2 OC3 (specific to COMP instance: COMP1)

LL_COMP_BLANKINGSRC_TIM3_OC3_COMP1

Comparator output blanking source TIM3 OC3 (specific to COMP instance: COMP1)

LL_COMP_BLANKINGSRC_TIM3_OC4_COMP2

Comparator output blanking source TIM3 OC4 (specific to COMP instance: COMP2)

LL_COMP_BLANKINGSRC_TIM8_OC5_COMP2

Comparator output blanking source TIM8 OC5 (specific to COMP instance: COMP2)

LL_COMP_BLANKINGSRC_TIM15_OC1_COMP2

Comparator output blanking source TIM15 OC1 (specific to COMP instance: COMP2)

Comparator output blanking source legacy literals name

LL_COMP_BLANKINGSRC_TIM1_OC5

LL_COMP_BLANKINGSRC_TIM2_OC3

LL_COMP_BLANKINGSRC_TIM3_OC3

LL_COMP_BLANKINGSRC_TIM3_OC4

LL_COMP_BLANKINGSRC_TIM8_OC5

LL_COMP_BLANKINGSRC_TIM15_OC1

Comparator output - Output level

LL_COMP_OUTPUT_LEVEL_LOW

Comparator output level low (if the polarity is not inverted, otherwise to be complemented)

LL_COMP_OUTPUT_LEVEL_HIGH

Comparator output level high (if the polarity is not inverted, otherwise to be complemented)

Comparator output - Output polarity

LL_COMP_OUTPUTPOL_NONINVERTED

COMP output polarity is not inverted: comparator output is high when the plus (non-inverting) input is at a higher voltage than the minus (inverting) input

LL_COMP_OUTPUTPOL_INVERTED

COMP output polarity is inverted: comparator output is low when the plus (non-inverting) input is at a lower voltage than the minus (inverting) input

Comparator modes - Power mode

LL_COMP_POWERMODE_HIGHSPEED

COMP power mode to high speed

LL_COMP_POWERMODE_MEDIUMSPEED

COMP power mode to medium speed

LL_COMP_POWERMODE_ULTRALOWPOWER

COMP power mode to ultra-low power

COMP helper macro

__LL_COMP_COMMON_INSTANCE

Description:

- Helper macro to select the COMP common instance to which is belonging the selected COMP instance.

Parameters:

- __COMPx__: COMP instance

Return value:

- COMP: common instance or value "0" if there is no COMP common instance.

Notes:

- COMP common register instance can be used to set parameters common to several COMP instances. Refer to functions having argument "COMPxy_COMMON" as parameter.

Common write and read registers macro

LL_COMP_WriteReg

Description:

- Write a value in COMP register.

Parameters:

- __INSTANCE__: comparator instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_COMP_ReadReg

Description:

- Read a value in COMP register.

Parameters:

- __INSTANCE__: comparator instance
- __REG__: Register to be read

Return value:

- Register: value

83 LL CORTEX Generic Driver

83.1 CORTEX Firmware driver API description

The following section lists the various functions of the CORTEX library.

83.1.1 Detailed description of functions

`LL_SYSTICK_IsActiveCounterFlag`

Function name

__STATIC_INLINE uint32_t LL_SYSTICK_IsActiveCounterFlag (void)

Function description

This function checks if the Systick counter flag is active or not.

Return values

- **State:** of bit (1 or 0).

Notes

- It can be used in timeout function on application side.

Reference Manual to LL API cross reference:

- STK_CTRL COUNTFLAG LL_SYSTICK_IsActiveCounterFlag

`LL_SYSTICK_SetClkSource`

Function name

__STATIC_INLINE void LL_SYSTICK_SetClkSource (uint32_t Source)

Function description

Configures the SysTick clock source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_SYSTICK_CLKSOURCE_HCLK_DIV8
  - LL_SYSTICK_CLKSOURCE_HCLK

Return values

- **None:**

Reference Manual to LL API cross reference:

- STK_CTRL CLKSOURCE LL_SYSTICK_SetClkSource

`LL_SYSTICK_GetClkSource`

Function name

__STATIC_INLINE uint32_t LL_SYSTICK_GetClkSource (void)

Function description

Get the SysTick clock source.

Return values

- **Returned:** value can be one of the following values:
  - LL_SYSTICK_CLKSOURCE_HCLK_DIV8
  - LL_SYSTICK_CLKSOURCE_HCLK

Reference Manual to LL API cross reference:

- STK_CTRL CLKSOURCE LL_SYSTICK_GetClkSource

LL_SYSTICK_EnableIT

Function name

__STATIC_INLINE void LL_SYSTICK_EnableIT (void)

Function description

Enable SysTick exception request.

Return values

- **None:**

Reference Manual to LL API cross reference:

- STK_CTRL TICKINT LL_SYSTICK_EnableIT

LL_SYSTICK_DisableIT

Function name

__STATIC_INLINE void LL_SYSTICK_DisableIT (void)

Function description

Disable SysTick exception request.

Return values

- **None:**

Reference Manual to LL API cross reference:

- STK_CTRL TICKINT LL_SYSTICK_DisableIT

LL_SYSTICK_IsEnabledIT

Function name

__STATIC_INLINE uint32_t LL_SYSTICK_IsEnabledIT (void)

Function description

Checks if the SYSTICK interrupt is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- STK_CTRL TICKINT LL_SYSTICK_IsEnabledIT

LL_LPM_EnableSleep

Function name

__STATIC_INLINE void LL_LPM_EnableSleep (void)

Function description

Processor uses sleep as its low power mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SCR SLEEPDEEP LL_LPM_EnableSleep

`LL_LPM_EnableDeepSleep`

Function name

__STATIC_INLINE void LL_LPM_EnableDeepSleep (void)

Function description

Processor uses deep sleep as its low power mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SCR SLEEPDEEP LL_LPM_EnableDeepSleep

`LL_LPM_EnableSleepOnExit`

Function name

__STATIC_INLINE void LL_LPM_EnableSleepOnExit (void)

Function description

Configures sleep-on-exit when returning from Handler mode to Thread mode.

Return values

- **None:**

Notes

- Setting this bit to 1 enables an interrupt-driven application to avoid returning to an empty main application.

Reference Manual to LL API cross reference:

- SCB_SCR SLEEPONEXIT LL_LPM_EnableSleepOnExit

`LL_LPM_DisableSleepOnExit`

Function name

__STATIC_INLINE void LL_LPM_DisableSleepOnExit (void)

Function description

Do not sleep when returning to Thread mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SCR SLEEPONEXIT LL_LPM_DisableSleepOnExit

`LL_LPM_EnableEventOnPend`

Function name

__STATIC_INLINE void LL_LPM_EnableEventOnPend (void)

Function description

Enabled events and all interrupts, including disabled interrupts, can wakeup the processor.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SCR SEVEONPEND LL_LPM_EnableEventOnPend

`LL_LPM_DisableEventOnPend`

Function name

__STATIC_INLINE void LL_LPM_DisableEventOnPend (void)

Function description

Only enabled interrupts or events can wakeup the processor, disabled interrupts are excluded.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SCR SEVEONPEND LL_LPM_DisableEventOnPend

`LL_HANDLER_EnableFault`

Function name

__STATIC_INLINE void LL_HANDLER_EnableFault (uint32_t Fault)

Function description

Enable a fault in System handler control register (SHCSR)

Parameters

- **Fault:** This parameter can be a combination of the following values:
  - LL_HANDLER_FAULT_USG
  - LL_HANDLER_FAULT_BUS
  - LL_HANDLER_FAULT_MEM

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SHCSR MEMFAULTENA LL_HANDLER_EnableFault

`LL_HANDLER_DisableFault`

Function name

__STATIC_INLINE void LL_HANDLER_DisableFault (uint32_t Fault)

Function description

Disable a fault in System handler control register (SHCSR)

Parameters

- **Fault:** This parameter can be a combination of the following values:
  - LL_HANDLER_FAULT_USG
  - LL_HANDLER_FAULT_BUS
  - LL_HANDLER_FAULT_MEM

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCB_SHCSR MEMFAULTENA LL_HANDLER_DisableFault

`LL_CPUID_GetImplementer`

Function name

__STATIC_INLINE uint32_t LL_CPUID_GetImplementer (void)

Function description

Get Implementer code.

Return values

- **Value:** should be equal to 0x41 for ARM

Reference Manual to LL API cross reference:

- SCB_CPUID IMPLEMENTER LL_CPUID_GetImplementer

`LL_CPUID_GetVariant`

Function name

__STATIC_INLINE uint32_t LL_CPUID_GetVariant (void)

Function description

Get Variant number (The r value in the rnpn product revision identifier)

Return values

- **Value:** between 0 and 255 (0x0: revision 0)

Reference Manual to LL API cross reference:

- SCB_CPUID VARIANT LL_CPUID_GetVariant

`LL_CPUID_GetConstant`

Function name

__STATIC_INLINE uint32_t LL_CPUID_GetConstant (void)

Function description

Get Constant number.

Return values

- **Value:** should be equal to 0xF for Cortex-M4 devices

Reference Manual to LL API cross reference:

- SCB_CPUID ARCHITECTURE LL_CPUID_GetConstant

`LL_CPUID_GetParNo`

Function name

__STATIC_INLINE uint32_t LL_CPUID_GetParNo (void)

Function description

Get Part number.

Return values

- **Value:** should be equal to 0xC24 for Cortex-M4

Reference Manual to LL API cross reference:

- SCB_CPUID PARTNO LL_CPUID_GetParNo

`LL_CPUID_GetRevision`

Function name

__STATIC_INLINE uint32_t LL_CPUID_GetRevision (void)

Function description

Get Revision number (The p value in the rnpn product revision identifier, indicates patch release)

Return values

- **Value:** between 0 and 255 (0x1: patch 1)

Reference Manual to LL API cross reference:

- SCB_CPUID REVISION LL_CPUID_GetRevision

`LL_MPU_Enable`

Function name

__STATIC_INLINE void LL_MPU_Enable (uint32_t Options)

Function description

Enable MPU with input options.

Parameters

- **Options:** This parameter can be one of the following values:
  - LL_MPU_CTRL_HFNMI_PRIVDEF_NONE
  - LL_MPU_CTRL_HARDFAULT_NMI
  - LL_MPU_CTRL_PRIVILEGED_DEFAULT
  - LL_MPU_CTRL_HFNMI_PRIVDEF

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_CTRL ENABLE LL_MPU_Enable

`LL_MPU_Disable`

Function name

__STATIC_INLINE void LL_MPU_Disable (void)

Function description

Disable MPU.

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_CTRL ENABLE LL_MPU_Disable

LL_MPU_IsEnabled

Function name

__STATIC_INLINE uint32_t LL_MPU_IsEnabled (void)

Function description

Check if MPU is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- MPU_CTRL ENABLE LL_MPU_IsEnabled

LL_MPU_EnableRegion

Function name

__STATIC_INLINE void LL_MPU_EnableRegion (uint32_t Region)

Function description

Enable a MPU region.

Parameters

- **Region:** This parameter can be one of the following values:
  - LL_MPU_REGION_NUMBER0
  - LL_MPU_REGION_NUMBER1
  - LL_MPU_REGION_NUMBER2
  - LL_MPU_REGION_NUMBER3
  - LL_MPU_REGION_NUMBER4
  - LL_MPU_REGION_NUMBER5
  - LL_MPU_REGION_NUMBER6
  - LL_MPU_REGION_NUMBER7

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_RASR ENABLE LL_MPU_EnableRegion

LL_MPU_ConfigRegion

Function name

__STATIC_INLINE void LL_MPU_ConfigRegion (uint32_t Region, uint32_t SubRegionDisable, uint32_t Address, uint32_t Attributes)

Function description

Configure and enable a region.

Parameters

- **Region:** This parameter can be one of the following values:
  - LL_MPU_REGION_NUMBER0
  - LL_MPU_REGION_NUMBER1
  - LL_MPU_REGION_NUMBER2
  - LL_MPU_REGION_NUMBER3
  - LL_MPU_REGION_NUMBER4
  - LL_MPU_REGION_NUMBER5
  - LL_MPU_REGION_NUMBER6
  - LL_MPU_REGION_NUMBER7
- **Address:** Value of region base address
- **SubRegionDisable:** Sub-region disable value between Min_Data = 0x00 and Max_Data = 0xFF
- **Attributes:** This parameter can be a combination of the following values:
  - LL_MPU_REGION_SIZE_32B or LL_MPU_REGION_SIZE_64B or LL_MPU_REGION_SIZE_128B or LL_MPU_REGION_SIZE_256B or LL_MPU_REGION_SIZE_512B or LL_MPU_REGION_SIZE_1KB or LL_MPU_REGION_SIZE_2KB or LL_MPU_REGION_SIZE_4KB or LL_MPU_REGION_SIZE_8KB or LL_MPU_REGION_SIZE_16KB or LL_MPU_REGION_SIZE_32KB or LL_MPU_REGION_SIZE_64KB or LL_MPU_REGION_SIZE_128KB or LL_MPU_REGION_SIZE_256KB or LL_MPU_REGION_SIZE_512KB or LL_MPU_REGION_SIZE_1MB or LL_MPU_REGION_SIZE_2MB or LL_MPU_REGION_SIZE_4MB or LL_MPU_REGION_SIZE_8MB or LL_MPU_REGION_SIZE_16MB or LL_MPU_REGION_SIZE_32MB or LL_MPU_REGION_SIZE_64MB or LL_MPU_REGION_SIZE_128MB or LL_MPU_REGION_SIZE_256MB or LL_MPU_REGION_SIZE_512MB or LL_MPU_REGION_SIZE_1GB or LL_MPU_REGION_SIZE_2GB or LL_MPU_REGION_SIZE_4GB
  - LL_MPU_REGION_NO_ACCESS or LL_MPU_REGION_PRIV_RW or LL_MPU_REGION_PRIV_RW_URO or LL_MPU_REGION_FULL_ACCESS or LL_MPU_REGION_PRIV_RO or LL_MPU_REGION_PRIV_RO_URO
  - LL_MPU_TEX_LEVEL0 or LL_MPU_TEX_LEVEL1 or LL_MPU_TEX_LEVEL2 or LL_MPU_TEX_LEVEL4
  - LL_MPU_INSTRUCTION_ACCESS_ENABLE or LL_MPU_INSTRUCTION_ACCESS_DISABLE
  - LL_MPU_ACCESS_SHAREABLE or LL_MPU_ACCESS_NOT_SHAREABLE
  - LL_MPU_ACCESS_CACHEABLE or LL_MPU_ACCESS_NOT_CACHEABLE
  - LL_MPU_ACCESS_BUFFERABLE or LL_MPU_ACCESS_NOT_BUFFERABLE

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_RNR REGION LL_MPU_ConfigRegion
- MPU_RBAR REGION LL_MPU_ConfigRegion
- MPU_RBAR ADDR LL_MPU_ConfigRegion
- MPU_RASR XN LL_MPU_ConfigRegion
- MPU_RASR AP LL_MPU_ConfigRegion
- MPU_RASR S LL_MPU_ConfigRegion
- MPU_RASR C LL_MPU_ConfigRegion
- MPU_RASR B LL_MPU_ConfigRegion
- MPU_RASR SIZE LL_MPU_ConfigRegion

LL_MPU_DisableRegion

Function name

__STATIC_INLINE void LL_MPU_DisableRegion (uint32_t Region)

Function description

Disable a region.

Parameters

- **Region:** This parameter can be one of the following values:
  - LL_MPU_REGION_NUMBER0
  - LL_MPU_REGION_NUMBER1
  - LL_MPU_REGION_NUMBER2
  - LL_MPU_REGION_NUMBER3
  - LL_MPU_REGION_NUMBER4
  - LL_MPU_REGION_NUMBER5
  - LL_MPU_REGION_NUMBER6
  - LL_MPU_REGION_NUMBER7

Return values

- **None:**

Reference Manual to LL API cross reference:

- MPU_RNR REGION LL_MPU_DisableRegion
- MPU_RASR ENABLE LL_MPU_DisableRegion

83.2 CORTEX Firmware driver defines

The following section lists the various define and macros of the module.

83.2.1 CORTEX

CORTEX

MPU Bufferable Access

LL_MPU_ACCESS_BUFFERABLE

Bufferable memory attribute

LL_MPU_ACCESS_NOT_BUFFERABLE

Not Bufferable memory attribute

MPU Cacheable Access

LL_MPU_ACCESS_CACHEABLE

Cacheable memory attribute

LL_MPU_ACCESS_NOT_CACHEABLE

Not Cacheable memory attribute

SYSTICK Clock Source

LL_SYSTICK_CLKSOURCE_HCLK_DIV8

AHB clock divided by 8 selected as SysTick clock source.

LL_SYSTICK_CLKSOURCE_HCLK

AHB clock selected as SysTick clock source.

MPU Control

LL_MPU_CTRL_HFNMI_PRIVDEF_NONE

Disable NMI and privileged SW access

LL_MPU_CTRL_HARDFAULT_NMI

Enables the operation of MPU during hard fault, NMI, and FAULTMASK handlers

LL_MPU_CTRL_PRIVILEGED_DEFAULT

Enable privileged software access to default memory map

LL_MPU_CTRL_HFNMI_PRIVDEF

Enable NMI and privileged SW access

Handler Fault type

LL_HANDLER_FAULT_USG

Usage fault

LL_HANDLER_FAULT_BUS

Bus fault

LL_HANDLER_FAULT_MEM

Memory management fault

MPU Instruction Access

LL_MPU_INSTRUCTION_ACCESS_ENABLE

Instruction fetches enabled

LL_MPU_INSTRUCTION_ACCESS_DISABLE

Instruction fetches disabled

MPU Region Number

LL_MPU_REGION_NUMBER0

REGION Number 0

LL_MPU_REGION_NUMBER1

REGION Number 1

LL_MPU_REGION_NUMBER2

REGION Number 2

LL_MPU_REGION_NUMBER3

REGION Number 3

LL_MPU_REGION_NUMBER4

REGION Number 4

LL_MPU_REGION_NUMBER5

REGION Number 5

LL_MPU_REGION_NUMBER6

REGION Number 6

LL_MPU_REGION_NUMBER7

REGION Number 7

MPU Region Privileges

LL_MPU_REGION_NO_ACCESS

No access

LL_MPU_REGION_PRIV_RW

RW privileged (privileged access only)

LL_MPU_REGION_PRIV_RW_URO

RW privileged - RO user (Write in a user program generates a fault)

LL_MPU_REGION_FULL_ACCESS

RW privileged & user (Full access)

LL_MPU_REGION_PRIV_RO

RO privileged (privileged read only)

LL_MPU_REGION_PRIV_RO_URO

RO privileged & user (read only)

MPU Region Size

LL_MPU_REGION_SIZE_32B

32B Size of the MPU protection region

LL_MPU_REGION_SIZE_64B

64B Size of the MPU protection region

LL_MPU_REGION_SIZE_128B

128B Size of the MPU protection region

LL_MPU_REGION_SIZE_256B

256B Size of the MPU protection region

LL_MPU_REGION_SIZE_512B

512B Size of the MPU protection region

LL_MPU_REGION_SIZE_1KB

1KB Size of the MPU protection region

LL_MPU_REGION_SIZE_2KB

2KB Size of the MPU protection region

LL_MPU_REGION_SIZE_4KB

4KB Size of the MPU protection region

LL_MPU_REGION_SIZE_8KB

8KB Size of the MPU protection region

LL_MPU_REGION_SIZE_16KB

16KB Size of the MPU protection region

LL_MPU_REGION_SIZE_32KB

32KB Size of the MPU protection region

LL_MPU_REGION_SIZE_64KB

64KB Size of the MPU protection region

LL_MPU_REGION_SIZE_128KB

128KB Size of the MPU protection region

LL_MPU_REGION_SIZE_256KB

256KB Size of the MPU protection region

LL_MPU_REGION_SIZE_512KB

512KB Size of the MPU protection region

LL_MPU_REGION_SIZE_1MB

1MB Size of the MPU protection region

LL_MPU_REGION_SIZE_2MB

2MB Size of the MPU protection region

LL_MPU_REGION_SIZE_4MB

4MB Size of the MPU protection region

LL_MPU_REGION_SIZE_8MB

8MB Size of the MPU protection region

LL_MPU_REGION_SIZE_16MB

16MB Size of the MPU protection region

LL_MPU_REGION_SIZE_32MB

32MB Size of the MPU protection region

LL_MPU_REGION_SIZE_64MB

64MB Size of the MPU protection region

LL_MPU_REGION_SIZE_128MB

128MB Size of the MPU protection region

LL_MPU_REGION_SIZE_256MB

256MB Size of the MPU protection region

LL_MPU_REGION_SIZE_512MB

512MB Size of the MPU protection region

LL_MPU_REGION_SIZE_1GB

1GB Size of the MPU protection region

LL_MPU_REGION_SIZE_2GB

2GB Size of the MPU protection region

LL_MPU_REGION_SIZE_4GB

4GB Size of the MPU protection region

MPU Shareable Access

LL_MPU_ACCESS_SHAREABLE

Shareable memory attribute

LL_MPU_ACCESS_NOT_SHAREABLE

Not Shareable memory attribute

MPU TEX Level

LL_MPU_TEX_LEVEL0

b000 for TEX bits

LL_MPU_TEX_LEVEL1

b001 for TEX bits

LL_MPU_TEX_LEVEL2

b010 for TEX bits

LL_MPU_TEX_LEVEL4

b100 for TEX bits

84 LL CRC Generic Driver

84.1 CRC Firmware driver API description

The following section lists the various functions of the CRC library.

84.1.1 Detailed description of functions

`LL_CRC_ResetCRCCalculationUnit`

Function name

__STATIC_INLINE void LL_CRC_ResetCRCCalculationUnit (CRC_TypeDef * CRCx)

Function description

Reset the CRC calculation unit.

Parameters

- **CRCx:** CRC Instance

Return values

- **None:**

Notes

- If Programmable Initial CRC value feature is available, also set the Data Register to the value stored in the CRC_INIT register, otherwise, reset Data Register to its default value.

Reference Manual to LL API cross reference:

- CR RESET LL_CRC_ResetCRCCalculationUnit

`LL_CRC_SetPolynomialSize`

Function name

__STATIC_INLINE void LL_CRC_SetPolynomialSize (CRC_TypeDef * CRCx, uint32_t PolySize)

Function description

Configure size of the polynomial.

Parameters

- **CRCx:** CRC Instance
- **PolySize:** This parameter can be one of the following values:
  - LL_CRC_POLYLENGTH_32B
  - LL_CRC_POLYLENGTH_16B
  - LL_CRC_POLYLENGTH_8B
  - LL_CRC_POLYLENGTH_7B

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR POLYSIZE LL_CRC_SetPolynomialSize

`LL_CRC_GetPolynomialSize`

Function name

__STATIC_INLINE uint32_t LL_CRC_GetPolynomialSize (CRC_TypeDef * CRCx)

Function description

Return size of the polynomial.

Parameters

- **CRCx:** CRC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_CRC_POLYLENGTH_32B
  - LL_CRC_POLYLENGTH_16B
  - LL_CRC_POLYLENGTH_8B
  - LL_CRC_POLYLENGTH_7B

Reference Manual to LL API cross reference:

- CR POLYSIZE LL_CRC_GetPolynomialSize

`LL_CRC_SetInputDataReverseMode`

Function name

__STATIC_INLINE void LL_CRC_SetInputDataReverseMode (CRC_TypeDef * CRCx, uint32_t ReverseMode)

Function description

Configure the reversal of the bit order of the input data.

Parameters

- **CRCx:** CRC Instance
- **ReverseMode:** This parameter can be one of the following values:
  - LL_CRC_INDATA_REVERSE_NONE
  - LL_CRC_INDATA_REVERSE_BYTE
  - LL_CRC_INDATA_REVERSE_HALFWORD
  - LL_CRC_INDATA_REVERSE_WORD

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR REV_IN LL_CRC_SetInputDataReverseMode

`LL_CRC_GetInputDataReverseMode`

Function name

__STATIC_INLINE uint32_t LL_CRC_GetInputDataReverseMode (CRC_TypeDef * CRCx)

Function description

Return type of reversal for input data bit order.

Parameters

- **CRCx:** CRC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_CRC_INDATA_REVERSE_NONE
  - LL_CRC_INDATA_REVERSE_BYTE
  - LL_CRC_INDATA_REVERSE_HALFWORD
  - LL_CRC_INDATA_REVERSE_WORD

Reference Manual to LL API cross reference:

- CR REV_IN LL_CRC_GetInputDataReverseMode

`LL_CRC_SetOutputDataReverseMode`

Function name

__STATIC_INLINE void LL_CRC_SetOutputDataReverseMode (CRC_TypeDef * CRCx, uint32_t ReverseMode)

Function description

Configure the reversal of the bit order of the Output data.

Parameters

- **CRCx:** CRC Instance
- **ReverseMode:** This parameter can be one of the following values:
  - LL_CRC_OUTDATA_REVERSE_NONE
  - LL_CRC_OUTDATA_REVERSE_BIT

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR REV_OUT LL_CRC_SetOutputDataReverseMode

`LL_CRC_GetOutputDataReverseMode`

Function name

__STATIC_INLINE uint32_t LL_CRC_GetOutputDataReverseMode (CRC_TypeDef * CRCx)

Function description

Configure the reversal of the bit order of the Output data.

Parameters

- **CRCx:** CRC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_CRC_OUTDATA_REVERSE_NONE
  - LL_CRC_OUTDATA_REVERSE_BIT

Reference Manual to LL API cross reference:

- CR REV_OUT LL_CRC_GetOutputDataReverseMode

`LL_CRC_SetInitialData`

Function name

__STATIC_INLINE void LL_CRC_SetInitialData (CRC_TypeDef * CRCx, uint32_t InitCrc)

Function description

Initialize the Programmable initial CRC value.

Parameters

- **CRCx:** CRC Instance
- **InitCrc:** Value to be programmed in Programmable initial CRC value register

Return values

- **None:**

Notes

- If the CRC size is less than 32 bits, the least significant bits are used to write the correct value
- LL_CRC_DEFAULT_CRC_INITVALUE could be used as value for InitCrc parameter.

Reference Manual to LL API cross reference:

- INIT INIT LL_CRC_SetInitialData

`LL_CRC_GetInitialData`

Function name

__STATIC_INLINE uint32_t LL_CRC_GetInitialData (CRC_TypeDef * CRCx)

Function description

Return current Initial CRC value.

Parameters

- **CRCx:** CRC Instance

Return values

- **Value:** programmed in Programmable initial CRC value register

Notes

- If the CRC size is less than 32 bits, the least significant bits are used to read the correct value

Reference Manual to LL API cross reference:

- INIT INIT LL_CRC_GetInitialData

`LL_CRC_SetPolynomialCoef`

Function name

__STATIC_INLINE void LL_CRC_SetPolynomialCoef (CRC_TypeDef * CRCx, uint32_t PolynomCoef)

Function description

Initialize the Programmable polynomial value (coefficients of the polynomial to be used for CRC calculation).

Parameters

- **CRCx:** CRC Instance
- **PolynomCoef:** Value to be programmed in Programmable Polynomial value register

Return values

- **None:**

Notes

- LL_CRC_DEFAULT_CRC32_POLY could be used as value for PolynomCoef parameter.
- Please check Reference Manual and existing Errata Sheets, regarding possible limitations for Polynomial values usage. For example, for a polynomial of degree 7, X^7 + X^6 + X^5 + X^2 + 1 is written 0x65

Reference Manual to LL API cross reference:

- POL POL LL_CRC_SetPolynomialCoef

`LL_CRC_GetPolynomialCoef`

Function name

__STATIC_INLINE uint32_t LL_CRC_GetPolynomialCoef (CRC_TypeDef * CRCx)

Function description

Return current Programmable polynomial value.

Parameters

- **CRCx:** CRC Instance

Return values

- **Value:** programmed in Programmable Polynomial value register

Notes

- Please check Reference Manual and existing Errata Sheets, regarding possible limitations for Polynomial values usage. For example, for a polynomial of degree 7, X^7 + X^6 + X^5 + X^2 + 1 is written 0x65

Reference Manual to LL API cross reference:

- POL POL LL_CRC_GetPolynomialCoef

`LL_CRC_FeedData32`

Function name

__STATIC_INLINE void LL_CRC_FeedData32 (CRC_TypeDef * CRCx, uint32_t InData)

Function description

Write given 32-bit data to the CRC calculator.

Parameters

- **CRCx:** CRC Instance
- **InData:** value to be provided to CRC calculator between between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DR DR LL_CRC_FeedData32

`LL_CRC_FeedData16`

Function name

__STATIC_INLINE void LL_CRC_FeedData16 (CRC_TypeDef * CRCx, uint16_t InData)

Function description

Write given 16-bit data to the CRC calculator.

Parameters

- **CRCx:** CRC Instance
- **InData:** 16 bit value to be provided to CRC calculator between between Min_Data=0 and Max_Data=0xFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DR DR LL_CRC_FeedData16

`LL_CRC_FeedData8`

Function name

__STATIC_INLINE void LL_CRC_FeedData8 (CRC_TypeDef * CRCx, uint8_t InData)

Function description

Write given 8-bit data to the CRC calculator.

Parameters

- **CRCx:** CRC Instance
- **InData:** 8 bit value to be provided to CRC calculator between between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DR DR LL_CRC_FeedData8

`LL_CRC_ReadData32`

Function name

__STATIC_INLINE uint32_t LL_CRC_ReadData32 (CRC_TypeDef * CRCx)

Function description

Return current CRC calculation result.

Parameters

- **CRCx:** CRC Instance

Return values

- **Current:** CRC calculation result as stored in CRC_DR register (32 bits).

Reference Manual to LL API cross reference:

- DR DR LL_CRC_ReadData32

`LL_CRC_ReadData16`

Function name

__STATIC_INLINE uint16_t LL_CRC_ReadData16 (CRC_TypeDef * CRCx)

Function description

Return current CRC calculation result.

Parameters

- **CRCx:** CRC Instance

Return values

- **Current:** CRC calculation result as stored in CRC_DR register (16 bits).

Notes

- This function is expected to be used in a 16 bits CRC polynomial size context.

Reference Manual to LL API cross reference:

- DR DR LL_CRC_ReadData16

`LL_CRC_ReadData8`

Function name

__STATIC_INLINE uint8_t LL_CRC_ReadData8 (CRC_TypeDef * CRCx)

Function description

Return current CRC calculation result.

Parameters

- **CRCx:** CRC Instance

Return values

- **Current:** CRC calculation result as stored in CRC_DR register (8 bits).

Notes

- This function is expected to be used in a 8 bits CRC polynomial size context.

Reference Manual to LL API cross reference:

- DR DR LL_CRC_ReadData8

`LL_CRC_ReadData7`

Function name

__STATIC_INLINE uint8_t LL_CRC_ReadData7 (CRC_TypeDef * CRCx)

Function description

Return current CRC calculation result.

Parameters

- **CRCx:** CRC Instance

Return values

- **Current:** CRC calculation result as stored in CRC_DR register (7 bits).

Notes

- This function is expected to be used in a 7 bits CRC polynomial size context.

Reference Manual to LL API cross reference:

- DR DR LL_CRC_ReadData7

`LL_CRC_Read_IDR`

Function name

__STATIC_INLINE uint32_t LL_CRC_Read_IDR (CRC_TypeDef * CRCx)

Function description

Return data stored in the Independent Data(IDR) register.

Parameters

- **CRCx:** CRC Instance

Return values

- **Value:** stored in CRC_IDR register

Notes

- This register can be used as a temporary storage location.
- Refer to the Reference Manual to get the authorized data length in bits.

Reference Manual to LL API cross reference:

- IDR IDR LL_CRC_Read_IDR

`LL_CRC_Write_IDR`

Function name

__STATIC_INLINE void LL_CRC_Write_IDR (CRC_TypeDef * CRCx, uint32_t InData)

Function description

Store data in the Independent Data(IDR) register.

Parameters

- **CRCx:** CRC Instance
- **InData:** value to be stored in CRC_IDR register

Return values

- **None:**

Notes

- This register can be used as a temporary storage location.
- Refer to the Reference Manual to get the authorized data length in bits.

Reference Manual to LL API cross reference:

- IDR IDR LL_CRC_Write_IDR

`LL_CRC_DeInit`

Function name

ErrorStatus LL_CRC_DeInit (CRC_TypeDef * CRCx)

Function description

De-initialize CRC registers (Registers restored to their default values).

Parameters

- **CRCx:** CRC Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: CRC registers are de-initialized
  - ERROR: CRC registers are not de-initialized

84.2 CRC Firmware driver defines

The following section lists the various define and macros of the module.

84.2.1 CRC

CRC

Default CRC computation initialization value

LL_CRC_DEFAULT_CRC_INITVALUE

Default CRC computation initialization value

Default CRC generating polynomial value

LL_CRC_DEFAULT_CRC32_POLY

Default CRC generating polynomial value

Input Data Reverse

LL_CRC_INDATA_REVERSE_NONE

Input Data bit order not affected

LL_CRC_INDATA_REVERSE_BYTE

Input Data bit reversal done by byte

LL_CRC_INDATA_REVERSE_HALFWORD

Input Data bit reversal done by half-word

LL_CRC_INDATA_REVERSE_WORD

Input Data bit reversal done by word

Output Data Reverse

LL_CRC_OUTDATA_REVERSE_NONE

Output Data bit order not affected

LL_CRC_OUTDATA_REVERSE_BIT

Output Data bit reversal done by bit

Polynomial length

LL_CRC_POLYLENGTH_32B

32 bits Polynomial size

LL_CRC_POLYLENGTH_16B

16 bits Polynomial size

LL_CRC_POLYLENGTH_8B

8 bits Polynomial size

LL_CRC_POLYLENGTH_7B

7 bits Polynomial size

Common Write and read registers Macros

LL_CRC_WriteReg

Description:

- Write a value in CRC register.

Parameters:

- __INSTANCE__: CRC Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_CRC_ReadReg

Description:

- Read a value in CRC register.

Parameters:

- __INSTANCE__: CRC Instance
- __REG__: Register to be read

Return value:

- Register: value

85 LL CRS Generic Driver

85.1 CRS Firmware driver API description

The following section lists the various functions of the CRS library.

85.1.1 Detailed description of functions

`LL_CRS_EnableFreqErrorCounter`

Function name

__STATIC_INLINE void LL_CRS_EnableFreqErrorCounter (void)

Function description

Enable Frequency error counter.

Return values

- **None:**

Notes

- When this bit is set, the CRS_CFGR register is write-protected and cannot be modified

Reference Manual to LL API cross reference:

- CR CEN LL_CRS_EnableFreqErrorCounter

`LL_CRS_DisableFreqErrorCounter`

Function name

__STATIC_INLINE void LL_CRS_DisableFreqErrorCounter (void)

Function description

Disable Frequency error counter.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CEN LL_CRS_DisableFreqErrorCounter

`LL_CRS_IsEnabledFreqErrorCounter`

Function name

__STATIC_INLINE uint32_t LL_CRS_IsEnabledFreqErrorCounter (void)

Function description

Check if Frequency error counter is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CEN LL_CRS_IsEnabledFreqErrorCounter

LL_CRS_EnableAutoTrimming

Function name

__STATIC_INLINE void LL_CRS_EnableAutoTrimming (void)

Function description

Enable Automatic trimming counter.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR AUTOTRIMEN LL_CRS_EnableAutoTrimming

LL_CRS_DisableAutoTrimming

Function name

__STATIC_INLINE void LL_CRS_DisableAutoTrimming (void)

Function description

Disable Automatic trimming counter.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR AUTOTRIMEN LL_CRS_DisableAutoTrimming

LL_CRS_IsEnabledAutoTrimming

Function name

__STATIC_INLINE uint32_t LL_CRS_IsEnabledAutoTrimming (void)

Function description

Check if Automatic trimming is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR AUTOTRIMEN LL_CRS_IsEnabledAutoTrimming

LL_CRS_SetHSI48SmoothTrimming

Function name

__STATIC_INLINE void LL_CRS_SetHSI48SmoothTrimming (uint32_t Value)

Function description

Set HSI48 oscillator smooth trimming.

Parameters

- **Value:** a number between Min_Data = 0 and Max_Data = 127 for STM32L412xx/L422xx or 63 otherwise

Return values

- **None:**

Notes

- When the AUTOTRIMEN bit is set, this field is controlled by hardware and is read-only
- Default value can be set thanks to LL_CRS_HSI48CALIBRATION_DEFAULT

Reference Manual to LL API cross reference:

- CR TRIM LL_CRS_SetHSI48SmoothTrimming

`LL_CRS_GetHSI48SmoothTrimming`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetHSI48SmoothTrimming (void)

Function description

Get HSI48 oscillator smooth trimming.

Return values

- **a:** number between Min_Data = 0 and Max_Data = 127 for STM32L412xx/L422xx or 63 otherwise

Reference Manual to LL API cross reference:

- CR TRIM LL_CRS_GetHSI48SmoothTrimming

`LL_CRS_SetReloadCounter`

Function name

__STATIC_INLINE void LL_CRS_SetReloadCounter (uint32_t Value)

Function description

Set counter reload value.

Parameters

- **Value:** a number between Min_Data = 0 and Max_Data = 0xFFFF

Return values

- **None:**

Notes

- Default value can be set thanks to LL_CRS_RELOADVALUE_DEFAULT Otherwise it can be calculated in using macro __LL_CRS_CALC_CALCULATE_RELOADVALUE (_FTARGET_, _FSYNC_)

Reference Manual to LL API cross reference:

- CFGR RELOAD LL_CRS_SetReloadCounter

`LL_CRS_GetReloadCounter`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetReloadCounter (void)

Function description

Get counter reload value.

Return values

- **a:** number between Min_Data = 0 and Max_Data = 0xFFFF

Reference Manual to LL API cross reference:

- CFGR RELOAD LL_CRS_GetReloadCounter

`LL_CRS_SetFreqErrorLimit`

Function name

__STATIC_INLINE void LL_CRS_SetFreqErrorLimit (uint32_t Value)

Function description

Set frequency error limit.

Parameters

- **Value:** a number between Min_Data = 0 and Max_Data = 255

Return values

- **None:**

Notes

- Default value can be set thanks to LL_CRS_ERRORLIMIT_DEFAULT

Reference Manual to LL API cross reference:

- CFGR FELIM LL_CRS_SetFreqErrorLimit

`LL_CRS_GetFreqErrorLimit`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetFreqErrorLimit (void)

Function description

Get frequency error limit.

Return values

- **A:** number between Min_Data = 0 and Max_Data = 255

Reference Manual to LL API cross reference:

- CFGR FELIM LL_CRS_GetFreqErrorLimit

`LL_CRS_SetSyncDivider`

Function name

__STATIC_INLINE void LL_CRS_SetSyncDivider (uint32_t Divider)

Function description

Set division factor for SYNC signal.

Parameters

- **Divider:** This parameter can be one of the following values:
  - LL_CRS_SYNC_DIV_1
  - LL_CRS_SYNC_DIV_2
  - LL_CRS_SYNC_DIV_4
  - LL_CRS_SYNC_DIV_8
  - LL_CRS_SYNC_DIV_16
  - LL_CRS_SYNC_DIV_32
  - LL_CRS_SYNC_DIV_64
  - LL_CRS_SYNC_DIV_128

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR SYNCDIV LL_CRS_SetSyncDivider

`LL_CRS_GetSyncDivider`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetSyncDivider (void)

Function description

Get division factor for SYNC signal.

Return values

- **Returned:** value can be one of the following values:
  - LL_CRS_SYNC_DIV_1
  - LL_CRS_SYNC_DIV_2
  - LL_CRS_SYNC_DIV_4
  - LL_CRS_SYNC_DIV_8
  - LL_CRS_SYNC_DIV_16
  - LL_CRS_SYNC_DIV_32
  - LL_CRS_SYNC_DIV_64
  - LL_CRS_SYNC_DIV_128

Reference Manual to LL API cross reference:

- CFGR SYNCDIV LL_CRS_GetSyncDivider

`LL_CRS_SetSyncSignalSource`

Function name

__STATIC_INLINE void LL_CRS_SetSyncSignalSource (uint32_t Source)

Function description

Set SYNC signal source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_CRS_SYNC_SOURCE_GPIO
  - LL_CRS_SYNC_SOURCE_LSE
  - LL_CRS_SYNC_SOURCE_USB

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR SYNCSRC LL_CRS_SetSyncSignalSource

`LL_CRS_GetSyncSignalSource`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetSyncSignalSource (void)

Function description

Get SYNC signal source.

Return values

- **Returned:** value can be one of the following values:
  - LL_CRS_SYNC_SOURCE_GPIO
  - LL_CRS_SYNC_SOURCE_LSE
  - LL_CRS_SYNC_SOURCE_USB

Reference Manual to LL API cross reference:

- CFGR SYNCSRC LL_CRS_GetSyncSignalSource

`LL_CRS_SetSyncPolarity`

Function name

__STATIC_INLINE void LL_CRS_SetSyncPolarity (uint32_t Polarity)

Function description

Set input polarity for the SYNC signal source.

Parameters

- **Polarity:** This parameter can be one of the following values:
  - LL_CRS_SYNC_POLARITY_RISING
  - LL_CRS_SYNC_POLARITY_FALLING

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR SYNCPOL LL_CRS_SetSyncPolarity

`LL_CRS_GetSyncPolarity`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetSyncPolarity (void)

Function description

Get input polarity for the SYNC signal source.

Return values

- **Returned:** value can be one of the following values:
  - LL_CRS_SYNC_POLARITY_RISING
  - LL_CRS_SYNC_POLARITY_FALLING

Reference Manual to LL API cross reference:

- CFGR SYNCPOL LL_CRS_GetSyncPolarity

`LL_CRS_ConfigSynchronization`

Function name

__STATIC_INLINE void LL_CRS_ConfigSynchronization (uint32_t HSI48CalibrationValue, uint32_t ErrorLimitValue, uint32_t ReloadValue, uint32_t Settings)

Function description

Configure CRS for the synchronization.

Parameters

- **HSI48CalibrationValue:** a number between Min_Data = 0 and Max_Data = 63
- **ErrorLimitValue:** a number between Min_Data = 0 and Max_Data = 0xFFFF
- **ReloadValue:** a number between Min_Data = 0 and Max_Data = 255
- **Settings:** This parameter can be a combination of the following values:
  - LL_CRS_SYNC_DIV_1 or LL_CRS_SYNC_DIV_2 or LL_CRS_SYNC_DIV_4 or LL_CRS_SYNC_DIV_8 or LL_CRS_SYNC_DIV_16 or LL_CRS_SYNC_DIV_32 or LL_CRS_SYNC_DIV_64 or LL_CRS_SYNC_DIV_128
  - LL_CRS_SYNC_SOURCE_GPIO or LL_CRS_SYNC_SOURCE_LSE or LL_CRS_SYNC_SOURCE_USB
  - LL_CRS_SYNC_POLARITY_RISING or LL_CRS_SYNC_POLARITY_FALLING

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TRIM LL_CRS_ConfigSynchronization
- CFGR RELOAD LL_CRS_ConfigSynchronization
- CFGR FELIM LL_CRS_ConfigSynchronization
- CFGR SYNCDIV LL_CRS_ConfigSynchronization
- CFGR SYNCSRC LL_CRS_ConfigSynchronization
- CFGR SYNCPOL LL_CRS_ConfigSynchronization

`LL_CRS_GenerateEvent_SWSYNC`

Function name

__STATIC_INLINE void LL_CRS_GenerateEvent_SWSYNC (void)

Function description

Generate software SYNC event.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR SWSYNC LL_CRS_GenerateEvent_SWSYNC

`LL_CRS_GetFreqErrorDirection`

Function name

__STATIC_INLINE uint32_t LL_CRS_GetFreqErrorDirection (void)

Function description

Get the frequency error direction latched in the time of the last SYNC event.

Return values

- **Returned:** value can be one of the following values:
  - LL_CRS_FREQ_ERROR_DIR_UP
  - LL_CRS_FREQ_ERROR_DIR_DOWN

Reference Manual to LL API cross reference:

- ISR FEDIR LL_CRS_GetFreqErrorDirection

LL_CRS_GetFreqErrorCapture

Function name

__STATIC_INLINE uint32_t LL_CRS_GetFreqErrorCapture (void)

Function description

Get the frequency error counter value latched in the time of the last SYNC event.

Return values

- **A:** number between Min_Data = 0x0000 and Max_Data = 0xFFFF

Reference Manual to LL API cross reference:

- ISR FECAP LL_CRS_GetFreqErrorCapture

LL_CRS_IsActiveFlag_SYNCOK

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_SYNCOK (void)

Function description

Check if SYNC event OK signal occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SYNCOKF LL_CRS_IsActiveFlag_SYNCOK

LL_CRS_IsActiveFlag_SYNCWARN

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_SYNCWARN (void)

Function description

Check if SYNC warning signal occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SYNCWARNF LL_CRS_IsActiveFlag_SYNCWARN

LL_CRS_IsActiveFlag_ERR

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_ERR (void)

Function description

Check if Synchronization or trimming error signal occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ERRF LL_CRS_IsActiveFlag_ERR

LL_CRS_IsActiveFlag_ESYNC

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_ESYNC (void)

Function description

Check if Expected SYNC signal occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ESYNCF LL_CRS_IsActiveFlag_ESYNC

LL_CRS_IsActiveFlag_SYNCERR

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_SYNCERR (void)

Function description

Check if SYNC error signal occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SYNCERR LL_CRS_IsActiveFlag_SYNCERR

LL_CRS_IsActiveFlag_SYNCMISS

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_SYNCMISS (void)

Function description

Check if SYNC missed error signal occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SYNCMISS LL_CRS_IsActiveFlag_SYNCMISS

LL_CRS_IsActiveFlag_TRIMOVF

Function name

__STATIC_INLINE uint32_t LL_CRS_IsActiveFlag_TRIMOVF (void)

Function description

Check if Trimming overflow or underflow occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TRIMOVF LL_CRS_IsActiveFlag_TRIMOVF

`LL_CRS_ClearFlag_SYNCOK`

Function name

__STATIC_INLINE void LL_CRS_ClearFlag_SYNCOK (void)

Function description

Clear the SYNC event OK flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR SYNCOKC LL_CRS_ClearFlag_SYNCOK

`LL_CRS_ClearFlag_SYNCWARN`

Function name

__STATIC_INLINE void LL_CRS_ClearFlag_SYNCWARN (void)

Function description

Clear the SYNC warning flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR SYNCWARNC LL_CRS_ClearFlag_SYNCWARN

`LL_CRS_ClearFlag_ERR`

Function name

__STATIC_INLINE void LL_CRS_ClearFlag_ERR (void)

Function description

Clear TRIMOVF, SYNCMISS and SYNCERR bits and consequently also the ERR flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ERRC LL_CRS_ClearFlag_ERR

`LL_CRS_ClearFlag_ESYNC`

Function name

__STATIC_INLINE void LL_CRS_ClearFlag_ESYNC (void)

Function description

Clear Expected SYNC flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ESYNCC LL_CRS_ClearFlag_ESYNC

`LL_CRS_EnableIT_SYNCOK`

Function name

__STATIC_INLINE void LL_CRS_EnableIT_SYNCOK (void)

Function description

Enable SYNC event OK interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR SYNCOKIE LL_CRS_EnableIT_SYNCOK

`LL_CRS_DisableIT_SYNCOK`

Function name

__STATIC_INLINE void LL_CRS_DisableIT_SYNCOK (void)

Function description

Disable SYNC event OK interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR SYNCOKIE LL_CRS_DisableIT_SYNCOK

`LL_CRS_IsEnabledIT_SYNCOK`

Function name

__STATIC_INLINE uint32_t LL_CRS_IsEnabledIT_SYNCOK (void)

Function description

Check if SYNC event OK interrupt is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR SYNCOKIE LL_CRS_IsEnabledIT_SYNCOK

`LL_CRS_EnableIT_SYNCWARN`

Function name

__STATIC_INLINE void LL_CRS_EnableIT_SYNCWARN (void)

Function description

Enable SYNC warning interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR SYNCWARNIE LL_CRS_EnableIT_SYNCWARN

`LL_CRS_DisableIT_SYNCWARN`

Function name

__STATIC_INLINE void LL_CRS_DisableIT_SYNCWARN (void)

Function description

Disable SYNC warning interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR SYNCWARNIE LL_CRS_DisableIT_SYNCWARN

`LL_CRS_IsEnabledIT_SYNCWARN`

Function name

__STATIC_INLINE uint32_t LL_CRS_IsEnabledIT_SYNCWARN (void)

Function description

Check if SYNC warning interrupt is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR SYNCWARNIE LL_CRS_IsEnabledIT_SYNCWARN

`LL_CRS_EnableIT_ERR`

Function name

__STATIC_INLINE void LL_CRS_EnableIT_ERR (void)

Function description

Enable Synchronization or trimming error interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR ERRIE LL_CRS_EnableIT_ERR

`LL_CRS_DisableIT_ERR`

Function name

__STATIC_INLINE void LL_CRS_DisableIT_ERR (void)

Function description

Disable Synchronization or trimming error interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR ERRIE LL_CRS_DisableIT_ERR

LL_CRS_IsEnabledIT_ERR

Function name

__STATIC_INLINE uint32_t LL_CRS_IsEnabledIT_ERR (void)

Function description

Check if Synchronization or trimming error interrupt is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR ERRIE LL_CRS_IsEnabledIT_ERR

LL_CRS_EnableIT_ESYNC

Function name

__STATIC_INLINE void LL_CRS_EnableIT_ESYNC (void)

Function description

Enable Expected SYNC interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR ESYNCIE LL_CRS_EnableIT_ESYNC

LL_CRS_DisableIT_ESYNC

Function name

__STATIC_INLINE void LL_CRS_DisableIT_ESYNC (void)

Function description

Disable Expected SYNC interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR ESYNCIE LL_CRS_DisableIT_ESYNC

LL_CRS_IsEnabledIT_ESYNC

Function name

__STATIC_INLINE uint32_t LL_CRS_IsEnabledIT_ESYNC (void)

Function description

Check if Expected SYNC interrupt is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR ESYNCIE LL_CRS_IsEnabledIT_ESYNC

`LL_CRS_DeInit`

Function name

ErrorStatus LL_CRS_DeInit (void)

Function description

De-Initializes CRS peripheral registers to their default reset values.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: CRS registers are de-initialized
  - ERROR: not applicable

85.2 CRS Firmware driver defines

The following section lists the various define and macros of the module.

85.2.1 CRS

CRS

Default Values

LL_CRS_RELOADVALUE_DEFAULT

Notes:

- The reset value of the RELOAD field corresponds to a target frequency of 48 MHz and a synchronization signal frequency of 1 kHz (SOF signal from USB)

LL_CRS_ERRORLIMIT_DEFAULT

LL_CRS_HSI48CALIBRATION_DEFAULT

Notes:

- The default value is 64 for STM32L412xx/L422xx, 32 otherwise, which corresponds to the middle of the trimming interval. The trimming step is around 67 kHz between two consecutive TRIM steps. A higher TRIM value corresponds to a higher output frequency

Frequency Error Direction

LL_CRS_FREQ_ERROR_DIR_UP

Upcounting direction, the actual frequency is above the target

LL_CRS_FREQ_ERROR_DIR_DOWN

Downcounting direction, the actual frequency is below the target

Get Flags Defines

LL_CRS_ISR_SYNCOKF

LL_CRS_ISR_SYNCWARNF

LL_CRS_ISR_ERRF

LL_CRS_ISR_ESYNCF

LL_CRS_ISR_SYNCERR

LL_CRS_ISR_SYNCMISS

LL_CRS_ISR_TRIMOVF

IT Defines

LL_CRS_CR_SYNCOKIE

LL_CRS_CR_SYNCWARNIE

LL_CRS_CR_ERRIE

LL_CRS_CR_ESYNCIE

Synchronization Signal Divider

LL_CRS_SYNC_DIV_1

Synchro Signal not divided (default)

LL_CRS_SYNC_DIV_2

Synchro Signal divided by 2

LL_CRS_SYNC_DIV_4

Synchro Signal divided by 4

LL_CRS_SYNC_DIV_8

Synchro Signal divided by 8

LL_CRS_SYNC_DIV_16

Synchro Signal divided by 16

LL_CRS_SYNC_DIV_32

Synchro Signal divided by 32

LL_CRS_SYNC_DIV_64

Synchro Signal divided by 64

LL_CRS_SYNC_DIV_128

Synchro Signal divided by 128

Synchronization Signal Polarity

LL_CRS_SYNC_POLARITY_RISING

Synchro Active on rising edge (default)

LL_CRS_SYNC_POLARITY_FALLING

Synchro Active on falling edge

Synchronization Signal Source

LL_CRS_SYNC_SOURCE_GPIO

Synchro Signal soucre GPIO

LL_CRS_SYNC_SOURCE_LSE

Synchro Signal source LSE

LL_CRS_SYNC_SOURCE_USB

Synchro Signal source USB SOF (default)

Exported_Macros_Calculate_Reload

__LL_CRS_CALC_CALCULATE_RELOADVALUE

Description:

- Macro to calculate reload value to be set in CRS register according to target and sync frequencies.

Parameters:

- __FTARGET__: Target frequency (value in Hz)
- __FSYNC__: Synchronization signal frequency (value in Hz)

Return value:

- Reload: value (in Hz)

Notes:

- The RELOAD value should be selected according to the ratio between the target frequency and the frequency of the synchronization source after prescaling. It is then decreased by one in order to reach the expected synchronization on the zero value. The formula is the following: RELOAD = (fTARGET / fSYNC) -1

Common Write and read registers Macros

LL_CRS_WriteReg

Description:

- Write a value in CRS register.

Parameters:

- __INSTANCE__: CRS Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_CRS_ReadReg

Description:

- Read a value in CRS register.

Parameters:

- __INSTANCE__: CRS Instance
- __REG__: Register to be read

Return value:

- Register: value

86 LL DAC Generic Driver

86.1 DAC Firmware driver registers structures

86.1.1 LL_DAC_InitTypeDef

LL_DAC_InitTypeDef is defined in the stm32l4xx_ll_dac.h

Data Fields

- ***uint32_t TriggerSource***
- ***uint32_t WaveAutoGeneration***
- ***uint32_t WaveAutoGenerationConfig***
- ***uint32_t OutputBuffer***
- ***uint32_t OutputConnection***
- ***uint32_t OutputMode***

Field Documentation

- ***uint32_t LL_DAC_InitTypeDef::TriggerSource***

  Set the conversion trigger source for the selected DAC channel: internal (SW start) or from external peripheral (timer event, external interrupt line). This parameter can be a value of *DAC_LL_EC_TRIGGER_SOURCE*This feature can be modified afterwards using unitary function **LL_DAC_SetTriggerSource()**.
- ***uint32_t LL_DAC_InitTypeDef::WaveAutoGeneration***

  Set the waveform automatic generation mode for the selected DAC channel. This parameter can be a value of *DAC_LL_EC_WAVE_AUTO_GENERATION_MODE*This feature can be modified afterwards using unitary function **LL_DAC_SetWaveAutoGeneration()**.
- ***uint32_t LL_DAC_InitTypeDef::WaveAutoGenerationConfig***

  Set the waveform automatic generation mode for the selected DAC channel. If waveform automatic generation mode is set to noise, this parameter can be a value of *DAC_LL_EC_WAVE_NOISE_LFSR_UNMASK_BITS* If waveform automatic generation mode is set to triangle, this parameter can be a value of *DAC_LL_EC_WAVE_TRIANGLE_AMPLITUDE*

  Note:

  – If waveform automatic generation mode is disabled, this parameter is discarded.

  This feature can be modified afterwards using unitary function **LL_DAC_SetWaveNoiseLFSR()**, **LL_DAC_SetWaveTriangleAmplitude()** depending on the wave automatic generation selected.
- ***uint32_t LL_DAC_InitTypeDef::OutputBuffer***

  Set the output buffer for the selected DAC channel. This parameter can be a value of *DAC_LL_EC_OUTPUT_BUFFER*This feature can be modified afterwards using unitary function **LL_DAC_SetOutputBuffer()**.
- ***uint32_t LL_DAC_InitTypeDef::OutputConnection***

  Set the output connection for the selected DAC channel. This parameter can be a value of *DAC_LL_EC_OUTPUT_CONNECTION*This feature can be modified afterwards using unitary function **LL_DAC_SetOutputConnection()**.
- ***uint32_t LL_DAC_InitTypeDef::OutputMode***

  Set the output mode normal or sample-and-hold for the selected DAC channel. This parameter can be a value of *DAC_LL_EC_OUTPUT_MODE*This feature can be modified afterwards using unitary function **LL_DAC_SetOutputMode()**.

86.2 DAC Firmware driver API description

The following section lists the various functions of the DAC library.

86.2.1 Detailed description of functions

`LL_DAC_SetHighFrequencyMode`

Function name

__STATIC_INLINE void LL_DAC_SetHighFrequencyMode (DAC_TypeDef * DACx, uint32_t HighFreqMode)

Function description

Set the high frequency interface mode for the selected DAC instance.

Parameters

- **DACx:** DAC instance
- **HighFreqMode:** This parameter can be one of the following values:
  - LL_DAC_HIGH_FREQ_MODE_DISABLE
  - LL_DAC_HIGH_FREQ_MODE_ABOVE_80MHZ

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HFSEL LL_DAC_SetHighFrequencyMode

`LL_DAC_GetHighFrequencyMode`

Function name

__STATIC_INLINE uint32_t LL_DAC_GetHighFrequencyMode (DAC_TypeDef * DACx)

Function description

Get the high frequency interface mode for the selected DAC instance.

Parameters

- **DACx:** DAC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_HIGH_FREQ_MODE_DISABLE
  - LL_DAC_HIGH_FREQ_MODE_ABOVE_80MHZ

Reference Manual to LL API cross reference:

- CR HFSEL LL_DAC_GetHighFrequencyMode

`LL_DAC_SetMode`

Function name

__STATIC_INLINE void LL_DAC_SetMode (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t ChannelMode)

Function description

Set the operating mode for the selected DAC channel: calibration or normal operating mode.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2
- **ChannelMode:** This parameter can be one of the following values:
  - LL_DAC_MODE_NORMAL_OPERATION
  - LL_DAC_MODE_CALIBRATION

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CEN1 LL_DAC_SetMode
- CR CEN2 LL_DAC_SetMode

LL_DAC_GetMode

Function name

__STATIC_INLINE uint32_t LL_DAC_GetMode (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the operating mode for the selected DAC channel: calibration or normal operating mode.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_MODE_NORMAL_OPERATION
  - LL_DAC_MODE_CALIBRATION

Reference Manual to LL API cross reference:

- CR CEN1 LL_DAC_GetMode
- CR CEN2 LL_DAC_GetMode

LL_DAC_SetTrimmingValue

Function name

__STATIC_INLINE void LL_DAC_SetTrimmingValue (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t TrimmingValue)

Function description

Set the offset trimming value for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2
- **TrimmingValue:** Value between Min_Data=0x00 and Max_Data=0x1F

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR OTRIM1 LL_DAC_SetTrimmingValue
- CCR OTRIM2 LL_DAC_SetTrimmingValue

LL_DAC_GetTrimmingValue

Function name

__STATIC_INLINE uint32_t LL_DAC_GetTrimmingValue (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the offset trimming value for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2

Return values

- **TrimmingValue:** Value between Min_Data=0x00 and Max_Data=0x1F

Reference Manual to LL API cross reference:

- CCR OTRIM1 LL_DAC_GetTrimmingValue
- CCR OTRIM2 LL_DAC_GetTrimmingValue

LL_DAC_SetTriggerSource

Function name

__STATIC_INLINE void LL_DAC_SetTriggerSource (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t TriggerSource)

Function description

Set the conversion trigger source for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2
- **TriggerSource:** This parameter can be one of the following values:
  - LL_DAC_TRIG_SOFTWARE
  - LL_DAC_TRIG_EXT_TIM1_TRGO
  - LL_DAC_TRIG_EXT_TIM2_TRGO
  - LL_DAC_TRIG_EXT_TIM4_TRGO
  - LL_DAC_TRIG_EXT_TIM5_TRGO
  - LL_DAC_TRIG_EXT_TIM6_TRGO
  - LL_DAC_TRIG_EXT_TIM7_TRGO
  - LL_DAC_TRIG_EXT_TIM8_TRGO
  - LL_DAC_TRIG_EXT_TIM15_TRGO
  - LL_DAC_TRIG_EXT_LPTIM1_OUT
  - LL_DAC_TRIG_EXT_LPTIM2_OUT
  - LL_DAC_TRIG_EXT_EXTI_LINE9

Return values

- **None:**

Notes

- For conversion trigger source to be effective, DAC trigger must be enabled using function LL_DAC_EnableTrigger().
- To set conversion trigger source, DAC channel must be disabled. Otherwise, the setting is discarded.
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:

- CR TSEL1 LL_DAC_SetTriggerSource
- CR TSEL2 LL_DAC_SetTriggerSource

LL_DAC_GetTriggerSource

Function name

__STATIC_INLINE uint32_t LL_DAC_GetTriggerSource (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the conversion trigger source for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_TRIG_SOFTWARE
  - LL_DAC_TRIG_EXT_TIM1_TRGO
  - LL_DAC_TRIG_EXT_TIM2_TRGO
  - LL_DAC_TRIG_EXT_TIM4_TRGO
  - LL_DAC_TRIG_EXT_TIM5_TRGO
  - LL_DAC_TRIG_EXT_TIM6_TRGO
  - LL_DAC_TRIG_EXT_TIM7_TRGO
  - LL_DAC_TRIG_EXT_TIM8_TRGO
  - LL_DAC_TRIG_EXT_TIM15_TRGO
  - LL_DAC_TRIG_EXT_LPTIM1_OUT
  - LL_DAC_TRIG_EXT_LPTIM2_OUT
  - LL_DAC_TRIG_EXT_EXTI_LINE9

Notes

- For conversion trigger source to be effective, DAC trigger must be enabled using function LL_DAC_EnableTrigger().
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:

- CR TSEL1 LL_DAC_GetTriggerSource
- CR TSEL2 LL_DAC_GetTriggerSource

LL_DAC_SetWaveAutoGeneration

Function name

__STATIC_INLINE void LL_DAC_SetWaveAutoGeneration (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t WaveAutoGeneration)

Function description

Set the waveform automatic generation mode for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **WaveAutoGeneration:** This parameter can be one of the following values:
  - LL_DAC_WAVE_AUTO_GENERATION_NONE
  - LL_DAC_WAVE_AUTO_GENERATION_NOISE
  - LL_DAC_WAVE_AUTO_GENERATION_TRIANGLE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR WAVE1 LL_DAC_SetWaveAutoGeneration
- CR WAVE2 LL_DAC_SetWaveAutoGeneration

`LL_DAC_GetWaveAutoGeneration`

Function name

__STATIC_INLINE uint32_t LL_DAC_GetWaveAutoGeneration (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the waveform automatic generation mode for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_WAVE_AUTO_GENERATION_NONE
  - LL_DAC_WAVE_AUTO_GENERATION_NOISE
  - LL_DAC_WAVE_AUTO_GENERATION_TRIANGLE

Reference Manual to LL API cross reference:

- CR WAVE1 LL_DAC_GetWaveAutoGeneration
- CR WAVE2 LL_DAC_GetWaveAutoGeneration

`LL_DAC_SetWaveNoiseLFSR`

Function name

__STATIC_INLINE void LL_DAC_SetWaveNoiseLFSR (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t NoiseLFSRMask)

Function description

Set the noise waveform generation for the selected DAC channel: Noise mode and parameters LFSR (linear feedback shift register).

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **NoiseLFSRMask:** This parameter can be one of the following values:
  - LL_DAC_NOISE_LFSR_UNMASK_BIT0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS1_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS2_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS3_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS4_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS5_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS6_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS7_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS8_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS9_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS10_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS11_0

Return values

- **None:**

Notes

- For wave generation to be effective, DAC channel wave generation mode must be enabled using function LL_DAC_SetWaveAutoGeneration().
- This setting can be set when the selected DAC channel is disabled (otherwise, the setting operation is ignored).

Reference Manual to LL API cross reference:

- CR MAMP1 LL_DAC_SetWaveNoiseLFSR
- CR MAMP2 LL_DAC_SetWaveNoiseLFSR

LL_DAC_GetWaveNoiseLFSR

Function name

__STATIC_INLINE uint32_t LL_DAC_GetWaveNoiseLFSR (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the noise waveform generation for the selected DAC channel: Noise mode and parameters LFSR (linear feedback shift register).

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_NOISE_LFSR_UNMASK_BIT0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS1_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS2_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS3_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS4_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS5_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS6_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS7_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS8_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS9_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS10_0
  - LL_DAC_NOISE_LFSR_UNMASK_BITS11_0

Reference Manual to LL API cross reference:

- CR MAMP1 LL_DAC_GetWaveNoiseLFSR
- CR MAMP2 LL_DAC_GetWaveNoiseLFSR

LL_DAC_SetWaveTriangleAmplitude

Function name

__STATIC_INLINE void LL_DAC_SetWaveTriangleAmplitude (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t TriangleAmplitude)

Function description

Set the triangle waveform generation for the selected DAC channel: triangle mode and amplitude.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **TriangleAmplitude:** This parameter can be one of the following values:
  - LL_DAC_TRIANGLE_AMPLITUDE_1
  - LL_DAC_TRIANGLE_AMPLITUDE_3
  - LL_DAC_TRIANGLE_AMPLITUDE_7
  - LL_DAC_TRIANGLE_AMPLITUDE_15
  - LL_DAC_TRIANGLE_AMPLITUDE_31
  - LL_DAC_TRIANGLE_AMPLITUDE_63
  - LL_DAC_TRIANGLE_AMPLITUDE_127
  - LL_DAC_TRIANGLE_AMPLITUDE_255
  - LL_DAC_TRIANGLE_AMPLITUDE_511
  - LL_DAC_TRIANGLE_AMPLITUDE_1023
  - LL_DAC_TRIANGLE_AMPLITUDE_2047
  - LL_DAC_TRIANGLE_AMPLITUDE_4095

Return values

- **None:**

Notes

- For wave generation to be effective, DAC channel wave generation mode must be enabled using function LL_DAC_SetWaveAutoGeneration().
- This setting can be set when the selected DAC channel is disabled (otherwise, the setting operation is ignored).

Reference Manual to LL API cross reference:

- CR MAMP1 LL_DAC_SetWaveTriangleAmplitude
- CR MAMP2 LL_DAC_SetWaveTriangleAmplitude

LL_DAC_GetWaveTriangleAmplitude

Function name

__STATIC_INLINE uint32_t LL_DAC_GetWaveTriangleAmplitude (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the triangle waveform generation for the selected DAC channel: triangle mode and amplitude.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_TRIANGLE_AMPLITUDE_1
  - LL_DAC_TRIANGLE_AMPLITUDE_3
  - LL_DAC_TRIANGLE_AMPLITUDE_7
  - LL_DAC_TRIANGLE_AMPLITUDE_15
  - LL_DAC_TRIANGLE_AMPLITUDE_31
  - LL_DAC_TRIANGLE_AMPLITUDE_63
  - LL_DAC_TRIANGLE_AMPLITUDE_127
  - LL_DAC_TRIANGLE_AMPLITUDE_255
  - LL_DAC_TRIANGLE_AMPLITUDE_511
  - LL_DAC_TRIANGLE_AMPLITUDE_1023
  - LL_DAC_TRIANGLE_AMPLITUDE_2047
  - LL_DAC_TRIANGLE_AMPLITUDE_4095

Reference Manual to LL API cross reference:

- CR MAMP1 LL_DAC_GetWaveTriangleAmplitude
- CR MAMP2 LL_DAC_GetWaveTriangleAmplitude

LL_DAC_ConfigOutput

Function name

__STATIC_INLINE void LL_DAC_ConfigOutput (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t OutputMode, uint32_t OutputBuffer, uint32_t OutputConnection)

Function description

Set the output for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **OutputMode:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_MODE_NORMAL
  - LL_DAC_OUTPUT_MODE_SAMPLE_AND_HOLD
- **OutputBuffer:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_BUFFER_ENABLE
  - LL_DAC_OUTPUT_BUFFER_DISABLE
- **OutputConnection:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_CONNECT_GPIO
  - LL_DAC_OUTPUT_CONNECT_INTERNAL

Return values

- **None:**

Notes

- This function set several features: mode normal or sample-and-holdbufferconnection to GPIO or internal path. These features can also be set individually using dedicated functions:LL_DAC_SetOutputBuffer()LL_DAC_SetOutputMode()LL_DAC_SetOutputConnection()
- On this STM32 serie, output connection depends on output mode (normal or sample and hold) and output buffer state. if output connection is set to internal path and output buffer is enabled (whatever output mode): output connection is also connected to GPIO pin (both connections to GPIO pin and internal path).if output connection is set to GPIO pin, output buffer is disabled, output mode set to sample and hold: output connection is also connected to internal path (both connections to GPIO pin and internal path).
- Mode sample-and-hold requires an external capacitor to be connected between DAC channel output and ground. Capacitor value depends on load on DAC channel output and sample-and-hold timings configured. As indication, capacitor typical value is 100nF (refer to device datasheet, parameter "CSH").

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_ConfigOutput
- CR MODE2 LL_DAC_ConfigOutput

LL_DAC_SetOutputMode

Function name

__STATIC_INLINE void LL_DAC_SetOutputMode (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t OutputMode)

Function description

Set the output mode normal or sample-and-hold for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **OutputMode:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_MODE_NORMAL
  - LL_DAC_OUTPUT_MODE_SAMPLE_AND_HOLD

Return values

- **None:**

Notes

- Mode sample-and-hold requires an external capacitor to be connected between DAC channel output and ground. Capacitor value depends on load on DAC channel output and sample-and-hold timings configured. As indication, capacitor typical value is 100nF (refer to device datasheet, parameter "CSH").

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_SetOutputMode
- CR MODE2 LL_DAC_SetOutputMode

LL_DAC_GetOutputMode

Function name

__STATIC_INLINE uint32_t LL_DAC_GetOutputMode (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the output mode normal or sample-and-hold for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_OUTPUT_MODE_NORMAL
  - LL_DAC_OUTPUT_MODE_SAMPLE_AND_HOLD

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_GetOutputMode
- CR MODE2 LL_DAC_GetOutputMode

LL_DAC_SetOutputBuffer

Function name

__STATIC_INLINE void LL_DAC_SetOutputBuffer (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t OutputBuffer)

Function description

Set the output buffer for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **OutputBuffer:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_BUFFER_ENABLE
  - LL_DAC_OUTPUT_BUFFER_DISABLE

Return values

- **None:**

Notes

- On this STM32 serie, when buffer is enabled, its offset can be trimmed: factory calibration default values can be replaced by user trimming values, using function LL_DAC_SetTrimmingValue().

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_SetOutputBuffer
- CR MODE2 LL_DAC_SetOutputBuffer

LL_DAC_GetOutputBuffer

Function name

__STATIC_INLINE uint32_t LL_DAC_GetOutputBuffer (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the output buffer state for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_OUTPUT_BUFFER_ENABLE
  - LL_DAC_OUTPUT_BUFFER_DISABLE

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_GetOutputBuffer
- CR MODE2 LL_DAC_GetOutputBuffer

`LL_DAC_SetOutputConnection`

Function name

__STATIC_INLINE void LL_DAC_SetOutputConnection (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t OutputConnection)

Function description

Set the output connection for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **OutputConnection:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_CONNECT_GPIO
  - LL_DAC_OUTPUT_CONNECT_INTERNAL

Return values

- **None:**

Notes

- On this STM32 serie, output connection depends on output mode (normal or sample and hold) and output buffer state. if output connection is set to internal path and output buffer is enabled (whatever output mode): output connection is also connected to GPIO pin (both connections to GPIO pin and internal path).if output connection is set to GPIO pin, output buffer is disabled, output mode set to sample and hold: output connection is also connected to internal path (both connections to GPIO pin and internal path).

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_SetOutputConnection
- CR MODE2 LL_DAC_SetOutputConnection

`LL_DAC_GetOutputConnection`

Function name

__STATIC_INLINE uint32_t LL_DAC_GetOutputConnection (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the output connection for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Returned:** value can be one of the following values:
  - LL_DAC_OUTPUT_CONNECT_GPIO
  - LL_DAC_OUTPUT_CONNECT_INTERNAL

Notes

- On this STM32 serie, output connection depends on output mode (normal or sample and hold) and output buffer state. if output connection is set to internal path and output buffer is enabled (whatever output mode): output connection is also connected to GPIO pin (both connections to GPIO pin and internal path).if output connection is set to GPIO pin, output buffer is disabled, output mode set to sample and hold: output connection is also connected to internal path (both connections to GPIO pin and internal path).

Reference Manual to LL API cross reference:

- CR MODE1 LL_DAC_GetOutputConnection
- CR MODE2 LL_DAC_GetOutputConnection

LL_DAC_SetSampleAndHoldSampleTime

Function name

__STATIC_INLINE void LL_DAC_SetSampleAndHoldSampleTime (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t SampleTime)

Function description

Set the sample-and-hold timing for the selected DAC channel: sample time.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **SampleTime:** Value between Min_Data=0x000 and Max_Data=0x3FF

Return values

- **None:**

Notes

- Sample time must be set when DAC channel is disabled or during DAC operation when DAC channel flag BWSTx is reset, otherwise the setting is ignored. Check BWSTx flag state using function "LL_DAC_IsActiveFlag_BWSTx()".

Reference Manual to LL API cross reference:

- SHSR1 TSAMPLE1 LL_DAC_SetSampleAndHoldSampleTime
- SHSR2 TSAMPLE2 LL_DAC_SetSampleAndHoldSampleTime

LL_DAC_GetSampleAndHoldSampleTime

Function name

__STATIC_INLINE uint32_t LL_DAC_GetSampleAndHoldSampleTime (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the sample-and-hold timing for the selected DAC channel: sample time.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0x3FF

Reference Manual to LL API cross reference:

- SHSR1 TSAMPLE1 LL_DAC_GetSampleAndHoldSampleTime
- SHSR2 TSAMPLE2 LL_DAC_GetSampleAndHoldSampleTime

`LL_DAC_SetSampleAndHoldHoldTime`

Function name

__STATIC_INLINE void LL_DAC_SetSampleAndHoldHoldTime (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t HoldTime)

Function description

Set the sample-and-hold timing for the selected DAC channel: hold time.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **HoldTime:** Value between Min_Data=0x000 and Max_Data=0x3FF

Return values

- **None:**

Reference Manual to LL API cross reference:

- SHHR THOLD1 LL_DAC_SetSampleAndHoldHoldTime
- SHHR THOLD2 LL_DAC_SetSampleAndHoldHoldTime

`LL_DAC_GetSampleAndHoldHoldTime`

Function name

__STATIC_INLINE uint32_t LL_DAC_GetSampleAndHoldHoldTime (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the sample-and-hold timing for the selected DAC channel: hold time.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0x3FF

Reference Manual to LL API cross reference:

- SHHR THOLD1 LL_DAC_GetSampleAndHoldHoldTime
- SHHR THOLD2 LL_DAC_GetSampleAndHoldHoldTime

LL_DAC_SetSampleAndHoldRefreshTime

Function name

__STATIC_INLINE void LL_DAC_SetSampleAndHoldRefreshTime (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t RefreshTime)

Function description

Set the sample-and-hold timing for the selected DAC channel: refresh time.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **RefreshTime:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- SHRR TREFRESH1 LL_DAC_SetSampleAndHoldRefreshTime
- SHRR TREFRESH2 LL_DAC_SetSampleAndHoldRefreshTime

LL_DAC_GetSampleAndHoldRefreshTime

Function name

__STATIC_INLINE uint32_t LL_DAC_GetSampleAndHoldRefreshTime (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get the sample-and-hold timing for the selected DAC channel: refresh time.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- SHRR TREFRESH1 LL_DAC_GetSampleAndHoldRefreshTime
- SHRR TREFRESH2 LL_DAC_GetSampleAndHoldRefreshTime

LL_DAC_EnableDMAReq

Function name

__STATIC_INLINE void LL_DAC_EnableDMAReq (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Enable DAC DMA transfer request of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Notes

- To configure DMA source address (peripheral address), use function LL_DAC_DMA_GetRegAddr().

Reference Manual to LL API cross reference:

- CR DMAEN1 LL_DAC_EnableDMAReq
- CR DMAEN2 LL_DAC_EnableDMAReq

LL_DAC_DisableDMAReq

Function name

__STATIC_INLINE void LL_DAC_DisableDMAReq (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Disable DAC DMA transfer request of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Notes

- To configure DMA source address (peripheral address), use function LL_DAC_DMA_GetRegAddr().

Reference Manual to LL API cross reference:

- CR DMAEN1 LL_DAC_DisableDMAReq
- CR DMAEN2 LL_DAC_DisableDMAReq

LL_DAC_IsDMAReqEnabled

Function name

__STATIC_INLINE uint32_t LL_DAC_IsDMAReqEnabled (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get DAC DMA transfer request state of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR DMAEN1 LL_DAC_IsDMAReqEnabled
- CR DMAEN2 LL_DAC_IsDMAReqEnabled

LL_DAC_DMA_GetRegAddr

Function name

__STATIC_INLINE uint32_t LL_DAC_DMA_GetRegAddr (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Register)

Function description

Function to help to configure DMA transfer to DAC: retrieve the DAC register address from DAC instance and a list of DAC registers intended to be used (most commonly) with DMA transfer.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **Register:** This parameter can be one of the following values:
  - LL_DAC_DMA_REG_DATA_12BITS_RIGHT_ALIGNED
  - LL_DAC_DMA_REG_DATA_12BITS_LEFT_ALIGNED
  - LL_DAC_DMA_REG_DATA_8BITS_RIGHT_ALIGNED

Return values

- **DAC:** register address

Notes

- These DAC registers are data holding registers: when DAC conversion is requested, DAC generates a DMA transfer request to have data available in DAC data holding registers.
- This macro is intended to be used with LL DMA driver, refer to function "LL_DMA_ConfigAddresses()". Example: LL_DMA_ConfigAddresses(DMA1, LL_DMA_CHANNEL_1, (uint32_t)&< array or variable >, LL_DAC_DMA_GetRegAddr(DAC1, LL_DAC_CHANNEL_1, LL_DAC_DMA_REG_DATA_12BITS_RIGHT_ALIGNED), LL_DMA_DIRECTION_MEMORY_TO_PERIPH);

Reference Manual to LL API cross reference:

- DHR12R1 DACC1DHR LL_DAC_DMA_GetRegAddr
- DHR12L1 DACC1DHR LL_DAC_DMA_GetRegAddr
- DHR8R1 DACC1DHR LL_DAC_DMA_GetRegAddr
- DHR12R2 DACC2DHR LL_DAC_DMA_GetRegAddr
- DHR12L2 DACC2DHR LL_DAC_DMA_GetRegAddr
- DHR8R2 DACC2DHR LL_DAC_DMA_GetRegAddr

LL_DAC_Enable

Function name

__STATIC_INLINE void LL_DAC_Enable (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Enable DAC selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Notes

- After enable from off state, DAC channel requires a delay for output voltage to reach accuracy +/- 1 LSB. Refer to device datasheet, parameter "tWAKEUP".

Reference Manual to LL API cross reference:

- CR EN1 LL_DAC_Enable
- CR EN2 LL_DAC_Enable

`LL_DAC_Disable`

Function name

__STATIC_INLINE void LL_DAC_Disable (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Disable DAC selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR EN1 LL_DAC_Disable
- CR EN2 LL_DAC_Disable

`LL_DAC_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsEnabled (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get DAC enable state of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR EN1 LL_DAC_IsEnabled
- CR EN2 LL_DAC_IsEnabled

`LL_DAC_EnableTrigger`

Function name

__STATIC_INLINE void LL_DAC_EnableTrigger (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Enable DAC trigger of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Notes

- - If DAC trigger is disabled, DAC conversion is performed automatically once the data holding register is updated, using functions "LL_DAC_ConvertData{8; 12}{Right; Left} Aligned()": LL_DAC_ConvertData12RightAligned(), ... If DAC trigger is enabled, DAC conversion is performed only when a hardware of software trigger event is occurring. Select trigger source using function LL_DAC_SetTriggerSource().

Reference Manual to LL API cross reference:

- CR TEN1 LL_DAC_EnableTrigger
- CR TEN2 LL_DAC_EnableTrigger

LL_DAC_DisableTrigger

Function name

__STATIC_INLINE void LL_DAC_DisableTrigger (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Disable DAC trigger of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TEN1 LL_DAC_DisableTrigger
- CR TEN2 LL_DAC_DisableTrigger

LL_DAC_IsTriggerEnabled

Function name

__STATIC_INLINE uint32_t LL_DAC_IsTriggerEnabled (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Get DAC trigger state of the selected channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR TEN1 LL_DAC_IsTriggerEnabled
- CR TEN2 LL_DAC_IsTriggerEnabled

LL_DAC_TrigSWConversion

Function name

__STATIC_INLINE void LL_DAC_TrigSWConversion (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Trig DAC conversion by software for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can a combination of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **None:**

Notes

- Preliminarily, DAC trigger must be set to software trigger using function LL_DAC_Init() LL_DAC_SetTriggerSource() with parameter "LL_DAC_TRIGGER_SOFTWARE". and DAC trigger must be enabled using function LL_DAC_EnableTrigger().
- For devices featuring DAC with 2 channels: this function can perform a SW start of both DAC channels simultaneously. Two channels can be selected as parameter. Example: (LL_DAC_CHANNEL_1 | LL_DAC_CHANNEL_2)

Reference Manual to LL API cross reference:

- SWTRIGR SWTRIG1 LL_DAC_TrigSWConversion
- SWTRIGR SWTRIG2 LL_DAC_TrigSWConversion

LL_DAC_ConvertData12RightAligned

Function name

__STATIC_INLINE void LL_DAC_ConvertData12RightAligned (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Data)

Function description

Set the data to be loaded in the data holding register in format 12 bits left alignment (LSB aligned on bit 0), for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **Data:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DHR12R1 DACC1DHR LL_DAC_ConvertData12RightAligned
- DHR12R2 DACC2DHR LL_DAC_ConvertData12RightAligned

LL_DAC_ConvertData12LeftAligned

Function name

__STATIC_INLINE void LL_DAC_ConvertData12LeftAligned (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Data)

Function description

Set the data to be loaded in the data holding register in format 12 bits left alignment (MSB aligned on bit 15), for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **Data:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DHR12L1 DACC1DHR LL_DAC_ConvertData12LeftAligned
- DHR12L2 DACC2DHR LL_DAC_ConvertData12LeftAligned

LL_DAC_ConvertData8RightAligned

Function name

__STATIC_INLINE void LL_DAC_ConvertData8RightAligned (DAC_TypeDef * DACx, uint32_t DAC_Channel, uint32_t Data)

Function description

Set the data to be loaded in the data holding register in format 8 bits left alignment (LSB aligned on bit 0), for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **Data:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DHR8R1 DACC1DHR LL_DAC_ConvertData8RightAligned
- DHR8R2 DACC2DHR LL_DAC_ConvertData8RightAligned

LL_DAC_ConvertDualData12RightAligned

Function name

__STATIC_INLINE void LL_DAC_ConvertDualData12RightAligned (DAC_TypeDef * DACx, uint32_t DataChannel1, uint32_t DataChannel2)

Function description

Set the data to be loaded in the data holding register in format 12 bits left alignment (LSB aligned on bit 0), for both DAC channels.

Parameters

- **DACx:** DAC instance
- **DataChannel1:** Value between Min_Data=0x000 and Max_Data=0xFFF
- **DataChannel2:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DHR12RD DACC1DHR LL_DAC_ConvertDualData12RightAligned
- DHR12RD DACC2DHR LL_DAC_ConvertDualData12RightAligned

LL_DAC_ConvertDualData12LeftAligned

Function name

__STATIC_INLINE void LL_DAC_ConvertDualData12LeftAligned (DAC_TypeDef * DACx, uint32_t DataChannel1, uint32_t DataChannel2)

Function description

Set the data to be loaded in the data holding register in format 12 bits left alignment (MSB aligned on bit 15), for both DAC channels.

Parameters

- **DACx:** DAC instance
- **DataChannel1:** Value between Min_Data=0x000 and Max_Data=0xFFF
- **DataChannel2:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DHR12LD DACC1DHR LL_DAC_ConvertDualData12LeftAligned
- DHR12LD DACC2DHR LL_DAC_ConvertDualData12LeftAligned

`LL_DAC_ConvertDualData8RightAligned`

Function name

__STATIC_INLINE void LL_DAC_ConvertDualData8RightAligned (DAC_TypeDef * DACx, uint32_t DataChannel1, uint32_t DataChannel2)

Function description

Set the data to be loaded in the data holding register in format 8 bits left alignment (LSB aligned on bit 0), for both DAC channels.

Parameters

- **DACx:** DAC instance
- **DataChannel1:** Value between Min_Data=0x00 and Max_Data=0xFF
- **DataChannel2:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DHR8RD DACC1DHR LL_DAC_ConvertDualData8RightAligned
- DHR8RD DACC2DHR LL_DAC_ConvertDualData8RightAligned

`LL_DAC_RetrieveOutputData`

Function name

__STATIC_INLINE uint32_t LL_DAC_RetrieveOutputData (DAC_TypeDef * DACx, uint32_t DAC_Channel)

Function description

Retrieve output data currently generated for the selected DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.

Return values

- **Value:** between Min_Data=0x000 and Max_Data=0xFFF

Notes

- Whatever alignment and resolution settings (using functions "LL_DAC_ConvertData{8; 12}{Right; Left} Aligned()": LL_DAC_ConvertData12RightAligned(), ...), output data format is 12 bits right aligned (LSB aligned on bit 0).

Reference Manual to LL API cross reference:

- DOR1 DACC1DOR LL_DAC_RetrieveOutputData
- DOR2 DACC2DOR LL_DAC_RetrieveOutputData

`LL_DAC_IsActiveFlag_CAL1`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_CAL1 (DAC_TypeDef * DACx)

Function description

Get DAC calibration offset flag for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CAL_FLAG1 LL_DAC_IsActiveFlag_CAL1

`LL_DAC_IsActiveFlag_CAL2`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_CAL2 (DAC_TypeDef * DACx)

Function description

Get DAC calibration offset flag for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CAL_FLAG2 LL_DAC_IsActiveFlag_CAL2

`LL_DAC_IsActiveFlag_BWST1`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_BWST1 (DAC_TypeDef * DACx)

Function description

Get DAC busy writing sample time flag for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR BWST1 LL_DAC_IsActiveFlag_BWST1

`LL_DAC_IsActiveFlag_BWST2`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_BWST2 (DAC_TypeDef * DACx)

Function description

Get DAC busy writing sample time flag for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR BWST2 LL_DAC_IsActiveFlag_BWST2

`LL_DAC_IsActiveFlag_DMAUDR1`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_DMAUDR1 (DAC_TypeDef * DACx)

Function description

Get DAC underrun flag for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR DMAUDR1 LL_DAC_IsActiveFlag_DMAUDR1

`LL_DAC_IsActiveFlag_DMAUDR2`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsActiveFlag_DMAUDR2 (DAC_TypeDef * DACx)

Function description

Get DAC underrun flag for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR DMAUDR2 LL_DAC_IsActiveFlag_DMAUDR2

`LL_DAC_ClearFlag_DMAUDR1`

Function name

__STATIC_INLINE void LL_DAC_ClearFlag_DMAUDR1 (DAC_TypeDef * DACx)

Function description

Clear DAC underrun flag for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR DMAUDR1 LL_DAC_ClearFlag_DMAUDR1

`LL_DAC_ClearFlag_DMAUDR2`

Function name

__STATIC_INLINE void LL_DAC_ClearFlag_DMAUDR2 (DAC_TypeDef * DACx)

Function description

Clear DAC underrun flag for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR DMAUDR2 LL_DAC_ClearFlag_DMAUDR2

`LL_DAC_EnableIT_DMAUDR1`

Function name

__STATIC_INLINE void LL_DAC_EnableIT_DMAUDR1 (DAC_TypeDef * DACx)

Function description

Enable DMA underrun interrupt for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR DMAUDRIE1 LL_DAC_EnableIT_DMAUDR1

`LL_DAC_EnableIT_DMAUDR2`

Function name

__STATIC_INLINE void LL_DAC_EnableIT_DMAUDR2 (DAC_TypeDef * DACx)

Function description

Enable DMA underrun interrupt for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR DMAUDRIE2 LL_DAC_EnableIT_DMAUDR2

`LL_DAC_DisableIT_DMAUDR1`

Function name

__STATIC_INLINE void LL_DAC_DisableIT_DMAUDR1 (DAC_TypeDef * DACx)

Function description

Disable DMA underrun interrupt for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR DMAUDRIE1 LL_DAC_DisableIT_DMAUDR1

`LL_DAC_DisableIT_DMAUDR2`

Function name

__STATIC_INLINE void LL_DAC_DisableIT_DMAUDR2 (DAC_TypeDef * DACx)

Function description

Disable DMA underrun interrupt for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR DMAUDRIE2 LL_DAC_DisableIT_DMAUDR2

`LL_DAC_IsEnabledIT_DMAUDR1`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsEnabledIT_DMAUDR1 (DAC_TypeDef * DACx)

Function description

Get DMA underrun interrupt for DAC channel 1.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR DMAUDRIE1 LL_DAC_IsEnabledIT_DMAUDR1

`LL_DAC_IsEnabledIT_DMAUDR2`

Function name

__STATIC_INLINE uint32_t LL_DAC_IsEnabledIT_DMAUDR2 (DAC_TypeDef * DACx)

Function description

Get DMA underrun interrupt for DAC channel 2.

Parameters

- **DACx:** DAC instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR DMAUDRIE2 LL_DAC_IsEnabledIT_DMAUDR2

LL_DAC_DeInit

Function name

ErrorStatus LL_DAC_DeInit (DAC_TypeDef * DACx)

Function description

De-initialize registers of the selected DAC instance to their default reset values.

Parameters

- **DACx:** DAC instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: DAC registers are de-initialized
  - ERROR: not applicable

LL_DAC_Init

Function name

ErrorStatus LL_DAC_Init (DAC_TypeDef * DACx, uint32_t DAC_Channel, LL_DAC_InitTypeDef * DAC_InitStruct)

Function description

Initialize some features of DAC channel.

Parameters

- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2 (1)

  (1) On this STM32 serie, parameter not available on all devices. Refer to device datasheet for channels availability.
- **DAC_InitStruct:** Pointer to a LL_DAC_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: DAC registers are initialized
  - ERROR: DAC registers are not initialized

Notes

- LL_DAC_Init() aims to ease basic configuration of a DAC channel. Leaving it ready to be enabled and output: a level by calling one of LL_DAC_ConvertData12RightAligned LL_DAC_ConvertData12LeftAligned LL_DAC_ConvertData8RightAligned or one of the supported autogenerated wave.
- This function allows configuration of: Output modeTriggerWave generation
- The setting of these parameters by function LL_DAC_Init() is conditioned to DAC state: DAC channel must be disabled.

`LL_DAC_StructInit`

Function name

void LL_DAC_StructInit (LL_DAC_InitTypeDef * DAC_InitStruct)

Function description

Set each LL_DAC_InitTypeDef field to default value.

Parameters

- **DAC_InitStruct:** pointer to a LL_DAC_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

86.3 DAC Firmware driver defines

The following section lists the various define and macros of the module.

86.3.1 DAC

DAC

DAC channels

LL_DAC_CHANNEL_1

DAC channel 1

LL_DAC_CHANNEL_2

DAC channel 2

DAC flags

LL_DAC_FLAG_DMAUDR1

DAC channel 1 flag DMA underrun

LL_DAC_FLAG_CAL1

DAC channel 1 flag offset calibration status

LL_DAC_FLAG_BWST1

DAC channel 1 flag busy writing sample time

LL_DAC_FLAG_DMAUDR2

DAC channel 2 flag DMA underrun

LL_DAC_FLAG_CAL2

DAC channel 2 flag offset calibration status

LL_DAC_FLAG_BWST2

DAC channel 2 flag busy writing sample time

DAC high frequency interface mode

LL_DAC_HIGH_FREQ_MODE_DISABLE

High frequency interface mode disabled

LL_DAC_HIGH_FREQ_MODE_ABOVE_80MHZ

High frequency interface mode compatible to AHB>80MHz enabled

Definitions of DAC hardware constraints delays

LL_DAC_DELAY_STARTUP_VOLTAGE_SETTLING_US

Delay for DAC channel voltage settling time from DAC channel startup (transition from disable to enable)

LL_DAC_DELAY_VOLTAGE_SETTLING_US

Delay for DAC channel voltage settling time

DAC interruptions

LL_DAC_IT_DMAUDRIE1

DAC channel 1 interruption DMA underrun

LL_DAC_IT_DMAUDRIE2

DAC channel 2 interruption DMA underrun

DAC operating mode

LL_DAC_MODE_NORMAL_OPERATION

DAC channel in mode normal operation

LL_DAC_MODE_CALIBRATION

DAC channel in mode calibration

DAC channel output buffer

LL_DAC_OUTPUT_BUFFER_ENABLE

The selected DAC channel output is buffered: higher drive current capability, but also higher current consumption

LL_DAC_OUTPUT_BUFFER_DISABLE

The selected DAC channel output is not buffered: lower drive current capability, but also lower current consumption

DAC channel output connection

LL_DAC_OUTPUT_CONNECT_GPIO

The selected DAC channel output is connected to external pin

LL_DAC_OUTPUT_CONNECT_INTERNAL

The selected DAC channel output is connected to on-chip peripherals via internal paths. On this STM32 serie, output connection depends on output mode (normal or sample and hold) and output buffer state. Refer to comments of function

DAC channel output mode

LL_DAC_OUTPUT_MODE_NORMAL

The selected DAC channel output is on mode normal.

LL_DAC_OUTPUT_MODE_SAMPLE_AND_HOLD

The selected DAC channel output is on mode sample-and-hold. Mode sample-and-hold requires an external capacitor, refer to description of function

DAC registers compliant with specific purpose

LL_DAC_DMA_REG_DATA_12BITS_RIGHT_ALIGNED

DAC channel data holding register 12 bits right aligned

LL_DAC_DMA_REG_DATA_12BITS_LEFT_ALIGNED

DAC channel data holding register 12 bits left aligned

LL_DAC_DMA_REG_DATA_8BITS_RIGHT_ALIGNED

DAC channel data holding register 8 bits right aligned

DAC channel output resolution

LL_DAC_RESOLUTION_12B

DAC channel resolution 12 bits

LL_DAC_RESOLUTION_8B

DAC channel resolution 8 bits

DAC trigger source

LL_DAC_TRIG_EXT_TIM1_TRGO

DAC channel conversion trigger from external IP: TIM1 TRGO.

LL_DAC_TRIG_EXT_TIM2_TRGO

DAC channel conversion trigger from external IP: TIM2 TRGO.

LL_DAC_TRIG_EXT_TIM4_TRGO

DAC channel conversion trigger from external IP: TIM4 TRGO.

LL_DAC_TRIG_EXT_TIM5_TRGO

DAC channel conversion trigger from external IP: TIM5 TRGO.

LL_DAC_TRIG_EXT_TIM6_TRGO

DAC channel conversion trigger from external IP: TIM6 TRGO.

LL_DAC_TRIG_EXT_TIM7_TRGO

DAC channel conversion trigger from external IP: TIM7 TRGO.

LL_DAC_TRIG_EXT_TIM8_TRGO

DAC channel conversion trigger from external IP: TIM8 TRGO.

LL_DAC_TRIG_EXT_TIM15_TRGO

DAC channel conversion trigger from external IP: TIM15 TRGO.

LL_DAC_TRIG_EXT_LPTIM1_OUT

DAC channel conversion trigger from external IP: LPTIM1 TRGO.

LL_DAC_TRIG_EXT_LPTIM2_OUT

DAC channel conversion trigger from external IP: LPTIM2 TRGO.

LL_DAC_TRIG_EXT_EXTI_LINE9

DAC channel conversion trigger from external IP: external interrupt line 9.

LL_DAC_TRIG_SOFTWARE

DAC channel conversion trigger internal (SW start)

DAC waveform automatic generation mode

LL_DAC_WAVE_AUTO_GENERATION_NONE

DAC channel wave auto generation mode disabled.

LL_DAC_WAVE_AUTO_GENERATION_NOISE

DAC channel wave auto generation mode enabled, set generated noise waveform.

LL_DAC_WAVE_AUTO_GENERATION_TRIANGLE

DAC channel wave auto generation mode enabled, set generated triangle waveform.

DAC wave generation - Noise LFSR unmask bits

LL_DAC_NOISE_LFSR_UNMASK_BIT0

Noise wave generation, unmask LFSR bit0, for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS1_0

Noise wave generation, unmask LFSR bits[1:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS2_0

Noise wave generation, unmask LFSR bits[2:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS3_0

Noise wave generation, unmask LFSR bits[3:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS4_0

Noise wave generation, unmask LFSR bits[4:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS5_0

Noise wave generation, unmask LFSR bits[5:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS6_0

Noise wave generation, unmask LFSR bits[6:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS7_0

Noise wave generation, unmask LFSR bits[7:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS8_0

Noise wave generation, unmask LFSR bits[8:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS9_0

Noise wave generation, unmask LFSR bits[9:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS10_0

Noise wave generation, unmask LFSR bits[10:0], for the selected DAC channel

LL_DAC_NOISE_LFSR_UNMASK_BITS11_0

Noise wave generation, unmask LFSR bits[11:0], for the selected DAC channel

DAC wave generation - Triangle amplitude

LL_DAC_TRIANGLE_AMPLITUDE_1

Triangle wave generation, amplitude of 1 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_3

Triangle wave generation, amplitude of 3 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_7

Triangle wave generation, amplitude of 7 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_15

Triangle wave generation, amplitude of 15 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_31

Triangle wave generation, amplitude of 31 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_63

Triangle wave generation, amplitude of 63 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_127

Triangle wave generation, amplitude of 127 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_255

Triangle wave generation, amplitude of 255 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_511

Triangle wave generation, amplitude of 512 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_1023

Triangle wave generation, amplitude of 1023 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_2047

Triangle wave generation, amplitude of 2047 LSB of DAC output range, for the selected DAC channel

LL_DAC_TRIANGLE_AMPLITUDE_4095

Triangle wave generation, amplitude of 4095 LSB of DAC output range, for the selected DAC channel

DAC helper macro

__LL_DAC_CHANNEL_TO_DECIMAL_NB

Description:

- Helper macro to get DAC channel number in decimal format from literals LL_DAC_CHANNEL_x.

Parameters:

- __CHANNEL__: This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2

Return value:

- 1...2

Notes:

- The input can be a value from functions where a channel number is returned.

__LL_DAC_DECIMAL_NB_TO_CHANNEL

Description:

- Helper macro to get DAC channel in literal format LL_DAC_CHANNEL_x from number in decimal format.

Parameters:

- __DECIMAL_NB__: 1...2

Return value:

- Returned: value can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2

Notes:

- If the input parameter does not correspond to a DAC channel, this macro returns value '0'.

__LL_DAC_DIGITAL_SCALE

Description:

- Helper macro to define the DAC conversion data full-scale digital value corresponding to the selected DAC resolution.

Parameters:

- __DAC_RESOLUTION__: This parameter can be one of the following values:
  - LL_DAC_RESOLUTION_12B
  - LL_DAC_RESOLUTION_8B

Return value:

- ADC: conversion data equivalent voltage value (unit: mVolt)

Notes:

- DAC conversion data full-scale corresponds to voltage range determined by analog voltage references Vref + and Vref- (refer to reference manual).

__LL_DAC_CALC_VOLTAGE_TO_DATA

Description:

- Helper macro to calculate the DAC conversion data (unit: digital value) corresponding to a voltage (unit: mVolt).

Parameters:

- __VREFANALOG_VOLTAGE__: Analog reference voltage (unit: mV)
- __DAC_VOLTAGE__: Voltage to be generated by DAC channel (unit: mVolt).
- __DAC_RESOLUTION__: This parameter can be one of the following values:
  - LL_DAC_RESOLUTION_12B
  - LL_DAC_RESOLUTION_8B

Return value:

- DAC: conversion data (unit: digital value)

Notes:

- This helper macro is intended to provide input data in voltage rather than digital value, to be used with LL DAC functions such as LL_DAC_ConvertData12RightAligned(). Analog reference voltage (Vref+) must be either known from user board environment or can be calculated using ADC measurement and ADC helper macro __LL_ADC_CALC_VREFANALOG_VOLTAGE().

Common write and read registers macros

LL_DAC_WriteReg

Description:

- Write a value in DAC register.

Parameters:

- __INSTANCE__: DAC Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_DAC_ReadReg

Description:

- Read a value in DAC register.

Parameters:

- __INSTANCE__: DAC Instance
- __REG__: Register to be read

Return value:

- Register: value

87 LL DMA2D Generic Driver

87.1 DMA2D Firmware driver registers structures

87.1.1 LL_DMA2D_InitTypeDef

LL_DMA2D_InitTypeDef is defined in the stm32l4xx_ll_dma2d.h

Data Fields

- ***uint32_t Mode***
- ***uint32_t ColorMode***
- ***uint32_t OutputBlue***
- ***uint32_t OutputGreen***
- ***uint32_t OutputRed***
- ***uint32_t OutputAlpha***
- ***uint32_t OutputMemoryAddress***
- ***uint32_t OutputSwapMode***
- ***uint32_t LineOffsetMode***
- ***uint32_t LineOffset***
- ***uint32_t NbrOfLines***
- ***uint32_t NbrOfPixelsPerLines***
- ***uint32_t AlphaInversionMode***
- ***uint32_t RBSwapMode***

Field Documentation

- ***uint32_t LL_DMA2D_InitTypeDef::Mode***

  Specifies the DMA2D transfer mode.
  - This parameter can be one value of ***DMA2D_LL_EC_MODE***.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetMode()**.
- ***uint32_t LL_DMA2D_InitTypeDef::ColorMode***

  Specifies the color format of the output image.
  - This parameter can be one value of ***DMA2D_LL_EC_OUTPUT_COLOR_MODE***.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColorMode()**.
- ***uint32_t LL_DMA2D_InitTypeDef::OutputBlue***

  Specifies the Blue value of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if RGB888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if RGB565 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.

- ***uint32_t LL_DMA2D_InitTypeDef::OutputGreen***

  Specifies the Green value of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if RGB888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x3F if RGB565 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- ***uint32_t LL_DMA2D_InitTypeDef::OutputRed***

  Specifies the Red value of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if RGB888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if RGB565 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- ***uint32_t LL_DMA2D_InitTypeDef::OutputAlpha***

  Specifies the Alpha channel of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x01 if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.
  - This parameter is not considered if RGB888 or RGB565 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- ***uint32_t LL_DMA2D_InitTypeDef::OutputMemoryAddress***

  Specifies the memory address.
  - This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFFFFFF.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputMemAddr()**.
- ***uint32_t LL_DMA2D_InitTypeDef::OutputSwapMode***

  Specifies the output swap mode color format of the output image.
  - This parameter can be one value of ***DMA2D_LL_EC_OUTPUT_SWAP_MODE***.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputSwapMode()**.
- ***uint32_t LL_DMA2D_InitTypeDef::LineOffsetMode***

  Specifies the output line offset mode.
  - This parameter can be one value of ***DMA2D_LL_EC_LINE_OFFSET_MODE***.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetLineOffsetMode()**.

- ***uint32_t LL_DMA2D_InitTypeDef::LineOffset***
  Specifies the output line offset value.
  – This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF on devices where the Line Offset Mode feature is available. else between Min_Data = 0x0000 and Max_Data = 0xFFFF on other devices.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetLineOffset()**.
- ***uint32_t LL_DMA2D_InitTypeDef::NbrOfLines***
  Specifies the number of lines of the area to be transferred.
  – This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetNbrOfLines()**.
- ***uint32_t LL_DMA2D_InitTypeDef::NbrOfPixelsPerLines***
  Specifies the number of pixels per lines of the area to be transfered.
  – This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetNbrOfPixelsPerLines()**.
- ***uint32_t LL_DMA2D_InitTypeDef::AlphaInversionMode***
  Specifies the output alpha inversion mode.
  – This parameter can be one value of ***DMA2D_LL_EC_ALPHA_INVERSION***.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputAlphaInvMode()**.
- ***uint32_t LL_DMA2D_InitTypeDef::RBSwapMode***
  Specifies the output Red Blue swap mode.
  – This parameter can be one value of ***DMA2D_LL_EC_RED_BLUE_SWAP***.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputRBSwapMode()**.

87.1.2 LL_DMA2D_LayerCfgTypeDef

LL_DMA2D_LayerCfgTypeDef is defined in the stm32l4xx_ll_dma2d.h

Data Fields

- ***uint32_t MemoryAddress***
- ***uint32_t LineOffset***
- ***uint32_t ColorMode***
- ***uint32_t CLUTColorMode***
- ***uint32_t CLUTSize***
- ***uint32_t AlphaMode***
- ***uint32_t Alpha***
- ***uint32_t Blue***
- ***uint32_t Green***
- ***uint32_t Red***
- ***uint32_t CLUTMemoryAddress***
- ***uint32_t AlphaInversionMode***
- ***uint32_t RBSwapMode***

Field Documentation

- ***uint32_t LL_DMA2D_LayerCfgTypeDef::MemoryAddress***
  Specifies the foreground or background memory address.
  – This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFFFFFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetMemAddr()** for foreground layer,
  – **LL_DMA2D_BGND_SetMemAddr()** for background layer.

- ***uint32_t LL_DMA2D_LayerCfgTypeDef::LineOffset***
  Specifies the foreground or background line offset value.
  – This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0x3FFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetLineOffset()** for foreground layer,
  – **LL_DMA2D_BGND_SetLineOffset()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::ColorMode***
  Specifies the foreground or background color mode.
  – This parameter can be one value of ***DMA2D_LL_EC_INPUT_COLOR_MODE***.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetColorMode()** for foreground layer,
  – **LL_DMA2D_BGND_SetColorMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::CLUTColorMode***
  Specifies the foreground or background CLUT color mode.
  – This parameter can be one value of ***DMA2D_LL_EC_CLUT_COLOR_MODE***.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetCLUTColorMode()** for foreground layer,
  – **LL_DMA2D_BGND_SetCLUTColorMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::CLUTSize***
  Specifies the foreground or background CLUT size.
  – This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetCLUTSize()** for foreground layer,
  – **LL_DMA2D_BGND_SetCLUTSize()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::AlphaMode***
  Specifies the foreground or background alpha mode.
  – This parameter can be one value of ***DMA2D_LL_EC_ALPHA_MODE***.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetAlphaMode()** for foreground layer,
  – **LL_DMA2D_BGND_SetAlphaMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Alpha***
  Specifies the foreground or background Alpha value.
  – This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetAlpha()** for foreground layer,
  – **LL_DMA2D_BGND_SetAlpha()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Blue***
  Specifies the foreground or background Blue color value.
  – This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetBlueColor()** for foreground layer,
  – **LL_DMA2D_BGND_SetBlueColor()** for background layer.

- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Green***
  Specifies the foreground or background Green color value.
  – This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetGreenColor()** for foreground layer,
  – **LL_DMA2D_BGND_SetGreenColor()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::Red***
  Specifies the foreground or background Red color value.
  – This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetRedColor()** for foreground layer,
  – **LL_DMA2D_BGND_SetRedColor()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::CLUTMemoryAddress***
  Specifies the foreground or background CLUT memory address.
  – This parameter must be a number between Min_Data = 0x0000 and Max_Data = 0xFFFFFFFF.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetCLUTMemAddr()** for foreground layer,
  – **LL_DMA2D_BGND_SetCLUTMemAddr()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::AlphaInversionMode***
  Specifies the foreground or background alpha inversion mode.
  – This parameter can be one value of *DMA2D_LL_EC_ALPHA_INVERSION*.

  This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetAlphaInvMode()** for foreground layer,
  – **LL_DMA2D_BGND_SetAlphaInvMode()** for background layer.
- ***uint32_t LL_DMA2D_LayerCfgTypeDef::RBSwapMode***
  Specifies the foreground or background Red Blue swap mode. This parameter can be one value of *DMA2D_LL_EC_RED_BLUE_SWAP* .This parameter can be modified afterwards using unitary functions
  – **LL_DMA2D_FGND_SetRBSwapMode()** for foreground layer,
  – **LL_DMA2D_BGND_SetRBSwapMode()** for background layer.

87.1.3 LL_DMA2D_ColorTypeDef

LL_DMA2D_ColorTypeDef is defined in the stm32l4xx_ll_dma2d.h

Data Fields

- ***uint32_t ColorMode***
- ***uint32_t OutputBlue***
- ***uint32_t OutputGreen***
- ***uint32_t OutputRed***
- ***uint32_t OutputAlpha***

Field Documentation

- ***uint32_t LL_DMA2D_ColorTypeDef::ColorMode***
  Specifies the color format of the output image.
  – This parameter can be one value of *DMA2D_LL_EC_OUTPUT_COLOR_MODE*.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColorMode()**.

- ***uint32_t LL_DMA2D_ColorTypeDef::OutputBlue***

  Specifies the Blue value of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if RGB888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if RGB565 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- ***uint32_t LL_DMA2D_ColorTypeDef::OutputGreen***

  Specifies the Green value of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if RGB888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x3F if RGB565 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.
- ***uint32_t LL_DMA2D_ColorTypeDef::OutputRed***

  Specifies the Red value of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if RGB888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if RGB565 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1F if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.

- ***uint32_t LL_DMA2D_ColorTypeDef::OutputAlpha***

  Specifies the Alpha channel of the output image.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFF if ARGB8888 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x01 if ARGB1555 color mode is selected.
  - This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x0F if ARGB4444 color mode is selected.
  - This parameter is not considered if RGB888 or RGB565 color mode is selected.

  This parameter can be modified afterwards using unitary function **LL_DMA2D_SetOutputColor()** or configuration function **LL_DMA2D_ConfigOutputColor()**.

87.2 DMA2D Firmware driver API description

The following section lists the various functions of the DMA2D library.

87.2.1 Detailed description of functions

`LL_DMA2D_Start`

Function name

__STATIC_INLINE void LL_DMA2D_Start (DMA2D_TypeDef * DMA2Dx)

Function description

Start a DMA2D transfer.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR START LL_DMA2D_Start

`LL_DMA2D_IsTransferOngoing`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsTransferOngoing (DMA2D_TypeDef * DMA2Dx)

Function description

Indicate if a DMA2D transfer is ongoing.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR START LL_DMA2D_IsTransferOngoing

`LL_DMA2D_Suspend`

Function name

__STATIC_INLINE void LL_DMA2D_Suspend (DMA2D_TypeDef * DMA2Dx)

Function description

Suspend DMA2D transfer.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Notes

- This API can be used to suspend automatic foreground or background CLUT loading.

Reference Manual to LL API cross reference:

- CR SUSP LL_DMA2D_Suspend

`LL_DMA2D_Resume`

Function name

__STATIC_INLINE void LL_DMA2D_Resume (DMA2D_TypeDef * DMA2Dx)

Function description

Resume DMA2D transfer.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Notes

- This API can be used to resume automatic foreground or background CLUT loading.

Reference Manual to LL API cross reference:

- CR SUSP LL_DMA2D_Resume

`LL_DMA2D_IsSuspended`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsSuspended (DMA2D_TypeDef * DMA2Dx)

Function description

Indicate if DMA2D transfer is suspended.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Notes

- This API can be used to indicate whether or not automatic foreground or background CLUT loading is suspended.

Reference Manual to LL API cross reference:

- CR SUSP LL_DMA2D_IsSuspended

`LL_DMA2D_Abort`

Function name

__STATIC_INLINE void LL_DMA2D_Abort (DMA2D_TypeDef * DMA2Dx)

Function description

Abort DMA2D transfer.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Notes

- This API can be used to abort automatic foreground or background CLUT loading.

Reference Manual to LL API cross reference:

- CR ABORT LL_DMA2D_Abort

`LL_DMA2D_IsAborted`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsAborted (DMA2D_TypeDef * DMA2Dx)

Function description

Indicate if DMA2D transfer is aborted.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Notes

- This API can be used to indicate whether or not automatic foreground or background CLUT loading is aborted.

Reference Manual to LL API cross reference:

- CR ABORT LL_DMA2D_IsAborted

`LL_DMA2D_SetMode`

Function name

__STATIC_INLINE void LL_DMA2D_SetMode (DMA2D_TypeDef * DMA2Dx, uint32_t Mode)

Function description

Set DMA2D mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **Mode:** This parameter can be one of the following values:
  - LL_DMA2D_MODE_M2M
  - LL_DMA2D_MODE_M2M_PFC
  - LL_DMA2D_MODE_M2M_BLEND
  - LL_DMA2D_MODE_R2M
  - LL_DMA2D_MODE_M2M_BLEND_FIXED_COLOR_FG (*)
  - LL_DMA2D_MODE_M2M_BLEND_FIXED_COLOR_BG (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR MODE LL_DMA2D_SetMode

LL_DMA2D_GetMode

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_MODE_M2M
  - LL_DMA2D_MODE_M2M_PFC
  - LL_DMA2D_MODE_M2M_BLEND
  - LL_DMA2D_MODE_R2M
  - LL_DMA2D_MODE_M2M_BLEND_FIXED_COLOR_FG (*)
  - LL_DMA2D_MODE_M2M_BLEND_FIXED_COLOR_BG (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CR MODE LL_DMA2D_GetMode

LL_DMA2D_SetOutputColorMode

Function name

__STATIC_INLINE void LL_DMA2D_SetOutputColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Set DMA2D output color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_OUTPUT_MODE_ARGB8888
  - LL_DMA2D_OUTPUT_MODE_RGB888
  - LL_DMA2D_OUTPUT_MODE_RGB565
  - LL_DMA2D_OUTPUT_MODE_ARGB1555
  - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **None:**

Reference Manual to LL API cross reference:

- OPFCCR CM LL_DMA2D_SetOutputColorMode

`LL_DMA2D_GetOutputColorMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetOutputColorMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D output color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_OUTPUT_MODE_ARGB8888
  - LL_DMA2D_OUTPUT_MODE_RGB888
  - LL_DMA2D_OUTPUT_MODE_RGB565
  - LL_DMA2D_OUTPUT_MODE_ARGB1555
  - LL_DMA2D_OUTPUT_MODE_ARGB4444

Reference Manual to LL API cross reference:

- OPFCCR CM LL_DMA2D_GetOutputColorMode

`LL_DMA2D_SetOutputRBSwapMode`

Function name

__STATIC_INLINE void LL_DMA2D_SetOutputRBSwapMode (DMA2D_TypeDef * DMA2Dx, uint32_t RBSwapMode)

Function description

Set DMA2D output Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **RBSwapMode:** This parameter can be one of the following values:
  - LL_DMA2D_RB_MODE_REGULAR
  - LL_DMA2D_RB_MODE_SWAP

Return values

- **None:**

Reference Manual to LL API cross reference:

- OPFCCR RBS LL_DMA2D_SetOutputRBSwapMode

`LL_DMA2D_GetOutputRBSwapMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetOutputRBSwapMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D output Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_RB_MODE_REGULAR
  - LL_DMA2D_RB_MODE_SWAP

Reference Manual to LL API cross reference:

- OPFCCR RBS LL_DMA2D_GetOutputRBSwapMode

`LL_DMA2D_SetOutputAlphaInvMode`

Function name

__STATIC_INLINE void LL_DMA2D_SetOutputAlphaInvMode (DMA2D_TypeDef * DMA2Dx, uint32_t AlphaInversionMode)

Function description

Set DMA2D output alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AlphaInversionMode:** This parameter can be one of the following values:
  - LL_DMA2D_ALPHA_REGULAR
  - LL_DMA2D_ALPHA_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- OPFCCR AI LL_DMA2D_SetOutputAlphaInvMode

`LL_DMA2D_GetOutputAlphaInvMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetOutputAlphaInvMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D output alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_ALPHA_REGULAR
  - LL_DMA2D_ALPHA_INVERTED

Reference Manual to LL API cross reference:

- OPFCCR AI LL_DMA2D_GetOutputAlphaInvMode

`LL_DMA2D_SetOutputSwapMode`

Function name

__STATIC_INLINE void LL_DMA2D_SetOutputSwapMode (DMA2D_TypeDef * DMA2Dx, uint32_t OutputSwapMode)

Function description

Set DMA2D output swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **OutputSwapMode:** This parameter can be one of the following values:
  - LL_DMA2D_SWAP_MODE_REGULAR
  - LL_DMA2D_SWAP_MODE_TWO_BY_TWO

Return values

- **None:**

Reference Manual to LL API cross reference:

- OPFCCR SB LL_DMA2D_SetOutputSwapMode

`LL_DMA2D_GetOutputSwapMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetOutputSwapMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D output swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_SWAP_MODE_REGULAR
  - LL_DMA2D_SWAP_MODE_TWO_BY_TWO

Reference Manual to LL API cross reference:

- OPFCCR SB LL_DMA2D_GetOutputSwapMode

`LL_DMA2D_SetLineOffsetMode`

Function name

__STATIC_INLINE void LL_DMA2D_SetLineOffsetMode (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffsetMode)

Function description

Set DMA2D line offset mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **LineOffsetMode:** This parameter can be one of the following values:
  - LL_DMA2D_LINE_OFFSET_PIXELS
  - LL_DMA2D_LINE_OFFSET_BYTES

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR LOM LL_DMA2D_SetLineOffsetMode

`LL_DMA2D_GetLineOffsetMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetLineOffsetMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D line offset mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_LINE_OFFSET_PIXELS
  - LL_DMA2D_LINE_OFFSET_BYTES

Reference Manual to LL API cross reference:

- CR LOM LL_DMA2D_GetLineOffsetMode

`LL_DMA2D_SetLineOffset`

Function name

__STATIC_INLINE void LL_DMA2D_SetLineOffset (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffset)

Function description

Set DMA2D line offset, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **LineOffset:** Value between Min_Data=0 and Max_Data=0x3FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- OOR LO LL_DMA2D_SetLineOffset

`LL_DMA2D_GetLineOffset`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetLineOffset (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D line offset, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Line:** offset value between Min_Data=0 and Max_Data=0x3FFF

Reference Manual to LL API cross reference:

- OOR LO LL_DMA2D_GetLineOffset

`LL_DMA2D_SetNbrOfPixelsPerLines`

Function name

__STATIC_INLINE void LL_DMA2D_SetNbrOfPixelsPerLines (DMA2D_TypeDef * DMA2Dx, uint32_t NbrOfPixelsPerLines)

Function description

Set DMA2D number of pixels per lines, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **NbrOfPixelsPerLines:** Value between Min_Data=0 and Max_Data=0x3FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- NLR PL LL_DMA2D_SetNbrOfPixelsPerLines

`LL_DMA2D_GetNbrOfPixelsPerLines`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetNbrOfPixelsPerLines (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D number of pixels per lines, expressed on 14 bits ([13:0] bits)

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Number:** of pixels per lines value between Min_Data=0 and Max_Data=0x3FFF

Reference Manual to LL API cross reference:

- NLR PL LL_DMA2D_GetNbrOfPixelsPerLines

`LL_DMA2D_SetNbrOfLines`

Function name

__STATIC_INLINE void LL_DMA2D_SetNbrOfLines (DMA2D_TypeDef * DMA2Dx, uint32_t NbrOfLines)

Function description

Set DMA2D number of lines, expressed on 16 bits ([15:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **NbrOfLines:** Value between Min_Data=0 and Max_Data=0xFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- NLR NL LL_DMA2D_SetNbrOfLines

`LL_DMA2D_GetNbrOfLines`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetNbrOfLines (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D number of lines, expressed on 16 bits ([15:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Number:** of lines value between Min_Data=0 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- NLR NL LL_DMA2D_GetNbrOfLines

`LL_DMA2D_SetOutputMemAddr`

Function name

__STATIC_INLINE void LL_DMA2D_SetOutputMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t OutputMemoryAddress)

Function description

Set DMA2D output memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **OutputMemoryAddress:** Value between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- OMAR MA LL_DMA2D_SetOutputMemAddr

`LL_DMA2D_GetOutputMemAddr`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetOutputMemAddr (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D output memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Output:** memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- OMAR MA LL_DMA2D_GetOutputMemAddr

`LL_DMA2D_SetOutputColor`

Function name

__STATIC_INLINE void LL_DMA2D_SetOutputColor (DMA2D_TypeDef * DMA2Dx, uint32_t OutputColor)

Function description

Set DMA2D output color, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **OutputColor:** Value between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Notes

- Output color format depends on output color mode, ARGB8888, RGB888, RGB565, ARGB1555 or ARGB4444.
- LL_DMA2D_ConfigOutputColor() API may be used instead if colors values formatting with respect to color mode is not done by the user code.

Reference Manual to LL API cross reference:

- OCOLR BLUE LL_DMA2D_SetOutputColor
- OCOLR GREEN LL_DMA2D_SetOutputColor
- OCOLR RED LL_DMA2D_SetOutputColor
- OCOLR ALPHA LL_DMA2D_SetOutputColor

`LL_DMA2D_GetOutputColor`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetOutputColor (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D output color, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Output:** color value between Min_Data=0 and Max_Data=0xFFFFFFFF

Notes

- Alpha channel and red, green, blue color values must be retrieved from the returned value based on the output color mode (ARGB8888, RGB888, RGB565, ARGB1555 or ARGB4444) as set by LL_DMA2D_SetOutputColorMode.

Reference Manual to LL API cross reference:

- OCOLR BLUE LL_DMA2D_GetOutputColor
- OCOLR GREEN LL_DMA2D_GetOutputColor
- OCOLR RED LL_DMA2D_GetOutputColor
- OCOLR ALPHA LL_DMA2D_GetOutputColor

LL_DMA2D_SetLineWatermark

Function name

__STATIC_INLINE void LL_DMA2D_SetLineWatermark (DMA2D_TypeDef * DMA2Dx, uint32_t LineWatermark)

Function description

Set DMA2D line watermark, expressed on 16 bits ([15:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **LineWatermark:** Value between Min_Data=0 and Max_Data=0xFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- LWR LW LL_DMA2D_SetLineWatermark

LL_DMA2D_GetLineWatermark

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetLineWatermark (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D line watermark, expressed on 16 bits ([15:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Line:** watermark value between Min_Data=0 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- LWR LW LL_DMA2D_GetLineWatermark

LL_DMA2D_SetDeadTime

Function name

__STATIC_INLINE void LL_DMA2D_SetDeadTime (DMA2D_TypeDef * DMA2Dx, uint32_t DeadTime)

Function description

Set DMA2D dead time, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **DeadTime:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- AMTCR DT LL_DMA2D_SetDeadTime

LL_DMA2D_GetDeadTime

Function name

__STATIC_INLINE uint32_t LL_DMA2D_GetDeadTime (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D dead time, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Dead:** time value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- AMTCR DT LL_DMA2D_GetDeadTime

LL_DMA2D_EnableDeadTime

Function name

__STATIC_INLINE void LL_DMA2D_EnableDeadTime (DMA2D_TypeDef * DMA2Dx)

Function description

Enable DMA2D dead time functionality.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- AMTCR EN LL_DMA2D_EnableDeadTime

LL_DMA2D_DisableDeadTime

Function name

__STATIC_INLINE void LL_DMA2D_DisableDeadTime (DMA2D_TypeDef * DMA2Dx)

Function description

Disable DMA2D dead time functionality.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- AMTCR EN LL_DMA2D_DisableDeadTime

LL_DMA2D_IsEnabledDeadTime

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledDeadTime (DMA2D_TypeDef * DMA2Dx)

Function description

Indicate if DMA2D dead time functionality is enabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- AMTCR EN LL_DMA2D_IsEnabledDeadTime

LL_DMA2D_FGND_SetMemAddr

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t MemoryAddress)

Function description

Set DMA2D foreground memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **MemoryAddress:** Value between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGMAR MA LL_DMA2D_FGND_SetMemAddr

LL_DMA2D_FGND_GetMemAddr

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetMemAddr (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D foreground memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Foreground:** memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- FGMAR MA LL_DMA2D_FGND_GetMemAddr

LL_DMA2D_FGND_EnableCLUTLoad

Function name

__STATIC_INLINE void LL_DMA2D_FGND_EnableCLUTLoad (DMA2D_TypeDef * DMA2Dx)

Function description

Enable DMA2D foreground CLUT loading.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR START LL_DMA2D_FGND_EnableCLUTLoad

`LL_DMA2D_FGND_IsEnabledCLUTLoad`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_IsEnabledCLUTLoad (DMA2D_TypeDef * DMA2Dx)

Function description

Indicate if DMA2D foreground CLUT loading is enabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- FGPFCCR START LL_DMA2D_FGND_IsEnabledCLUTLoad

`LL_DMA2D_FGND_SetColorMode`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Set DMA2D foreground color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_INPUT_MODE_ARGB8888
  - LL_DMA2D_INPUT_MODE_RGB888
  - LL_DMA2D_INPUT_MODE_RGB565
  - LL_DMA2D_INPUT_MODE_ARGB1555
  - LL_DMA2D_INPUT_MODE_ARGB4444
  - LL_DMA2D_INPUT_MODE_L8
  - LL_DMA2D_INPUT_MODE_AL44
  - LL_DMA2D_INPUT_MODE_AL88
  - LL_DMA2D_INPUT_MODE_L4
  - LL_DMA2D_INPUT_MODE_A8
  - LL_DMA2D_INPUT_MODE_A4

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR CM LL_DMA2D_FGND_SetColorMode

`LL_DMA2D_FGND_GetColorMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetColorMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_INPUT_MODE_ARGB8888
  - LL_DMA2D_INPUT_MODE_RGB888
  - LL_DMA2D_INPUT_MODE_RGB565
  - LL_DMA2D_INPUT_MODE_ARGB1555
  - LL_DMA2D_INPUT_MODE_ARGB4444
  - LL_DMA2D_INPUT_MODE_L8
  - LL_DMA2D_INPUT_MODE_AL44
  - LL_DMA2D_INPUT_MODE_AL88
  - LL_DMA2D_INPUT_MODE_L4
  - LL_DMA2D_INPUT_MODE_A8
  - LL_DMA2D_INPUT_MODE_A4

Reference Manual to LL API cross reference:

- FGPFCCR CM LL_DMA2D_FGND_GetColorMode

`LL_DMA2D_FGND_SetAlphaMode`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetAlphaMode (DMA2D_TypeDef * DMA2Dx, uint32_t AphaMode)

Function description

Set DMA2D foreground alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AphaMode:** This parameter can be one of the following values:
  - LL_DMA2D_ALPHA_MODE_NO_MODIF
  - LL_DMA2D_ALPHA_MODE_REPLACE
  - LL_DMA2D_ALPHA_MODE_COMBINE

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR AM LL_DMA2D_FGND_SetAlphaMode

`LL_DMA2D_FGND_GetAlphaMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetAlphaMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_ALPHA_MODE_NO_MODIF
  - LL_DMA2D_ALPHA_MODE_REPLACE
  - LL_DMA2D_ALPHA_MODE_COMBINE

Reference Manual to LL API cross reference:

- FGPFCCR AM LL_DMA2D_FGND_GetAlphaMode

LL_DMA2D_FGND_SetAlpha

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetAlpha (DMA2D_TypeDef * DMA2Dx, uint32_t Alpha)

Function description

Set DMA2D foreground alpha value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Alpha:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR ALPHA LL_DMA2D_FGND_SetAlpha

LL_DMA2D_FGND_GetAlpha

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetAlpha (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground alpha value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Alpha:** value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGPFCCR ALPHA LL_DMA2D_FGND_GetAlpha

LL_DMA2D_FGND_SetRBSwapMode

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetRBSwapMode (DMA2D_TypeDef * DMA2Dx, uint32_t RBSwapMode)

Function description

Set DMA2D foreground Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **RBSwapMode:** This parameter can be one of the following values:
  - LL_DMA2D_RB_MODE_REGULAR
  - LL_DMA2D_RB_MODE_SWAP

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR RBS LL_DMA2D_FGND_SetRBSwapMode

LL_DMA2D_FGND_GetRBSwapMode

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetRBSwapMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_RB_MODE_REGULAR
  - LL_DMA2D_RB_MODE_SWAP

Reference Manual to LL API cross reference:

- FGPFCCR RBS LL_DMA2D_FGND_GetRBSwapMode

LL_DMA2D_FGND_SetAlphaInvMode

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetAlphaInvMode (DMA2D_TypeDef * DMA2Dx, uint32_t AlphaInversionMode)

Function description

Set DMA2D foreground alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AlphaInversionMode:** This parameter can be one of the following values:
  - LL_DMA2D_ALPHA_REGULAR
  - LL_DMA2D_ALPHA_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR AI LL_DMA2D_FGND_SetAlphaInvMode

`LL_DMA2D_FGND_GetAlphaInvMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetAlphaInvMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_ALPHA_REGULAR
  - LL_DMA2D_ALPHA_INVERTED

Reference Manual to LL API cross reference:

- FGPFCCR AI LL_DMA2D_FGND_GetAlphaInvMode

`LL_DMA2D_FGND_SetLineOffset`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetLineOffset (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffset)

Function description

Set DMA2D foreground line offset, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **LineOffset:** Value between Min_Data=0 and Max_Data=0x3FF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGOR LO LL_DMA2D_FGND_SetLineOffset

`LL_DMA2D_FGND_GetLineOffset`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetLineOffset (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground line offset, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Foreground:** line offset value between Min_Data=0 and Max_Data=0x3FF

Reference Manual to LL API cross reference:

- FGOR LO LL_DMA2D_FGND_GetLineOffset

`LL_DMA2D_FGND_SetColor`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red, uint32_t Green, uint32_t Blue)

Function description

Set DMA2D foreground color values, expressed on 24 bits ([23:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Red:** Value between Min_Data=0 and Max_Data=0xFF
- **Green:** Value between Min_Data=0 and Max_Data=0xFF
- **Blue:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCOLR RED LL_DMA2D_FGND_SetColor
- FGCOLR GREEN LL_DMA2D_FGND_SetColor
- FGCOLR BLUE LL_DMA2D_FGND_SetColor

`LL_DMA2D_FGND_SetRedColor`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetRedColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red)

Function description

Set DMA2D foreground red color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Red:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCOLR RED LL_DMA2D_FGND_SetRedColor

`LL_DMA2D_FGND_GetRedColor`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetRedColor (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground red color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Red:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGCOLR RED LL_DMA2D_FGND_GetRedColor

`LL_DMA2D_FGND_SetGreenColor`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetGreenColor (DMA2D_TypeDef * DMA2Dx, uint32_t Green)

Function description

Set DMA2D foreground green color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Green:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCOLR GREEN LL_DMA2D_FGND_SetGreenColor

`LL_DMA2D_FGND_GetGreenColor`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetGreenColor (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground green color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Green:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGCOLR GREEN LL_DMA2D_FGND_GetGreenColor

`LL_DMA2D_FGND_SetBlueColor`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetBlueColor (DMA2D_TypeDef * DMA2Dx, uint32_t Blue)

Function description

Set DMA2D foreground blue color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Blue:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCOLR BLUE LL_DMA2D_FGND_SetBlueColor

LL_DMA2D_FGND_GetBlueColor

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetBlueColor (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground blue color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Blue:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGCOLR BLUE LL_DMA2D_FGND_GetBlueColor

LL_DMA2D_FGND_SetCLUTMemAddr

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTMemoryAddress)

Function description

Set DMA2D foreground CLUT memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTMemoryAddress:** Value between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGCMAR MA LL_DMA2D_FGND_SetCLUTMemAddr

LL_DMA2D_FGND_GetCLUTMemAddr

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D foreground CLUT memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Foreground:** CLUT memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- FGCMAR MA LL_DMA2D_FGND_GetCLUTMemAddr

`LL_DMA2D_FGND_SetCLUTSize`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetCLUTSize (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTSize)

Function description

Set DMA2D foreground CLUT size, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTSize:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR CS LL_DMA2D_FGND_SetCLUTSize

`LL_DMA2D_FGND_GetCLUTSize`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetCLUTSize (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D foreground CLUT size, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Foreground:** CLUT size value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- FGPFCCR CS LL_DMA2D_FGND_GetCLUTSize

`LL_DMA2D_FGND_SetCLUTColorMode`

Function name

__STATIC_INLINE void LL_DMA2D_FGND_SetCLUTColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTColorMode)

Function description

Set DMA2D foreground CLUT color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_CLUT_COLOR_MODE_ARGB8888
  - LL_DMA2D_CLUT_COLOR_MODE_RGB888

Return values

- **None:**

Reference Manual to LL API cross reference:

- FGPFCCR CCM LL_DMA2D_FGND_SetCLUTColorMode

`LL_DMA2D_FGND_GetCLUTColorMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_FGND_GetCLUTColorMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D foreground CLUT color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_CLUT_COLOR_MODE_ARGB8888
  - LL_DMA2D_CLUT_COLOR_MODE_RGB888

Reference Manual to LL API cross reference:

- FGPFCCR CCM LL_DMA2D_FGND_GetCLUTColorMode

`LL_DMA2D_BGND_SetMemAddr`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t MemoryAddress)

Function description

Set DMA2D background memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **MemoryAddress:** Value between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGMAR MA LL_DMA2D_BGND_SetMemAddr

`LL_DMA2D_BGND_GetMemAddr`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetMemAddr (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D background memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Background:** memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- BGMAR MA LL_DMA2D_BGND_GetMemAddr

LL_DMA2D_BGND_EnableCLUTLoad

Function name

__STATIC_INLINE void LL_DMA2D_BGND_EnableCLUTLoad (DMA2D_TypeDef * DMA2Dx)

Function description

Enable DMA2D background CLUT loading.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR START LL_DMA2D_BGND_EnableCLUTLoad

LL_DMA2D_BGND_IsEnabledCLUTLoad

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_IsEnabledCLUTLoad (DMA2D_TypeDef * DMA2Dx)

Function description

Indicate if DMA2D background CLUT loading is enabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- BGPFCCR START LL_DMA2D_BGND_IsEnabledCLUTLoad

LL_DMA2D_BGND_SetColorMode

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Set DMA2D background color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_INPUT_MODE_ARGB8888
  - LL_DMA2D_INPUT_MODE_RGB888
  - LL_DMA2D_INPUT_MODE_RGB565
  - LL_DMA2D_INPUT_MODE_ARGB1555
  - LL_DMA2D_INPUT_MODE_ARGB4444
  - LL_DMA2D_INPUT_MODE_L8
  - LL_DMA2D_INPUT_MODE_AL44
  - LL_DMA2D_INPUT_MODE_AL88
  - LL_DMA2D_INPUT_MODE_L4
  - LL_DMA2D_INPUT_MODE_A8
  - LL_DMA2D_INPUT_MODE_A4

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR CM LL_DMA2D_BGND_SetColorMode

LL_DMA2D_BGND_GetColorMode

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetColorMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_INPUT_MODE_ARGB8888
  - LL_DMA2D_INPUT_MODE_RGB888
  - LL_DMA2D_INPUT_MODE_RGB565
  - LL_DMA2D_INPUT_MODE_ARGB1555
  - LL_DMA2D_INPUT_MODE_ARGB4444
  - LL_DMA2D_INPUT_MODE_L8
  - LL_DMA2D_INPUT_MODE_AL44
  - LL_DMA2D_INPUT_MODE_AL88
  - LL_DMA2D_INPUT_MODE_L4
  - LL_DMA2D_INPUT_MODE_A8
  - LL_DMA2D_INPUT_MODE_A4

Reference Manual to LL API cross reference:

- BGPFCCR CM LL_DMA2D_BGND_GetColorMode

LL_DMA2D_BGND_SetAlphaMode

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetAlphaMode (DMA2D_TypeDef * DMA2Dx, uint32_t AphaMode)

Function description

Set DMA2D background alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AphaMode:** This parameter can be one of the following values:
  - LL_DMA2D_ALPHA_MODE_NO_MODIF
  - LL_DMA2D_ALPHA_MODE_REPLACE
  - LL_DMA2D_ALPHA_MODE_COMBINE

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR AM LL_DMA2D_BGND_SetAlphaMode

LL_DMA2D_BGND_GetAlphaMode

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetAlphaMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background alpha mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_ALPHA_MODE_NO_MODIF
  - LL_DMA2D_ALPHA_MODE_REPLACE
  - LL_DMA2D_ALPHA_MODE_COMBINE

Reference Manual to LL API cross reference:

- BGPFCCR AM LL_DMA2D_BGND_GetAlphaMode

LL_DMA2D_BGND_SetAlpha

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetAlpha (DMA2D_TypeDef * DMA2Dx, uint32_t Alpha)

Function description

Set DMA2D background alpha value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Alpha:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR ALPHA LL_DMA2D_BGND_SetAlpha

`LL_DMA2D_BGND_GetAlpha`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetAlpha (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background alpha value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Alpha:** value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- BGPFCCR ALPHA LL_DMA2D_BGND_GetAlpha

`LL_DMA2D_BGND_SetRBSwapMode`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetRBSwapMode (DMA2D_TypeDef * DMA2Dx, uint32_t RBSwapMode)

Function description

Set DMA2D background Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **RBSwapMode:** This parameter can be one of the following values:
  - LL_DMA2D_RB_MODE_REGULAR
  - LL_DMA2D_RB_MODE_SWAP

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR RBS LL_DMA2D_BGND_SetRBSwapMode

`LL_DMA2D_BGND_GetRBSwapMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetRBSwapMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background Red Blue swap mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_RB_MODE_REGULAR
  - LL_DMA2D_RB_MODE_SWAP

Reference Manual to LL API cross reference:

- BGPFCCR RBS LL_DMA2D_BGND_GetRBSwapMode

`LL_DMA2D_BGND_SetAlphaInvMode`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetAlphaInvMode (DMA2D_TypeDef * DMA2Dx, uint32_t AlphaInversionMode)

Function description

Set DMA2D background alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **AlphaInversionMode:** This parameter can be one of the following values:
  - LL_DMA2D_ALPHA_REGULAR
  - LL_DMA2D_ALPHA_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR AI LL_DMA2D_BGND_SetAlphaInvMode

`LL_DMA2D_BGND_GetAlphaInvMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetAlphaInvMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background alpha inversion mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_ALPHA_REGULAR
  - LL_DMA2D_ALPHA_INVERTED

Reference Manual to LL API cross reference:

- BGPFCCR AI LL_DMA2D_BGND_GetAlphaInvMode

`LL_DMA2D_BGND_SetLineOffset`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetLineOffset (DMA2D_TypeDef * DMA2Dx, uint32_t LineOffset)

Function description

Set DMA2D background line offset, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **LineOffset:** Value between Min_Data=0 and Max_Data=0x3FF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGOR LO LL_DMA2D_BGND_SetLineOffset

`LL_DMA2D_BGND_GetLineOffset`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetLineOffset (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background line offset, expressed on 14 bits ([13:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Background:** line offset value between Min_Data=0 and Max_Data=0x3FF

Reference Manual to LL API cross reference:

- BGOR LO LL_DMA2D_BGND_GetLineOffset

`LL_DMA2D_BGND_SetColor`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red, uint32_t Green, uint32_t Blue)

Function description

Set DMA2D background color values, expressed on 24 bits ([23:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Red:** Value between Min_Data=0 and Max_Data=0xFF
- **Green:** Value between Min_Data=0 and Max_Data=0xFF
- **Blue:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGCOLR RED LL_DMA2D_BGND_SetColor
- BGCOLR GREEN LL_DMA2D_BGND_SetColor
- BGCOLR BLUE LL_DMA2D_BGND_SetColor

`LL_DMA2D_BGND_SetRedColor`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetRedColor (DMA2D_TypeDef * DMA2Dx, uint32_t Red)

Function description

Set DMA2D background red color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Red:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGCOLR RED LL_DMA2D_BGND_SetRedColor

`LL_DMA2D_BGND_GetRedColor`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetRedColor (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background red color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Red:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- BGCOLR RED LL_DMA2D_BGND_GetRedColor

`LL_DMA2D_BGND_SetGreenColor`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetGreenColor (DMA2D_TypeDef * DMA2Dx, uint32_t Green)

Function description

Set DMA2D background green color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Green:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGCOLR GREEN LL_DMA2D_BGND_SetGreenColor

`LL_DMA2D_BGND_GetGreenColor`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetGreenColor (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background green color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Green:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- BGCOLR GREEN LL_DMA2D_BGND_GetGreenColor

`LL_DMA2D_BGND_SetBlueColor`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetBlueColor (DMA2D_TypeDef * DMA2Dx, uint32_t Blue)

Function description

Set DMA2D background blue color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **Blue:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGCOLR BLUE LL_DMA2D_BGND_SetBlueColor

`LL_DMA2D_BGND_GetBlueColor`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetBlueColor (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background blue color value, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Blue:** color value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- BGCOLR BLUE LL_DMA2D_BGND_GetBlueColor

`LL_DMA2D_BGND_SetCLUTMemAddr`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTMemoryAddress)

Function description

Set DMA2D background CLUT memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTMemoryAddress:** Value between Min_Data=0 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGCMAR MA LL_DMA2D_BGND_SetCLUTMemAddr

`LL_DMA2D_BGND_GetCLUTMemAddr`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetCLUTMemAddr (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D background CLUT memory address, expressed on 32 bits ([31:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Background:** CLUT memory address value between Min_Data=0 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- BGCMAR MA LL_DMA2D_BGND_GetCLUTMemAddr

`LL_DMA2D_BGND_SetCLUTSize`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetCLUTSize (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTSize)

Function description

Set DMA2D background CLUT size, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTSize:** Value between Min_Data=0 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR CS LL_DMA2D_BGND_SetCLUTSize

`LL_DMA2D_BGND_GetCLUTSize`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetCLUTSize (DMA2D_TypeDef * DMA2Dx)

Function description

Get DMA2D background CLUT size, expressed on 8 bits ([7:0] bits).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Background:** CLUT size value between Min_Data=0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- BGPFCCR CS LL_DMA2D_BGND_GetCLUTSize

`LL_DMA2D_BGND_SetCLUTColorMode`

Function name

__STATIC_INLINE void LL_DMA2D_BGND_SetCLUTColorMode (DMA2D_TypeDef * DMA2Dx, uint32_t CLUTColorMode)

Function description

Set DMA2D background CLUT color mode.

Parameters

- **DMA2Dx:** DMA2D Instance
- **CLUTColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_CLUT_COLOR_MODE_ARGB8888
  - LL_DMA2D_CLUT_COLOR_MODE_RGB888

Return values

- **None:**

Reference Manual to LL API cross reference:

- BGPFCCR CCM LL_DMA2D_BGND_SetCLUTColorMode

`LL_DMA2D_BGND_GetCLUTColorMode`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_BGND_GetCLUTColorMode (DMA2D_TypeDef * DMA2Dx)

Function description

Return DMA2D background CLUT color mode.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA2D_CLUT_COLOR_MODE_ARGB8888
  - LL_DMA2D_CLUT_COLOR_MODE_RGB888

Reference Manual to LL API cross reference:

- BGPFCCR CCM LL_DMA2D_BGND_GetCLUTColorMode

`LL_DMA2D_IsActiveFlag_CE`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_CE (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Configuration Error Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CEIF LL_DMA2D_IsActiveFlag_CE

`LL_DMA2D_IsActiveFlag_CTC`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_CTC (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D CLUT Transfer Complete Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CTCIF LL_DMA2D_IsActiveFlag_CTC

`LL_DMA2D_IsActiveFlag_CAE`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_CAE (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D CLUT Access Error Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CAEIF LL_DMA2D_IsActiveFlag_CAE

`LL_DMA2D_IsActiveFlag_TW`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_TW (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Transfer Watermark Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TWIF LL_DMA2D_IsActiveFlag_TW

LL_DMA2D_IsActiveFlag_TC

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_TC (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Transfer Complete Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF LL_DMA2D_IsActiveFlag_TC

LL_DMA2D_IsActiveFlag_TE

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsActiveFlag_TE (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Transfer Error Interrupt Flag is set or not.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF LL_DMA2D_IsActiveFlag_TE

LL_DMA2D_ClearFlag_CE

Function name

__STATIC_INLINE void LL_DMA2D_ClearFlag_CE (DMA2D_TypeDef * DMA2Dx)

Function description

Clear DMA2D Configuration Error Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CCEIF LL_DMA2D_ClearFlag_CE

LL_DMA2D_ClearFlag_CTC

Function name

__STATIC_INLINE void LL_DMA2D_ClearFlag_CTC (DMA2D_TypeDef * DMA2Dx)

Function description

Clear DMA2D CLUT Transfer Complete Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CCTCIF LL_DMA2D_ClearFlag_CTC

`LL_DMA2D_ClearFlag_CAE`

Function name

__STATIC_INLINE void LL_DMA2D_ClearFlag_CAE (DMA2D_TypeDef * DMA2Dx)

Function description

Clear DMA2D CLUT Access Error Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CAECIF LL_DMA2D_ClearFlag_CAE

`LL_DMA2D_ClearFlag_TW`

Function name

__STATIC_INLINE void LL_DMA2D_ClearFlag_TW (DMA2D_TypeDef * DMA2Dx)

Function description

Clear DMA2D Transfer Watermark Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTWIF LL_DMA2D_ClearFlag_TW

`LL_DMA2D_ClearFlag_TC`

Function name

__STATIC_INLINE void LL_DMA2D_ClearFlag_TC (DMA2D_TypeDef * DMA2Dx)

Function description

Clear DMA2D Transfer Complete Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF LL_DMA2D_ClearFlag_TC

`LL_DMA2D_ClearFlag_TE`

Function name

__STATIC_INLINE void LL_DMA2D_ClearFlag_TE (DMA2D_TypeDef * DMA2Dx)

Function description

Clear DMA2D Transfer Error Interrupt Flag.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF LL_DMA2D_ClearFlag_TE

`LL_DMA2D_EnableIT_CE`

Function name

__STATIC_INLINE void LL_DMA2D_EnableIT_CE (DMA2D_TypeDef * DMA2Dx)

Function description

Enable Configuration Error Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CEIE LL_DMA2D_EnableIT_CE

`LL_DMA2D_EnableIT_CTC`

Function name

__STATIC_INLINE void LL_DMA2D_EnableIT_CTC (DMA2D_TypeDef * DMA2Dx)

Function description

Enable CLUT Transfer Complete Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CTCIE LL_DMA2D_EnableIT_CTC

`LL_DMA2D_EnableIT_CAE`

Function name

__STATIC_INLINE void LL_DMA2D_EnableIT_CAE (DMA2D_TypeDef * DMA2Dx)

Function description

Enable CLUT Access Error Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CAEIE LL_DMA2D_EnableIT_CAE

`LL_DMA2D_EnableIT_TW`

Function name

__STATIC_INLINE void LL_DMA2D_EnableIT_TW (DMA2D_TypeDef * DMA2Dx)

Function description

Enable Transfer Watermark Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TWIE LL_DMA2D_EnableIT_TW

`LL_DMA2D_EnableIT_TC`

Function name

__STATIC_INLINE void LL_DMA2D_EnableIT_TC (DMA2D_TypeDef * DMA2Dx)

Function description

Enable Transfer Complete Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TCIE LL_DMA2D_EnableIT_TC

`LL_DMA2D_EnableIT_TE`

Function name

__STATIC_INLINE void LL_DMA2D_EnableIT_TE (DMA2D_TypeDef * DMA2Dx)

Function description

Enable Transfer Error Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TEIE LL_DMA2D_EnableIT_TE

`LL_DMA2D_DisableIT_CE`

Function name

__STATIC_INLINE void LL_DMA2D_DisableIT_CE (DMA2D_TypeDef * DMA2Dx)

Function description

Disable Configuration Error Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CEIE LL_DMA2D_DisableIT_CE

`LL_DMA2D_DisableIT_CTC`

Function name

__STATIC_INLINE void LL_DMA2D_DisableIT_CTC (DMA2D_TypeDef * DMA2Dx)

Function description

Disable CLUT Transfer Complete Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CTCIE LL_DMA2D_DisableIT_CTC

`LL_DMA2D_DisableIT_CAE`

Function name

__STATIC_INLINE void LL_DMA2D_DisableIT_CAE (DMA2D_TypeDef * DMA2Dx)

Function description

Disable CLUT Access Error Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CAEIE LL_DMA2D_DisableIT_CAE

`LL_DMA2D_DisableIT_TW`

Function name

__STATIC_INLINE void LL_DMA2D_DisableIT_TW (DMA2D_TypeDef * DMA2Dx)

Function description

Disable Transfer Watermark Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TWIE LL_DMA2D_DisableIT_TW

`LL_DMA2D_DisableIT_TC`

Function name

__STATIC_INLINE void LL_DMA2D_DisableIT_TC (DMA2D_TypeDef * DMA2Dx)

Function description

Disable Transfer Complete Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TCIE LL_DMA2D_DisableIT_TC

`LL_DMA2D_DisableIT_TE`

Function name

__STATIC_INLINE void LL_DMA2D_DisableIT_TE (DMA2D_TypeDef * DMA2Dx)

Function description

Disable Transfer Error Interrupt.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR TEIE LL_DMA2D_DisableIT_TE

`LL_DMA2D_IsEnabledIT_CE`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_CE (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Configuration Error interrupt source is enabled or disabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CEIE LL_DMA2D_IsEnabledIT_CE

`LL_DMA2D_IsEnabledIT_CTC`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_CTC (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D CLUT Transfer Complete interrupt source is enabled or disabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CTCIE LL_DMA2D_IsEnabledIT_CTC

`LL_DMA2D_IsEnabledIT_CAE`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_CAE (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D CLUT Access Error interrupt source is enabled or disabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CAEIE LL_DMA2D_IsEnabledIT_CAE

`LL_DMA2D_IsEnabledIT_TW`

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_TW (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Transfer Watermark interrupt source is enabled or disabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR TWIE LL_DMA2D_IsEnabledIT_TW

LL_DMA2D_IsEnabledIT_TC

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_TC (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Transfer Complete interrupt source is enabled or disabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR TCIE LL_DMA2D_IsEnabledIT_TC

LL_DMA2D_IsEnabledIT_TE

Function name

__STATIC_INLINE uint32_t LL_DMA2D_IsEnabledIT_TE (DMA2D_TypeDef * DMA2Dx)

Function description

Check if the DMA2D Transfer Error interrupt source is enabled or disabled.

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR TEIE LL_DMA2D_IsEnabledIT_TE

LL_DMA2D_DeInit

Function name

ErrorStatus LL_DMA2D_DeInit (DMA2D_TypeDef * DMA2Dx)

Function description

De-initialize DMA2D registers (registers restored to their default values).

Parameters

- **DMA2Dx:** DMA2D Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: DMA2D registers are de-initialized
  - ERROR: DMA2D registers are not de-initialized

LL_DMA2D_Init

Function name

ErrorStatus LL_DMA2D_Init (DMA2D_TypeDef * DMA2Dx, LL_DMA2D_InitTypeDef * DMA2D_InitStruct)

Function description

Initialize DMA2D registers according to the specified parameters in DMA2D_InitStruct.

Parameters

- **DMA2Dx:** DMA2D Instance
- **DMA2D_InitStruct:** pointer to a LL_DMA2D_InitTypeDef structure that contains the configuration information for the specified DMA2D peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: DMA2D registers are initialized according to DMA2D_InitStruct content
  - ERROR: Issue occurred during DMA2D registers initialization

Notes

- DMA2D transfers must be disabled to set initialization bits in configuration registers, otherwise ERROR result is returned.

LL_DMA2D_StructInit

Function name

void LL_DMA2D_StructInit (LL_DMA2D_InitTypeDef * DMA2D_InitStruct)

Function description

Set each LL_DMA2D_InitTypeDef field to default value.

Parameters

- **DMA2D_InitStruct:** pointer to a LL_DMA2D_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

LL_DMA2D_ConfigLayer

Function name

void LL_DMA2D_ConfigLayer (DMA2D_TypeDef * DMA2Dx, LL_DMA2D_LayerCfgTypeDef * DMA2D_LayerCfg, uint32_t LayerIdx)

Function description

Configure the foreground or background according to the specified parameters in the LL_DMA2D_LayerCfgTypeDef structure.

Parameters

- **DMA2Dx:** DMA2D Instance
- **DMA2D_LayerCfg:** pointer to a LL_DMA2D_LayerCfgTypeDef structure that contains the configuration information for the specified layer.
- **LayerIdx:** DMA2D Layer index. This parameter can be one of the following values: 0(background) / 1(foreground)

Return values

- **None:**

`LL_DMA2D_LayerCfgStructInit`

Function name

void LL_DMA2D_LayerCfgStructInit (LL_DMA2D_LayerCfgTypeDef * DMA2D_LayerCfg)

Function description

Set each LL_DMA2D_LayerCfgTypeDef field to default value.

Parameters

- **DMA2D_LayerCfg:** pointer to a LL_DMA2D_LayerCfgTypeDef structure whose fields will be set to default values.

Return values

- **None:**

`LL_DMA2D_ConfigOutputColor`

Function name

void LL_DMA2D_ConfigOutputColor (DMA2D_TypeDef * DMA2Dx, LL_DMA2D_ColorTypeDef * DMA2D_ColorStruct)

Function description

Initialize DMA2D output color register according to the specified parameters in DMA2D_ColorStruct.

Parameters

- **DMA2Dx:** DMA2D Instance
- **DMA2D_ColorStruct:** pointer to a LL_DMA2D_ColorTypeDef structure that contains the color configuration information for the specified DMA2D peripheral.

Return values

- **None:**

`LL_DMA2D_GetOutputBlueColor`

Function name

uint32_t LL_DMA2D_GetOutputBlueColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Return DMA2D output Blue color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_OUTPUT_MODE_ARGB8888
  - LL_DMA2D_OUTPUT_MODE_RGB888
  - LL_DMA2D_OUTPUT_MODE_RGB565
  - LL_DMA2D_OUTPUT_MODE_ARGB1555
  - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Blue color value between Min_Data=0 and Max_Data=0xFF

`LL_DMA2D_GetOutputGreenColor`

Function name

uint32_t LL_DMA2D_GetOutputGreenColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Return DMA2D output Green color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_OUTPUT_MODE_ARGB8888
  - LL_DMA2D_OUTPUT_MODE_RGB888
  - LL_DMA2D_OUTPUT_MODE_RGB565
  - LL_DMA2D_OUTPUT_MODE_ARGB1555
  - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Green color value between Min_Data=0 and Max_Data=0xFF

`LL_DMA2D_GetOutputRedColor`

Function name

uint32_t LL_DMA2D_GetOutputRedColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Return DMA2D output Red color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_OUTPUT_MODE_ARGB8888
  - LL_DMA2D_OUTPUT_MODE_RGB888
  - LL_DMA2D_OUTPUT_MODE_RGB565
  - LL_DMA2D_OUTPUT_MODE_ARGB1555
  - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Red color value between Min_Data=0 and Max_Data=0xFF

`LL_DMA2D_GetOutputAlphaColor`

Function name

uint32_t LL_DMA2D_GetOutputAlphaColor (DMA2D_TypeDef * DMA2Dx, uint32_t ColorMode)

Function description

Return DMA2D output Alpha color.

Parameters

- **DMA2Dx:** DMA2D Instance.
- **ColorMode:** This parameter can be one of the following values:
  - LL_DMA2D_OUTPUT_MODE_ARGB8888
  - LL_DMA2D_OUTPUT_MODE_RGB888
  - LL_DMA2D_OUTPUT_MODE_RGB565
  - LL_DMA2D_OUTPUT_MODE_ARGB1555
  - LL_DMA2D_OUTPUT_MODE_ARGB4444

Return values

- **Output:** Alpha color value between Min_Data=0 and Max_Data=0xFF

`LL_DMA2D_ConfigSize`

Function name

void LL_DMA2D_ConfigSize (DMA2D_TypeDef * DMA2Dx, uint32_t NbrOfLines, uint32_t NbrOfPixelsPerLines)

Function description

Configure DMA2D transfer size.

Parameters

- **DMA2Dx:** DMA2D Instance
- **NbrOfLines:** Value between Min_Data=0 and Max_Data=0xFFFF
- **NbrOfPixelsPerLines:** Value between Min_Data=0 and Max_Data=0x3FFF

Return values

- **None:**

87.3 DMA2D Firmware driver defines

The following section lists the various define and macros of the module.

87.3.1 DMA2D

DMA2D

Alpha Inversion

LL_DMA2D_ALPHA_REGULAR

Regular alpha

LL_DMA2D_ALPHA_INVERTED

Inverted alpha

Alpha Mode

LL_DMA2D_ALPHA_MODE_NO_MODIF

No modification of the alpha channel value

LL_DMA2D_ALPHA_MODE_REPLACE

Replace original alpha channel value by programmed alpha value

LL_DMA2D_ALPHA_MODE_COMBINE

Replace original alpha channel value by programmed alpha value with original alpha channel value

CLUT Color Mode

LL_DMA2D_CLUT_COLOR_MODE_ARGB8888

ARGB8888

LL_DMA2D_CLUT_COLOR_MODE_RGB888

RGB888

Get Flags Defines

LL_DMA2D_FLAG_CEIF

Configuration Error Interrupt Flag

LL_DMA2D_FLAG_CTCIF

CLUT Transfer Complete Interrupt Flag

LL_DMA2D_FLAG_CAEIF

CLUT Access Error Interrupt Flag

LL_DMA2D_FLAG_TWIF

Transfer Watermark Interrupt Flag

LL_DMA2D_FLAG_TCIF

Transfer Complete Interrupt Flag

LL_DMA2D_FLAG_TEIF

Transfer Error Interrupt Flag

Input Color Mode

LL_DMA2D_INPUT_MODE_ARGB8888

ARGB8888

LL_DMA2D_INPUT_MODE_RGB888

RGB888

LL_DMA2D_INPUT_MODE_RGB565

RGB565

LL_DMA2D_INPUT_MODE_ARGB1555

ARGB1555

LL_DMA2D_INPUT_MODE_ARGB4444

ARGB4444

LL_DMA2D_INPUT_MODE_L8

L8

LL_DMA2D_INPUT_MODE_AL44

AL44

LL_DMA2D_INPUT_MODE_AL88

AL88

LL_DMA2D_INPUT_MODE_L4

L4

LL_DMA2D_INPUT_MODE_A8

A8

LL_DMA2D_INPUT_MODE_A4

A4

IT Defines

LL_DMA2D_IT_CEIE

Configuration Error Interrupt

LL_DMA2D_IT_CTCIE

CLUT Transfer Complete Interrupt

LL_DMA2D_IT_CAEIE

CLUT Access Error Interrupt

LL_DMA2D_IT_TWIE

Transfer Watermark Interrupt

LL_DMA2D_IT_TCIE

Transfer Complete Interrupt

LL_DMA2D_IT_TEIE

Transfer Error Interrupt

Line Offset Mode

LL_DMA2D_LINE_OFFSET_PIXELS

Line offsets are expressed in pixels

LL_DMA2D_LINE_OFFSET_BYTES

Line offsets are expressed in bytes

Mode

LL_DMA2D_MODE_M2M

DMA2D memory to memory transfer mode

LL_DMA2D_MODE_M2M_PFC

DMA2D memory to memory with pixel format conversion transfer mode

LL_DMA2D_MODE_M2M_BLEND

DMA2D memory to memory with blending transfer mode

LL_DMA2D_MODE_R2M

DMA2D register to memory transfer mode

LL_DMA2D_MODE_M2M_BLEND_FIXED_COLOR_FG

DMA2D memory to memory with blending transfer mode and fixed color foreground

LL_DMA2D_MODE_M2M_BLEND_FIXED_COLOR_BG

DMA2D memory to memory with blending transfer mode and fixed color background

Output Color Mode

LL_DMA2D_OUTPUT_MODE_ARGB8888

ARGB8888

LL_DMA2D_OUTPUT_MODE_RGB888

RGB888

LL_DMA2D_OUTPUT_MODE_RGB565

RGB565

LL_DMA2D_OUTPUT_MODE_ARGB1555

ARGB1555

LL_DMA2D_OUTPUT_MODE_ARGB4444

ARGB4444

Swap Mode

LL_DMA2D_SWAP_MODE_REGULAR

Regular order

LL_DMA2D_SWAP_MODE_TWO_BY_TWO

Bytes swapped two by two

Red Blue Swap

LL_DMA2D_RB_MODE_REGULAR

RGB or ARGB

LL_DMA2D_RB_MODE_SWAP

BGR or ABGR

Common Write and read registers Macros

LL_DMA2D_WriteReg

Description:

- Write a value in DMA2D register.

Parameters:

- __INSTANCE__: DMA2D Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_DMA2D_ReadReg

Description:

- Read a value in DMA2D register.

Parameters:

- __INSTANCE__: DMA2D Instance
- __REG__: Register to be read

Return value:

- Register: value

88 LL DMAMUX Generic Driver

88.1 DMAMUX Firmware driver API description

The following section lists the various functions of the DMAMUX library.

88.1.1 Detailed description of functions

`LL_DMAMUX_SetRequestID`

Function name

__STATIC_INLINE void LL_DMAMUX_SetRequestID (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel, uint32_t Request)

Function description

Set DMAMUX request ID for DMAMUX Channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13
- **Request:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_MEM2MEM
  - LL_DMAMUX_REQ_GENERATOR0
  - LL_DMAMUX_REQ_GENERATOR1
  - LL_DMAMUX_REQ_GENERATOR2
  - LL_DMAMUX_REQ_GENERATOR3
  - LL_DMAMUX_REQ_ADC1
  - LL_DMAMUX_REQ_DAC1_CH1
  - LL_DMAMUX_REQ_DAC1_CH2
  - LL_DMAMUX_REQ_TIM6_UP
  - LL_DMAMUX_REQ_TIM7_UP
  - LL_DMAMUX_REQ_SPI1_RX
  - LL_DMAMUX_REQ_SPI1_TX
  - LL_DMAMUX_REQ_SPI2_RX
  - LL_DMAMUX_REQ_SPI2_TX
  - LL_DMAMUX_REQ_SPI3_RX
  - LL_DMAMUX_REQ_SPI3_TX
  - LL_DMAMUX_REQ_I2C1_RX
  - LL_DMAMUX_REQ_I2C1_TX
  - LL_DMAMUX_REQ_I2C2_RX
  - LL_DMAMUX_REQ_I2C2_TX
  - LL_DMAMUX_REQ_I2C3_RX
  - LL_DMAMUX_REQ_I2C3_TX
  - LL_DMAMUX_REQ_I2C4_RX
  - LL_DMAMUX_REQ_I2C4_TX
  - LL_DMAMUX_REQ_USART1_RX
  - LL_DMAMUX_REQ_USART1_TX
  - LL_DMAMUX_REQ_USART2_RX
  - LL_DMAMUX_REQ_USART2_TX
  - LL_DMAMUX_REQ_USART3_RX
  - LL_DMAMUX_REQ_USART3_TX
  - LL_DMAMUX_REQ_UART4_RX

- LL_DMAMUX_REQ_UART4_TX
- LL_DMAMUX_REQ_UART5_RX
- LL_DMAMUX_REQ_UART5_TX
- LL_DMAMUX_REQ_LPUART1_RX
- LL_DMAMUX_REQ_LPUART1_TX
- LL_DMAMUX_REQ_SAI1_A
- LL_DMAMUX_REQ_SAI1_B
- LL_DMAMUX_REQ_SAI2_A
- LL_DMAMUX_REQ_SAI2_B
- LL_DMAMUX_REQ_OSPI1
- LL_DMAMUX_REQ_OSPI2
- LL_DMAMUX_REQ_TIM1_CH1
- LL_DMAMUX_REQ_TIM1_CH2
- LL_DMAMUX_REQ_TIM1_CH3
- LL_DMAMUX_REQ_TIM1_CH4
- LL_DMAMUX_REQ_TIM1_UP
- LL_DMAMUX_REQ_TIM1_TRIG
- LL_DMAMUX_REQ_TIM1_COM
- LL_DMAMUX_REQ_TIM8_CH1
- LL_DMAMUX_REQ_TIM8_CH2
- LL_DMAMUX_REQ_TIM8_CH3
- LL_DMAMUX_REQ_TIM8_CH4
- LL_DMAMUX_REQ_TIM8_UP
- LL_DMAMUX_REQ_TIM8_TRIG
- LL_DMAMUX_REQ_TIM8_COM
- LL_DMAMUX_REQ_TIM2_CH1
- LL_DMAMUX_REQ_TIM2_CH2
- LL_DMAMUX_REQ_TIM2_CH3
- LL_DMAMUX_REQ_TIM2_CH4
- LL_DMAMUX_REQ_TIM2_UP
- LL_DMAMUX_REQ_TIM3_CH1
- LL_DMAMUX_REQ_TIM3_CH2
- LL_DMAMUX_REQ_TIM3_CH3
- LL_DMAMUX_REQ_TIM3_CH4
- LL_DMAMUX_REQ_TIM3_UP
- LL_DMAMUX_REQ_TIM3_TRIG
- LL_DMAMUX_REQ_TIM4_CH1
- LL_DMAMUX_REQ_TIM4_CH2
- LL_DMAMUX_REQ_TIM4_CH3
- LL_DMAMUX_REQ_TIM4_CH4
- LL_DMAMUX_REQ_TIM4_UP
- LL_DMAMUX_REQ_TIM5_CH1
- LL_DMAMUX_REQ_TIM5_CH2
- LL_DMAMUX_REQ_TIM5_CH3
- LL_DMAMUX_REQ_TIM5_CH4
- LL_DMAMUX_REQ_TIM5_UP
- LL_DMAMUX_REQ_TIM5_TRIG
- LL_DMAMUX_REQ_TIM15_CH1
- LL_DMAMUX_REQ_TIM15_UP

- LL_DMAMUX_REQ_TIM15_TRIG
- LL_DMAMUX_REQ_TIM15_COM
- LL_DMAMUX_REQ_TIM16_CH1
- LL_DMAMUX_REQ_TIM16_UP
- LL_DMAMUX_REQ_TIM17_CH1
- LL_DMAMUX_REQ_TIM17_UP
- LL_DMAMUX_REQ_DFSDM1_FLT0
- LL_DMAMUX_REQ_DFSDM1_FLT1
- LL_DMAMUX_REQ_DFSDM1_FLT2
- LL_DMAMUX_REQ_DFSDM1_FLT3
- LL_DMAMUX_REQ_DCMI
- LL_DMAMUX_REQ_AES_IN
- LL_DMAMUX_REQ_AES_OUT
- LL_DMAMUX_REQ_HASH_IN

Return values

- **None:**

Notes

- DMAMUX channel 0 to 6 are mapped to DMA1 channel 1 to 7. DMAMUX channel 7 to 13 are mapped to DMA2 channel 1 to 7.

Reference Manual to LL API cross reference:

- CxCR DMAREQ_ID LL_DMAMUX_SetRequestID

LL_DMAMUX_GetRequestID

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetRequestID (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Get DMAMUX request ID for DMAMUX Channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **Returned:** value can be one of the following values:
  - LL_DMAMUX_REQ_MEM2MEM
  - LL_DMAMUX_REQ_GENERATOR0
  - LL_DMAMUX_REQ_GENERATOR1
  - LL_DMAMUX_REQ_GENERATOR2
  - LL_DMAMUX_REQ_GENERATOR3
  - LL_DMAMUX_REQ_ADC1
  - LL_DMAMUX_REQ_DAC1_CH1
  - LL_DMAMUX_REQ_DAC1_CH2
  - LL_DMAMUX_REQ_TIM6_UP
  - LL_DMAMUX_REQ_TIM7_UP
  - LL_DMAMUX_REQ_SPI1_RX
  - LL_DMAMUX_REQ_SPI1_TX
  - LL_DMAMUX_REQ_SPI2_RX
  - LL_DMAMUX_REQ_SPI2_TX
  - LL_DMAMUX_REQ_SPI3_RX
  - LL_DMAMUX_REQ_SPI3_TX
  - LL_DMAMUX_REQ_I2C1_RX
  - LL_DMAMUX_REQ_I2C1_TX
  - LL_DMAMUX_REQ_I2C2_RX
  - LL_DMAMUX_REQ_I2C2_TX
  - LL_DMAMUX_REQ_I2C3_RX
  - LL_DMAMUX_REQ_I2C3_TX
  - LL_DMAMUX_REQ_I2C4_RX
  - LL_DMAMUX_REQ_I2C4_TX
  - LL_DMAMUX_REQ_USART1_RX
  - LL_DMAMUX_REQ_USART1_TX
  - LL_DMAMUX_REQ_USART2_RX
  - LL_DMAMUX_REQ_USART2_TX
  - LL_DMAMUX_REQ_USART3_RX
  - LL_DMAMUX_REQ_USART3_TX
  - LL_DMAMUX_REQ_UART4_RX
  - LL_DMAMUX_REQ_UART4_TX
  - LL_DMAMUX_REQ_UART5_RX
  - LL_DMAMUX_REQ_UART5_TX
  - LL_DMAMUX_REQ_LPUART1_RX
  - LL_DMAMUX_REQ_LPUART1_TX
  - LL_DMAMUX_REQ_SAI1_A
  - LL_DMAMUX_REQ_SAI1_B
  - LL_DMAMUX_REQ_SAI2_A
  - LL_DMAMUX_REQ_SAI2_B
  - LL_DMAMUX_REQ_OSPI1
  - LL_DMAMUX_REQ_OSPI2
  - LL_DMAMUX_REQ_TIM1_CH1
  - LL_DMAMUX_REQ_TIM1_CH2
  - LL_DMAMUX_REQ_TIM1_CH3
  - LL_DMAMUX_REQ_TIM1_CH4
  - LL_DMAMUX_REQ_TIM1_UP

- LL_DMAMUX_REQ_TIM1_TRIG
- LL_DMAMUX_REQ_TIM1_COM
- LL_DMAMUX_REQ_TIM8_CH1
- LL_DMAMUX_REQ_TIM8_CH2
- LL_DMAMUX_REQ_TIM8_CH3
- LL_DMAMUX_REQ_TIM8_CH4
- LL_DMAMUX_REQ_TIM8_UP
- LL_DMAMUX_REQ_TIM8_TRIG
- LL_DMAMUX_REQ_TIM8_COM
- LL_DMAMUX_REQ_TIM2_CH1
- LL_DMAMUX_REQ_TIM2_CH2
- LL_DMAMUX_REQ_TIM2_CH3
- LL_DMAMUX_REQ_TIM2_CH4
- LL_DMAMUX_REQ_TIM2_UP
- LL_DMAMUX_REQ_TIM3_CH1
- LL_DMAMUX_REQ_TIM3_CH2
- LL_DMAMUX_REQ_TIM3_CH3
- LL_DMAMUX_REQ_TIM3_CH4
- LL_DMAMUX_REQ_TIM3_UP
- LL_DMAMUX_REQ_TIM3_TRIG
- LL_DMAMUX_REQ_TIM4_CH1
- LL_DMAMUX_REQ_TIM4_CH2
- LL_DMAMUX_REQ_TIM4_CH3
- LL_DMAMUX_REQ_TIM4_CH4
- LL_DMAMUX_REQ_TIM4_UP
- LL_DMAMUX_REQ_TIM5_CH1
- LL_DMAMUX_REQ_TIM5_CH2
- LL_DMAMUX_REQ_TIM5_CH3
- LL_DMAMUX_REQ_TIM5_CH4
- LL_DMAMUX_REQ_TIM5_UP
- LL_DMAMUX_REQ_TIM5_TRIG
- LL_DMAMUX_REQ_TIM15_CH1
- LL_DMAMUX_REQ_TIM15_UP
- LL_DMAMUX_REQ_TIM15_TRIG
- LL_DMAMUX_REQ_TIM15_COM
- LL_DMAMUX_REQ_TIM16_CH1
- LL_DMAMUX_REQ_TIM16_UP
- LL_DMAMUX_REQ_TIM17_CH1
- LL_DMAMUX_REQ_TIM17_UP
- LL_DMAMUX_REQ_DFSDM1_FLT0
- LL_DMAMUX_REQ_DFSDM1_FLT1
- LL_DMAMUX_REQ_DFSDM1_FLT2
- LL_DMAMUX_REQ_DFSDM1_FLT3
- LL_DMAMUX_REQ_DCMI
- LL_DMAMUX_REQ_AES_IN
- LL_DMAMUX_REQ_AES_OUT
- LL_DMAMUX_REQ_HASH_IN

Notes

- DMAMUX channel 0 to 6 are mapped to DMA1 channel 1 to 7. DMAMUX channel 7 to 13 are mapped to DMA2 channel 1 to 7.

Reference Manual to LL API cross reference:

- CxCR DMAREQ_ID LL_DMAMUX_GetRequestID

LL_DMAMUX_SetSyncRequestNb

Function name

__STATIC_INLINE void LL_DMAMUX_SetSyncRequestNb (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel, uint32_t RequestNb)

Function description

Set the number of DMA request that will be autorized after a synchronization event and/or the number of DMA request needed to generate an event.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13
- **RequestNb:** This parameter must be a value between Min_Data = 1 and Max_Data = 32.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR NBREQ LL_DMAMUX_SetSyncRequestNb

LL_DMAMUX_GetSyncRequestNb

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetSyncRequestNb (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Get the number of DMA request that will be autorized after a synchronization event and/or the number of DMA request needed to generate an event.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **Between:** Min_Data = 1 and Max_Data = 32

Reference Manual to LL API cross reference:

- CxCR NBREQ LL_DMAMUX_GetSyncRequestNb

`LL_DMAMUX_SetSyncPolarity`

Function name

__STATIC_INLINE void LL_DMAMUX_SetSyncPolarity (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel, uint32_t Polarity)

Function description

Set the polarity of the signal on which the DMA request is synchronized.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13
- **Polarity:** This parameter can be one of the following values:
  - LL_DMAMUX_SYNC_NO_EVENT
  - LL_DMAMUX_SYNC_POL_RISING
  - LL_DMAMUX_SYNC_POL_FALLING
  - LL_DMAMUX_SYNC_POL_RISING_FALLING

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR SPOL LL_DMAMUX_SetSyncPolarity

`LL_DMAMUX_GetSyncPolarity`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetSyncPolarity (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Get the polarity of the signal on which the DMA request is synchronized.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **Returned:** value can be one of the following values:
  - LL_DMAMUX_SYNC_NO_EVENT
  - LL_DMAMUX_SYNC_POL_RISING
  - LL_DMAMUX_SYNC_POL_FALLING
  - LL_DMAMUX_SYNC_POL_RISING_FALLING

Reference Manual to LL API cross reference:

- CxCR SPOL LL_DMAMUX_GetSyncPolarity

LL_DMAMUX_EnableEventGeneration

Function name

__STATIC_INLINE void LL_DMAMUX_EnableEventGeneration (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Enable the Event Generation on DMAMUX channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR EGE LL_DMAMUX_EnableEventGeneration

LL_DMAMUX_DisableEventGeneration

Function name

__STATIC_INLINE void LL_DMAMUX_DisableEventGeneration (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Disable the Event Generation on DMAMUX channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR EGE LL_DMAMUX_DisableEventGeneration

LL_DMAMUX_IsEnabledEventGeneration

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsEnabledEventGeneration (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Check if the Event Generation on DMAMUX channel x is enabled or disabled.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CxCR EGE LL_DMAMUX_IsEnabledEventGeneration

LL_DMAMUX_EnableSync

Function name

__STATIC_INLINE void LL_DMAMUX_EnableSync (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Enable the synchronization mode.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR SE LL_DMAMUX_EnableSync

LL_DMAMUX_DisableSync

Function name

__STATIC_INLINE void LL_DMAMUX_DisableSync (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Disable the synchronization mode.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR SE LL_DMAMUX_DisableSync

LL_DMAMUX_IsEnabledSync

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsEnabledSync (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Check if the synchronization mode is enabled or disabled.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CxCR SE LL_DMAMUX_IsEnabledSync

LL_DMAMUX_SetSyncID

Function name

__STATIC_INLINE void LL_DMAMUX_SetSyncID (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel, uint32_t SyncID)

Function description

Set DMAMUX synchronization ID on DMAMUX Channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13
- **SyncID:** This parameter can be one of the following values:
  - LL_DMAMUX_SYNC_EXTI_LINE0
  - LL_DMAMUX_SYNC_EXTI_LINE1
  - LL_DMAMUX_SYNC_EXTI_LINE2
  - LL_DMAMUX_SYNC_EXTI_LINE3
  - LL_DMAMUX_SYNC_EXTI_LINE4
  - LL_DMAMUX_SYNC_EXTI_LINE5
  - LL_DMAMUX_SYNC_EXTI_LINE6
  - LL_DMAMUX_SYNC_EXTI_LINE7
  - LL_DMAMUX_SYNC_EXTI_LINE8
  - LL_DMAMUX_SYNC_EXTI_LINE9
  - LL_DMAMUX_SYNC_EXTI_LINE10
  - LL_DMAMUX_SYNC_EXTI_LINE11
  - LL_DMAMUX_SYNC_EXTI_LINE12
  - LL_DMAMUX_SYNC_EXTI_LINE13
  - LL_DMAMUX_SYNC_EXTI_LINE14
  - LL_DMAMUX_SYNC_EXTI_LINE15
  - LL_DMAMUX_SYNC_DMAMUX_CH0
  - LL_DMAMUX_SYNC_DMAMUX_CH1
  - LL_DMAMUX_SYNC_DMAMUX_CH2
  - LL_DMAMUX_SYNC_DMAMUX_CH3
  - LL_DMAMUX_SYNC_LPTIM1_OUT
  - LL_DMAMUX_SYNC_LPTIM2_OUT
  - LL_DMAMUX_SYNC_DSI_TE
  - LL_DMAMUX_SYNC_DSI_REFRESH_END
  - LL_DMAMUX_SYNC_DMA2D_TX_END
  - LL_DMAMUX_SYNC_LTDC_LINE_IT

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR SYNC_ID LL_DMAMUX_SetSyncID

`LL_DMAMUX_GetSyncID`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetSyncID (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Get DMAMUX synchronization ID on DMAMUX Channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **Returned:** value can be one of the following values:
  - LL_DMAMUX_SYNC_EXTI_LINE0
  - LL_DMAMUX_SYNC_EXTI_LINE1
  - LL_DMAMUX_SYNC_EXTI_LINE2
  - LL_DMAMUX_SYNC_EXTI_LINE3
  - LL_DMAMUX_SYNC_EXTI_LINE4
  - LL_DMAMUX_SYNC_EXTI_LINE5
  - LL_DMAMUX_SYNC_EXTI_LINE6
  - LL_DMAMUX_SYNC_EXTI_LINE7
  - LL_DMAMUX_SYNC_EXTI_LINE8
  - LL_DMAMUX_SYNC_EXTI_LINE9
  - LL_DMAMUX_SYNC_EXTI_LINE10
  - LL_DMAMUX_SYNC_EXTI_LINE11
  - LL_DMAMUX_SYNC_EXTI_LINE12
  - LL_DMAMUX_SYNC_EXTI_LINE13
  - LL_DMAMUX_SYNC_EXTI_LINE14
  - LL_DMAMUX_SYNC_EXTI_LINE15
  - LL_DMAMUX_SYNC_DMAMUX_CH0
  - LL_DMAMUX_SYNC_DMAMUX_CH1
  - LL_DMAMUX_SYNC_DMAMUX_CH2
  - LL_DMAMUX_SYNC_DMAMUX_CH3
  - LL_DMAMUX_SYNC_LPTIM1_OUT
  - LL_DMAMUX_SYNC_LPTIM2_OUT
  - LL_DMAMUX_SYNC_DSI_TE
  - LL_DMAMUX_SYNC_DSI_REFRESH_END
  - LL_DMAMUX_SYNC_DMA2D_TX_END
  - LL_DMAMUX_SYNC_LTDC_LINE_IT

Reference Manual to LL API cross reference:

- CxCR SYNC_ID LL_DMAMUX_GetSyncID

LL_DMAMUX_EnableRequestGen

Function name

__STATIC_INLINE void LL_DMAMUX_EnableRequestGen (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Enable the Request Generator.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGxCR GE LL_DMAMUX_EnableRequestGen

`LL_DMAMUX_DisableRequestGen`

Function name

__STATIC_INLINE void LL_DMAMUX_DisableRequestGen (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Disable the Request Generator.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGxCR GE LL_DMAMUX_DisableRequestGen

`LL_DMAMUX_IsEnabledRequestGen`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsEnabledRequestGen (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Check if the Request Generator is enabled or disabled.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RGxCR GE LL_DMAMUX_IsEnabledRequestGen

`LL_DMAMUX_SetRequestGenPolarity`

Function name

__STATIC_INLINE void LL_DMAMUX_SetRequestGenPolarity (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel, uint32_t Polarity)

Function description

Set the polarity of the signal on which the DMA request is generated.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3
- **Polarity:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_NO_EVENT
  - LL_DMAMUX_REQ_GEN_POL_RISING
  - LL_DMAMUX_REQ_GEN_POL_FALLING
  - LL_DMAMUX_REQ_GEN_POL_RISING_FALLING

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGxCR GPOL LL_DMAMUX_SetRequestGenPolarity

LL_DMAMUX_GetRequestGenPolarity

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetRequestGenPolarity (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Get the polarity of the signal on which the DMA request is generated.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **Returned:** value can be one of the following values:
  - LL_DMAMUX_REQ_GEN_NO_EVENT
  - LL_DMAMUX_REQ_GEN_POL_RISING
  - LL_DMAMUX_REQ_GEN_POL_FALLING
  - LL_DMAMUX_REQ_GEN_POL_RISING_FALLING

Reference Manual to LL API cross reference:

- RGxCR GPOL LL_DMAMUX_GetRequestGenPolarity

LL_DMAMUX_SetGenRequestNb

Function name

__STATIC_INLINE void LL_DMAMUX_SetGenRequestNb (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel, uint32_t RequestNb)

Function description

Set the number of DMA request that will be autorized after a generation event.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3
- **RequestNb:** This parameter must be a value between Min_Data = 1 and Max_Data = 32.

Return values

- **None:**

Notes

- This field can only be written when Generator is disabled.

Reference Manual to LL API cross reference:

- RGxCR GNBREQ LL_DMAMUX_SetGenRequestNb

LL_DMAMUX_GetGenRequestNb

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetGenRequestNb (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Get the number of DMA request that will be autorized after a generation event.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **Between:** Min_Data = 1 and Max_Data = 32

Reference Manual to LL API cross reference:

- RGxCR GNBREQ LL_DMAMUX_GetGenRequestNb

LL_DMAMUX_SetRequestSignalID

Function name

__STATIC_INLINE void LL_DMAMUX_SetRequestSignalID (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel, uint32_t RequestSignalID)

Function description

Set DMAMUX external Request Signal ID on DMAMUX Request Generation Trigger Event Channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3
- **RequestSignalID:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_EXTI_LINE0
  - LL_DMAMUX_REQ_GEN_EXTI_LINE1
  - LL_DMAMUX_REQ_GEN_EXTI_LINE2
  - LL_DMAMUX_REQ_GEN_EXTI_LINE3
  - LL_DMAMUX_REQ_GEN_EXTI_LINE4
  - LL_DMAMUX_REQ_GEN_EXTI_LINE5
  - LL_DMAMUX_REQ_GEN_EXTI_LINE6
  - LL_DMAMUX_REQ_GEN_EXTI_LINE7
  - LL_DMAMUX_REQ_GEN_EXTI_LINE8
  - LL_DMAMUX_REQ_GEN_EXTI_LINE9
  - LL_DMAMUX_REQ_GEN_EXTI_LINE10
  - LL_DMAMUX_REQ_GEN_EXTI_LINE11
  - LL_DMAMUX_REQ_GEN_EXTI_LINE12
  - LL_DMAMUX_REQ_GEN_EXTI_LINE13
  - LL_DMAMUX_REQ_GEN_EXTI_LINE14
  - LL_DMAMUX_REQ_GEN_EXTI_LINE15
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH0
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH1
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH2
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH3
  - LL_DMAMUX_REQ_GEN_LPTIM1_OUT
  - LL_DMAMUX_REQ_GEN_LPTIM2_OUT
  - LL_DMAMUX_REQ_GEN_DSI_TE
  - LL_DMAMUX_REQ_GEN_DSI_REFRESH_END
  - LL_DMAMUX_REQ_GEN_DMA2D_TX_END
  - LL_DMAMUX_REQ_GEN_LTDC_LINE_IT

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGxCR SIG_ID LL_DMAMUX_SetRequestSignalID

`LL_DMAMUX_GetRequestSignalID`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_GetRequestSignalID (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Get DMAMUX external Request Signal ID set on DMAMUX Channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **Returned:** value can be one of the following values:
  - LL_DMAMUX_REQ_GEN_EXTI_LINE0
  - LL_DMAMUX_REQ_GEN_EXTI_LINE1
  - LL_DMAMUX_REQ_GEN_EXTI_LINE2
  - LL_DMAMUX_REQ_GEN_EXTI_LINE3
  - LL_DMAMUX_REQ_GEN_EXTI_LINE4
  - LL_DMAMUX_REQ_GEN_EXTI_LINE5
  - LL_DMAMUX_REQ_GEN_EXTI_LINE6
  - LL_DMAMUX_REQ_GEN_EXTI_LINE7
  - LL_DMAMUX_REQ_GEN_EXTI_LINE8
  - LL_DMAMUX_REQ_GEN_EXTI_LINE9
  - LL_DMAMUX_REQ_GEN_EXTI_LINE10
  - LL_DMAMUX_REQ_GEN_EXTI_LINE11
  - LL_DMAMUX_REQ_GEN_EXTI_LINE12
  - LL_DMAMUX_REQ_GEN_EXTI_LINE13
  - LL_DMAMUX_REQ_GEN_EXTI_LINE14
  - LL_DMAMUX_REQ_GEN_EXTI_LINE15
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH0
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH1
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH2
  - LL_DMAMUX_REQ_GEN_DMAMUX_CH3
  - LL_DMAMUX_REQ_GEN_LPTIM1_OUT
  - LL_DMAMUX_REQ_GEN_LPTIM2_OUT
  - LL_DMAMUX_REQ_GEN_DSI_TE
  - LL_DMAMUX_REQ_GEN_DSI_REFRESH_END
  - LL_DMAMUX_REQ_GEN_DMA2D_TX_END
  - LL_DMAMUX_REQ_GEN_LTDC_LINE_IT

Reference Manual to LL API cross reference:

- RGxCR SIG_ID LL_DMAMUX_GetRequestSignalID

LL_DMAMUX_IsActiveFlag_SO0

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO0 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 0.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF0 LL_DMAMUX_IsActiveFlag_SO0

`LL_DMAMUX_IsActiveFlag_SO1`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO1 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 1.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF1 LL_DMAMUX_IsActiveFlag_SO1

`LL_DMAMUX_IsActiveFlag_SO2`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO2 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 2.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF2 LL_DMAMUX_IsActiveFlag_SO2

`LL_DMAMUX_IsActiveFlag_SO3`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO3 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 3.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF3 LL_DMAMUX_IsActiveFlag_SO3

`LL_DMAMUX_IsActiveFlag_SO4`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO4 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 4.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF4 LL_DMAMUX_IsActiveFlag_SO4

`LL_DMAMUX_IsActiveFlag_SO5`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO5 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 5.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF5 LL_DMAMUX_IsActiveFlag_SO5

`LL_DMAMUX_IsActiveFlag_SO6`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO6 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 6.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF6 LL_DMAMUX_IsActiveFlag_SO6

`LL_DMAMUX_IsActiveFlag_SO7`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO7 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 7.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF7 LL_DMAMUX_IsActiveFlag_SO7

`LL_DMAMUX_IsActiveFlag_SO8`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO8 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 8.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF8 LL_DMAMUX_IsActiveFlag_SO8

`LL_DMAMUX_IsActiveFlag_SO9`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO9 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 9.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF9 LL_DMAMUX_IsActiveFlag_SO9

`LL_DMAMUX_IsActiveFlag_SO10`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO10 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 10.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF10 LL_DMAMUX_IsActiveFlag_SO10

`LL_DMAMUX_IsActiveFlag_SO11`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO11 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 11.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF11 LL_DMAMUX_IsActiveFlag_SO11

`LL_DMAMUX_IsActiveFlag_SO12`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO12 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 12.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF12 LL_DMAMUX_IsActiveFlag_SO12

`LL_DMAMUX_IsActiveFlag_SO13`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_SO13 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Synchronization Event Overrun Flag Channel 13.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SOF13 LL_DMAMUX_IsActiveFlag_SO13

`LL_DMAMUX_IsActiveFlag_RGO0`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_RGO0 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Request Generator 0 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RGSR OF0 LL_DMAMUX_IsActiveFlag_RGO0

`LL_DMAMUX_IsActiveFlag_RGO1`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_RGO1 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Request Generator 1 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RGSR OF1 LL_DMAMUX_IsActiveFlag_RGO1

`LL_DMAMUX_IsActiveFlag_RGO2`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_RGO2 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Request Generator 2 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RGSR OF2 LL_DMAMUX_IsActiveFlag_RGO2

`LL_DMAMUX_IsActiveFlag_RGO3`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsActiveFlag_RGO3 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Get Request Generator 3 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RGSR OF3 LL_DMAMUX_IsActiveFlag_RGO3

`LL_DMAMUX_ClearFlag_SO0`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO0 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 0.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF0 LL_DMAMUX_ClearFlag_SO0

`LL_DMAMUX_ClearFlag_SO1`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO1 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 1.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF1 LL_DMAMUX_ClearFlag_SO1

`LL_DMAMUX_ClearFlag_SO2`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO2 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 2.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF2 LL_DMAMUX_ClearFlag_SO2

`LL_DMAMUX_ClearFlag_SO3`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO3 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 3.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF3 LL_DMAMUX_ClearFlag_SO3

`LL_DMAMUX_ClearFlag_SO4`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO4 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 4.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF4 LL_DMAMUX_ClearFlag_SO4

`LL_DMAMUX_ClearFlag_SO5`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO5 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 5.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF5 LL_DMAMUX_ClearFlag_SO5

`LL_DMAMUX_ClearFlag_SO6`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO6 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 6.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF6 LL_DMAMUX_ClearFlag_SO6

`LL_DMAMUX_ClearFlag_SO7`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO7 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 7.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF7 LL_DMAMUX_ClearFlag_SO7

`LL_DMAMUX_ClearFlag_SO8`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO8 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 8.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF8 LL_DMAMUX_ClearFlag_SO8

`LL_DMAMUX_ClearFlag_SO9`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO9 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 9.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF9 LL_DMAMUX_ClearFlag_SO9

`LL_DMAMUX_ClearFlag_SO10`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO10 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 10.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF10 LL_DMAMUX_ClearFlag_SO10

`LL_DMAMUX_ClearFlag_SO11`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO11 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 11.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF11 LL_DMAMUX_ClearFlag_SO11

`LL_DMAMUX_ClearFlag_SO12`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO12 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 12.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF12 LL_DMAMUX_ClearFlag_SO12

`LL_DMAMUX_ClearFlag_SO13`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_SO13 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Synchronization Event Overrun Flag Channel 13.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFR CSOF13 LL_DMAMUX_ClearFlag_SO13

`LL_DMAMUX_ClearFlag_RGO0`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_RGO0 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Request Generator 0 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGCFR COF0 LL_DMAMUX_ClearFlag_RGO0

`LL_DMAMUX_ClearFlag_RGO1`

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_RGO1 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Request Generator 1 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGCFR COF1 LL_DMAMUX_ClearFlag_RGO1

LL_DMAMUX_ClearFlag_RGO2

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_RGO2 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Request Generator 2 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGCFR COF2 LL_DMAMUX_ClearFlag_RGO2

LL_DMAMUX_ClearFlag_RGO3

Function name

__STATIC_INLINE void LL_DMAMUX_ClearFlag_RGO3 (DMAMUX_Channel_TypeDef * DMAMUXx)

Function description

Clear Request Generator 3 Trigger Event Overrun Flag.

Parameters

- **DMAMUXx:** DMAMUXx DMAMUXx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGCFR COF3 LL_DMAMUX_ClearFlag_RGO3

LL_DMAMUX_EnableIT_SO

Function name

__STATIC_INLINE void LL_DMAMUX_EnableIT_SO (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Enable the Synchronization Event Overrun Interrupt on DMAMUX channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR SOIE LL_DMAMUX_EnableIT_SO

LL_DMAMUX_DisableIT_SO

Function name

__STATIC_INLINE void LL_DMAMUX_DisableIT_SO (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Disable the Synchronization Event Overrun Interrupt on DMAMUX channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **None:**

Reference Manual to LL API cross reference:

- CxCR SOIE LL_DMAMUX_DisableIT_SO

`LL_DMAMUX_IsEnabledIT_SO`

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsEnabledIT_SO (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t Channel)

Function description

Check if the Synchronization Event Overrun Interrupt on DMAMUX channel x is enabled or disabled.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMAMUX_CHANNEL_0
  - LL_DMAMUX_CHANNEL_1
  - LL_DMAMUX_CHANNEL_2
  - LL_DMAMUX_CHANNEL_3
  - LL_DMAMUX_CHANNEL_4
  - LL_DMAMUX_CHANNEL_5
  - LL_DMAMUX_CHANNEL_6
  - LL_DMAMUX_CHANNEL_7
  - LL_DMAMUX_CHANNEL_8
  - LL_DMAMUX_CHANNEL_9
  - LL_DMAMUX_CHANNEL_10
  - LL_DMAMUX_CHANNEL_11
  - LL_DMAMUX_CHANNEL_12
  - LL_DMAMUX_CHANNEL_13

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CxCR SOIE LL_DMAMUX_IsEnabledIT_SO

`LL_DMAMUX_EnableIT_RGO`

Function name

__STATIC_INLINE void LL_DMAMUX_EnableIT_RGO (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Enable the Request Generation Trigger Event Overrun Interrupt on DMAMUX channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGxCR OIE LL_DMAMUX_EnableIT_RGO

LL_DMAMUX_DisableIT_RGO

Function name

__STATIC_INLINE void LL_DMAMUX_DisableIT_RGO (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Disable the Request Generation Trigger Event Overrun Interrupt on DMAMUX channel x.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **None:**

Reference Manual to LL API cross reference:

- RGxCR OIE LL_DMAMUX_DisableIT_RGO

LL_DMAMUX_IsEnabledIT_RGO

Function name

__STATIC_INLINE uint32_t LL_DMAMUX_IsEnabledIT_RGO (DMAMUX_Channel_TypeDef * DMAMUXx, uint32_t RequestGenChannel)

Function description

Check if the Request Generation Trigger Event Overrun Interrupt on DMAMUX channel x is enabled or disabled.

Parameters

- **DMAMUXx:** DMAMUXx Instance
- **RequestGenChannel:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_GEN_0
  - LL_DMAMUX_REQ_GEN_1
  - LL_DMAMUX_REQ_GEN_2
  - LL_DMAMUX_REQ_GEN_3

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RGxCR OIE LL_DMAMUX_IsEnabledIT_RGO

88.2 DMAMUX Firmware driver defines

The following section lists the various define and macros of the module.

88.2.1 DMAMUX

DMAMUX

DMAMUX Channel

LL_DMAMUX_CHANNEL_0

DMAMUX Channel 0 connected to DMA1 Channel 1

LL_DMAMUX_CHANNEL_1

DMAMUX Channel 1 connected to DMA1 Channel 2

LL_DMAMUX_CHANNEL_2

DMAMUX Channel 2 connected to DMA1 Channel 3

LL_DMAMUX_CHANNEL_3

DMAMUX Channel 3 connected to DMA1 Channel 4

LL_DMAMUX_CHANNEL_4

DMAMUX Channel 4 connected to DMA1 Channel 5

LL_DMAMUX_CHANNEL_5

DMAMUX Channel 5 connected to DMA1 Channel 6

LL_DMAMUX_CHANNEL_6

DMAMUX Channel 6 connected to DMA1 Channel 7

LL_DMAMUX_CHANNEL_7

DMAMUX Channel 7 connected to DMA2 Channel 1

LL_DMAMUX_CHANNEL_8

DMAMUX Channel 8 connected to DMA2 Channel 2

LL_DMAMUX_CHANNEL_9

DMAMUX Channel 9 connected to DMA2 Channel 3

LL_DMAMUX_CHANNEL_10

DMAMUX Channel 10 connected to DMA2 Channel 4

LL_DMAMUX_CHANNEL_11

DMAMUX Channel 11 connected to DMA2 Channel 5

LL_DMAMUX_CHANNEL_12

DMAMUX Channel 12 connected to DMA2 Channel 6

LL_DMAMUX_CHANNEL_13

DMAMUX Channel 13 connected to DMA2 Channel 7

Clear Flags Defines

LL_DMAMUX_CFR_CSOF0

Synchronization Event Overrun Flag Channel 0

LL_DMAMUX_CFR_CSOF1

Synchronization Event Overrun Flag Channel 1

LL_DMAMUX_CFR_CSOF2

Synchronization Event Overrun Flag Channel 2

LL_DMAMUX_CFR_CSOF3

Synchronization Event Overrun Flag Channel 3

LL_DMAMUX_CFR_CSOF4

Synchronization Event Overrun Flag Channel 4

LL_DMAMUX_CFR_CSOF5

Synchronization Event Overrun Flag Channel 5

LL_DMAMUX_CFR_CSOF6

Synchronization Event Overrun Flag Channel 6

LL_DMAMUX_CFR_CSOF7

Synchronization Event Overrun Flag Channel 7

LL_DMAMUX_CFR_CSOF8

Synchronization Event Overrun Flag Channel 8

LL_DMAMUX_CFR_CSOF9

Synchronization Event Overrun Flag Channel 9

LL_DMAMUX_CFR_CSOF10

Synchronization Event Overrun Flag Channel 10

LL_DMAMUX_CFR_CSOF11

Synchronization Event Overrun Flag Channel 11

LL_DMAMUX_CFR_CSOF12

Synchronization Event Overrun Flag Channel 12

LL_DMAMUX_CFR_CSOF13

Synchronization Event Overrun Flag Channel 13

LL_DMAMUX_RGCFR_RGCOF0

Request Generator 0 Trigger Event Overrun Flag

LL_DMAMUX_RGCFR_RGCOF1

Request Generator 1 Trigger Event Overrun Flag

LL_DMAMUX_RGCFR_RGCOF2

Request Generator 2 Trigger Event Overrun Flag

LL_DMAMUX_RGCFR_RGCOF3

Request Generator 3 Trigger Event Overrun Flag

Get Flags Defines

LL_DMAMUX_CSR_SOF0

Synchronization Event Overrun Flag Channel 0

LL_DMAMUX_CSR_SOF1

Synchronization Event Overrun Flag Channel 1

LL_DMAMUX_CSR_SOF2

Synchronization Event Overrun Flag Channel 2

LL_DMAMUX_CSR_SOF3

Synchronization Event Overrun Flag Channel 3

LL_DMAMUX_CSR_SOF4

Synchronization Event Overrun Flag Channel 4

LL_DMAMUX_CSR_SOF5

Synchronization Event Overrun Flag Channel 5

LL_DMAMUX_CSR_SOF6

Synchronization Event Overrun Flag Channel 6

LL_DMAMUX_CSR_SOF7

Synchronization Event Overrun Flag Channel 7

LL_DMAMUX_CSR_SOF8

Synchronization Event Overrun Flag Channel 8

LL_DMAMUX_CSR_SOF9

Synchronization Event Overrun Flag Channel 9

LL_DMAMUX_CSR_SOF10

Synchronization Event Overrun Flag Channel 10

LL_DMAMUX_CSR_SOF11

Synchronization Event Overrun Flag Channel 11

LL_DMAMUX_CSR_SOF12

Synchronization Event Overrun Flag Channel 12

LL_DMAMUX_CSR_SOF13

Synchronization Event Overrun Flag Channel 13

LL_DMAMUX_RGSR_RGOF0

Request Generator 0 Trigger Event Overrun Flag

LL_DMAMUX_RGSR_RGOF1

Request Generator 1 Trigger Event Overrun Flag

LL_DMAMUX_RGSR_RGOF2

Request Generator 2 Trigger Event Overrun Flag

LL_DMAMUX_RGSR_RGOF3

Request Generator 3 Trigger Event Overrun Flag

IT Defines

LL_DMAMUX_CCR_SOIE

Synchronization Event Overrun Interrupt

LL_DMAMUX_RGCR_RGOIE

Request Generation Trigger Event Overrun Interrupt

Transfer request

LL_DMAMUX_REQ_MEM2MEM

Memory to memory transfer

LL_DMAMUX_REQ_GENERATOR0

DMAMUX request generator 0

LL_DMAMUX_REQ_GENERATOR1

DMAMUX request generator 1

LL_DMAMUX_REQ_GENERATOR2

DMAMUX request generator 2

LL_DMAMUX_REQ_GENERATOR3

DMAMUX request generator 3

LL_DMAMUX_REQ_ADC1

DMAMUX ADC1 request

LL_DMAMUX_REQ_DAC1_CH1

DMAMUX DAC1 CH1 request

LL_DMAMUX_REQ_DAC1_CH2

DMAMUX DAC1 CH2 request

LL_DMAMUX_REQ_TIM6_UP

DMAMUX TIM6 UP request

LL_DMAMUX_REQ_TIM7_UP

DMAMUX TIM7 UP request

LL_DMAMUX_REQ_SPI1_RX

DMAMUX SPI1 RX request

LL_DMAMUX_REQ_SPI1_TX

DMAMUX SPI1 TX request

LL_DMAMUX_REQ_SPI2_RX

DMAMUX SPI2 RX request

LL_DMAMUX_REQ_SPI2_TX

DMAMUX SPI2 TX request

LL_DMAMUX_REQ_SPI3_RX

DMAMUX SPI3 RX request

LL_DMAMUX_REQ_SPI3_TX

DMAMUX SPI3 TX request

LL_DMAMUX_REQ_I2C1_RX

DMAMUX I2C1 RX request

LL_DMAMUX_REQ_I2C1_TX

DMAMUX I2C1 TX request

LL_DMAMUX_REQ_I2C2_RX

DMAMUX I2C2 RX request

LL_DMAMUX_REQ_I2C2_TX

DMAMUX I2C2 TX request

LL_DMAMUX_REQ_I2C3_RX

DMAMUX I2C3 RX request

LL_DMAMUX_REQ_I2C3_TX

DMAMUX I2C3 TX request

LL_DMAMUX_REQ_I2C4_RX

DMAMUX I2C4 RX request

LL_DMAMUX_REQ_I2C4_TX

DMAMUX I2C4 TX request

LL_DMAMUX_REQ_USART1_RX

DMAMUX USART1 RX request

LL_DMAMUX_REQ_USART1_TX

DMAMUX USART1 TX request

LL_DMAMUX_REQ_USART2_RX

DMAMUX USART2 RX request

LL_DMAMUX_REQ_USART2_TX

DMAMUX USART2 TX request

LL_DMAMUX_REQ_USART3_RX

DMAMUX USART3 RX request

LL_DMAMUX_REQ_USART3_TX

DMAMUX USART3 TX request

LL_DMAMUX_REQ_UART4_RX

DMAMUX UART4 RX request

LL_DMAMUX_REQ_UART4_TX

DMAMUX UART4 TX request

LL_DMAMUX_REQ_UART5_RX

DMAMUX UART5 RX request

LL_DMAMUX_REQ_UART5_TX

DMAMUX UART5 TX request

LL_DMAMUX_REQ_LPUART1_RX

DMAMUX LPUART1 RX request

LL_DMAMUX_REQ_LPUART1_TX

DMAMUX LPUART1 TX request

LL_DMAMUX_REQ_SAI1_A

DMAMUX SAI1 A request

LL_DMAMUX_REQ_SAI1_B

DMAMUX SAI1 B request

LL_DMAMUX_REQ_SAI2_A

DMAMUX SAI2 A request

LL_DMAMUX_REQ_SAI2_B

DMAMUX SAI2 B request

LL_DMAMUX_REQ_OSPI1

DMAMUX OCTOSPI1 request

LL_DMAMUX_REQ_OSPI2

DMAMUX OCTOSPI2 request

LL_DMAMUX_REQ_TIM1_CH1

DMAMUX TIM1 CH1 request

LL_DMAMUX_REQ_TIM1_CH2

DMAMUX TIM1 CH2 request

LL_DMAMUX_REQ_TIM1_CH3

DMAMUX TIM1 CH3 request

LL_DMAMUX_REQ_TIM1_CH4

DMAMUX TIM1 CH4 request

LL_DMAMUX_REQ_TIM1_UP

DMAMUX TIM1 UP request

LL_DMAMUX_REQ_TIM1_TRIG

DMAMUX TIM1 TRIG request

LL_DMAMUX_REQ_TIM1_COM

DMAMUX TIM1 COM request

LL_DMAMUX_REQ_TIM8_CH1

DMAMUX TIM8 CH1 request

LL_DMAMUX_REQ_TIM8_CH2

DMAMUX TIM8 CH2 request

LL_DMAMUX_REQ_TIM8_CH3

DMAMUX TIM8 CH3 request

LL_DMAMUX_REQ_TIM8_CH4

DMAMUX TIM8 CH4 request

LL_DMAMUX_REQ_TIM8_UP

DMAMUX TIM8 UP request

LL_DMAMUX_REQ_TIM8_TRIG

DMAMUX TIM8 TRIG request

LL_DMAMUX_REQ_TIM8_COM

DMAMUX TIM8 COM request

LL_DMAMUX_REQ_TIM2_CH1

DMAMUX TIM2 CH1 request

LL_DMAMUX_REQ_TIM2_CH2

DMAMUX TIM2 CH2 request

LL_DMAMUX_REQ_TIM2_CH3

DMAMUX TIM2 CH3 request

LL_DMAMUX_REQ_TIM2_CH4

DMAMUX TIM2 CH4 request

LL_DMAMUX_REQ_TIM2_UP

DMAMUX TIM2 UP request

LL_DMAMUX_REQ_TIM3_CH1

DMAMUX TIM3 CH1 request

LL_DMAMUX_REQ_TIM3_CH2

DMAMUX TIM3 CH2 request

LL_DMAMUX_REQ_TIM3_CH3

DMAMUX TIM3 CH3 request

LL_DMAMUX_REQ_TIM3_CH4

DMAMUX TIM3 CH4 request

LL_DMAMUX_REQ_TIM3_UP

DMAMUX TIM3 UP request

LL_DMAMUX_REQ_TIM3_TRIG

DMAMUX TIM3 TRIG request

LL_DMAMUX_REQ_TIM4_CH1

DMAMUX TIM4 CH1 request

LL_DMAMUX_REQ_TIM4_CH2

DMAMUX TIM4 CH2 request

LL_DMAMUX_REQ_TIM4_CH3

DMAMUX TIM4 CH3 request

LL_DMAMUX_REQ_TIM4_CH4

DMAMUX TIM4 CH4 request

LL_DMAMUX_REQ_TIM4_UP

DMAMUX TIM4 UP request

LL_DMAMUX_REQ_TIM5_CH1

DMAMUX TIM5 CH1 request

LL_DMAMUX_REQ_TIM5_CH2

DMAMUX TIM5 CH2 request

LL_DMAMUX_REQ_TIM5_CH3

DMAMUX TIM5 CH3 request

LL_DMAMUX_REQ_TIM5_CH4

DMAMUX TIM5 CH4 request

LL_DMAMUX_REQ_TIM5_UP

DMAMUX TIM5 UP request

LL_DMAMUX_REQ_TIM5_TRIG

DMAMUX TIM5 TRIG request

LL_DMAMUX_REQ_TIM15_CH1

DMAMUX TIM15 CH1 request

LL_DMAMUX_REQ_TIM15_UP

DMAMUX TIM15 UP request

LL_DMAMUX_REQ_TIM15_TRIG

DMAMUX TIM15 TRIG request

LL_DMAMUX_REQ_TIM15_COM

DMAMUX TIM15 COM request

LL_DMAMUX_REQ_TIM16_CH1

DMAMUX TIM16 CH1 request

LL_DMAMUX_REQ_TIM16_UP

DMAMUX TIM16 UP request

LL_DMAMUX_REQ_TIM17_CH1

DMAMUX TIM17 CH1 request

LL_DMAMUX_REQ_TIM17_UP

DMAMUX TIM17 UP request

LL_DMAMUX_REQ_DFSDM1_FLT0

DMAMUX DFSDM1_FLT0 request

LL_DMAMUX_REQ_DFSDM1_FLT1

DMAMUX DFSDM1_FLT1 request

LL_DMAMUX_REQ_DFSDM1_FLT2

DMAMUX DFSDM1_FLT2 request

LL_DMAMUX_REQ_DFSDM1_FLT3

DMAMUX DFSDM1_FLT3 request

LL_DMAMUX_REQ_DCMI

DMAMUX DCMI request

LL_DMAMUX_REQ_AES_IN

DMAMUX AES_IN request

LL_DMAMUX_REQ_AES_OUT

DMAMUX AES_OUT request

LL_DMAMUX_REQ_HASH_IN

DMAMUX HASH_IN request

External Request Signal Generation

LL_DMAMUX_REQ_GEN_EXTI_LINE0

Request signal generation from EXTI Line0

LL_DMAMUX_REQ_GEN_EXTI_LINE1

Request signal generation from EXTI Line1

LL_DMAMUX_REQ_GEN_EXTI_LINE2

Request signal generation from EXTI Line2

LL_DMAMUX_REQ_GEN_EXTI_LINE3

Request signal generation from EXTI Line3

LL_DMAMUX_REQ_GEN_EXTI_LINE4

Request signal generation from EXTI Line4

LL_DMAMUX_REQ_GEN_EXTI_LINE5

Request signal generation from EXTI Line5

LL_DMAMUX_REQ_GEN_EXTI_LINE6

Request signal generation from EXTI Line6

LL_DMAMUX_REQ_GEN_EXTI_LINE7

Request signal generation from EXTI Line7

LL_DMAMUX_REQ_GEN_EXTI_LINE8

Request signal generation from EXTI Line8

LL_DMAMUX_REQ_GEN_EXTI_LINE9

Request signal generation from EXTI Line9

LL_DMAMUX_REQ_GEN_EXTI_LINE10

Request signal generation from EXTI Line10

LL_DMAMUX_REQ_GEN_EXTI_LINE11

Request signal generation from EXTI Line11

LL_DMAMUX_REQ_GEN_EXTI_LINE12

Request signal generation from EXTI Line12

LL_DMAMUX_REQ_GEN_EXTI_LINE13

Request signal generation from EXTI Line13

LL_DMAMUX_REQ_GEN_EXTI_LINE14

Request signal generation from EXTI Line14

LL_DMAMUX_REQ_GEN_EXTI_LINE15

Request signal generation from EXTI Line15

LL_DMAMUX_REQ_GEN_DMAMUX_CH0

Request signal generation from DMAMUX channel0 Event

LL_DMAMUX_REQ_GEN_DMAMUX_CH1

Request signal generation from DMAMUX channel1 Event

LL_DMAMUX_REQ_GEN_DMAMUX_CH2

Request signal generation from DMAMUX channel2 Event

LL_DMAMUX_REQ_GEN_DMAMUX_CH3

Request signal generation from DMAMUX channel3 Event

LL_DMAMUX_REQ_GEN_LPTIM1_OUT

Request signal generation from LPTIM1 Ouput

LL_DMAMUX_REQ_GEN_LPTIM2_OUT

Request signal generation from LPTIM2 Ouput

LL_DMAMUX_REQ_GEN_DSI_TE

Request signal generation from DSI Tearing Effect

LL_DMAMUX_REQ_GEN_DSI_REFRESH_END

Request signal generation from DSI End of Refresh

LL_DMAMUX_REQ_GEN_DMA2D_TX_END

Request signal generation from DMA2D End of Transfer

LL_DMAMUX_REQ_GEN_LTDC_LINE_IT

Request signal generation from LTDC Line Interrupt

Request Generator Channel

LL_DMAMUX_REQ_GEN_0

LL_DMAMUX_REQ_GEN_1

LL_DMAMUX_REQ_GEN_2

LL_DMAMUX_REQ_GEN_3

External Request Signal Generation Polarity

LL_DMAMUX_REQ_GEN_NO_EVENT

No external DMA request generation

LL_DMAMUX_REQ_GEN_POL_RISING

External DMA request generation on event on rising edge

LL_DMAMUX_REQ_GEN_POL_FALLING

External DMA request generation on event on falling edge

LL_DMAMUX_REQ_GEN_POL_RISING_FALLING

External DMA request generation on rising and falling edge

Synchronization Signal Event

LL_DMAMUX_SYNC_EXTI_LINE0

Synchronization signal from EXTI Line0

LL_DMAMUX_SYNC_EXTI_LINE1

Synchronization signal from EXTI Line1

LL_DMAMUX_SYNC_EXTI_LINE2

Synchronization signal from EXTI Line2

LL_DMAMUX_SYNC_EXTI_LINE3

Synchronization signal from EXTI Line3

LL_DMAMUX_SYNC_EXTI_LINE4

Synchronization signal from EXTI Line4

LL_DMAMUX_SYNC_EXTI_LINE5

Synchronization signal from EXTI Line5

LL_DMAMUX_SYNC_EXTI_LINE6

Synchronization signal from EXTI Line6

LL_DMAMUX_SYNC_EXTI_LINE7

Synchronization signal from EXTI Line7

LL_DMAMUX_SYNC_EXTI_LINE8

Synchronization signal from EXTI Line8

LL_DMAMUX_SYNC_EXTI_LINE9

Synchronization signal from EXTI Line9

LL_DMAMUX_SYNC_EXTI_LINE10

Synchronization signal from EXTI Line10

LL_DMAMUX_SYNC_EXTI_LINE11

Synchronization signal from EXTI Line11

LL_DMAMUX_SYNC_EXTI_LINE12

Synchronization signal from EXTI Line12

LL_DMAMUX_SYNC_EXTI_LINE13

Synchronization signal from EXTI Line13

LL_DMAMUX_SYNC_EXTI_LINE14

Synchronization signal from EXTI Line14

LL_DMAMUX_SYNC_EXTI_LINE15

Synchronization signal from EXTI Line15

LL_DMAMUX_SYNC_DMAMUX_CH0

Synchronization signal from DMAMUX channel0 Event

LL_DMAMUX_SYNC_DMAMUX_CH1

Synchronization signal from DMAMUX channel1 Event

LL_DMAMUX_SYNC_DMAMUX_CH2

Synchronization signal from DMAMUX channel2 Event

LL_DMAMUX_SYNC_DMAMUX_CH3

Synchronization signal from DMAMUX channel3 Event

LL_DMAMUX_SYNC_LPTIM1_OUT

Synchronization signal from LPTIM1 Ouput

LL_DMAMUX_SYNC_LPTIM2_OUT

Synchronization signal from LPTIM2 Ouput

LL_DMAMUX_SYNC_DSI_TE

Synchronization signal from DSI Tearing Effect

LL_DMAMUX_SYNC_DSI_REFRESH_END

Synchronization signal from DSI End of Refresh

LL_DMAMUX_SYNC_DMA2D_TX_END

Synchronization signal from DMA2D End of Transfer

LL_DMAMUX_SYNC_LTDC_LINE_IT

Synchronization signal from LTDC Line Interrupt

Synchronization Signal Polarity

LL_DMAMUX_SYNC_NO_EVENT

All requests are blocked

LL_DMAMUX_SYNC_POL_RISING

Synchronization on event on rising edge

LL_DMAMUX_SYNC_POL_FALLING

Synchronization on event on falling edge

LL_DMAMUX_SYNC_POL_RISING_FALLING

Synchronization on event on rising and falling edge

Common Write and read registers macros

LL_DMAMUX_WriteReg

Description:

- Write a value in DMAMUX register.

Parameters:

- __INSTANCE__: DMAMUX Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_DMAMUX_ReadReg

Description:

- Read a value in DMAMUX register.

Parameters:

- __INSTANCE__: DMAMUX Instance
- __REG__: Register to be read

Return value:

- Register: value

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89.1 DMA Firmware driver registers structures

89.1.1 LL_DMA_InitTypeDef

LL_DMA_InitTypeDef is defined in the stm32l4xx_ll_dma.h

Data Fields

- ***uint32_t PeriphOrM2MSrcAddress***
- ***uint32_t MemoryOrM2MDstAddress***
- ***uint32_t Direction***
- ***uint32_t Mode***
- ***uint32_t PeriphOrM2MSrcIncMode***
- ***uint32_t MemoryOrM2MDstIncMode***
- ***uint32_t PeriphOrM2MSrcDataSize***
- ***uint32_t MemoryOrM2MDstDataSize***
- ***uint32_t NbData***
- ***uint32_t PeriphRequest***
- ***uint32_t Priority***

Field Documentation

- ***uint32_t LL_DMA_InitTypeDef::PeriphOrM2MSrcAddress***

  Specifies the peripheral base address for DMA transfer or as Source base address in case of memory to memory transfer direction.This parameter must be a value between Min_Data = 0 and Max_Data = 0xFFFFFFFF.
- ***uint32_t LL_DMA_InitTypeDef::MemoryOrM2MDstAddress***

  Specifies the memory base address for DMA transfer or as Destination base address in case of memory to memory transfer direction.This parameter must be a value between Min_Data = 0 and Max_Data = 0xFFFFFFFF.
- ***uint32_t LL_DMA_InitTypeDef::Direction***

  Specifies if the data will be transferred from memory to peripheral, from memory to memory or from peripheral to memory. This parameter can be a value of ***DMA_LL_EC_DIRECTION***This feature can be modified afterwards using unitary function **LL_DMA_SetDataTransferDirection()**.
- ***uint32_t LL_DMA_InitTypeDef::Mode***

  Specifies the normal or circular operation mode. This parameter can be a value of ***DMA_LL_EC_MODE***

  Note:

  – : The circular buffer mode cannot be used if the memory to memory data transfer direction is configured on the selected Channel

  This feature can be modified afterwards using unitary function **LL_DMA_SetMode()**.
- ***uint32_t LL_DMA_InitTypeDef::PeriphOrM2MSrcIncMode***

  Specifies whether the Peripheral address or Source address in case of memory to memory transfer direction is incremented or not. This parameter can be a value of ***DMA_LL_EC_PERIPH***This feature can be modified afterwards using unitary function **LL_DMA_SetPeriphIncMode()**.
- ***uint32_t LL_DMA_InitTypeDef::MemoryOrM2MDstIncMode***

  Specifies whether the Memory address or Destination address in case of memory to memory transfer direction is incremented or not. This parameter can be a value of ***DMA_LL_EC_MEMORY***This feature can be modified afterwards using unitary function **LL_DMA_SetMemoryIncMode()**.
- ***uint32_t LL_DMA_InitTypeDef::PeriphOrM2MSrcDataSize***

  Specifies the Peripheral data size alignment or Source data size alignment (byte, half word, word) in case of memory to memory transfer direction. This parameter can be a value of ***DMA_LL_EC_PDATAALIGN***This feature can be modified afterwards using unitary function **LL_DMA_SetPeriphSize()**.

- ***uint32_t LL_DMA_InitTypeDef::MemoryOrM2MDstDataSize***

  Specifies the Memory data size alignment or Destination data size alignment (byte, half word, word) in case of memory to memory transfer direction. This parameter can be a value of ***DMA_LL_EC_MDATAALIGN***This feature can be modified afterwards using unitary function **LL_DMA_SetMemorySize()**.
- ***uint32_t LL_DMA_InitTypeDef::NbData***

  Specifies the number of data to transfer, in data unit. The data unit is equal to the source buffer configuration set in PeripheralSize or MemorySize parameters depending in the transfer direction. This parameter must be a value between Min_Data = 0 and Max_Data = 0x0000FFFFThis feature can be modified afterwards using unitary function **LL_DMA_SetDataLength()**.
- ***uint32_t LL_DMA_InitTypeDef::PeriphRequest***

  Specifies the peripheral request. This parameter can be a value of ***DMAMUX_LL_EC_REQUEST***This feature can be modified afterwards using unitary function **LL_DMA_SetPeriphRequest()**.
- ***uint32_t LL_DMA_InitTypeDef::Priority***

  Specifies the channel priority level. This parameter can be a value of ***DMA_LL_EC_PRIORITY***This feature can be modified afterwards using unitary function **LL_DMA_SetChannelPriorityLevel()**.

89.2 DMA Firmware driver API description

The following section lists the various functions of the DMA library.

89.2.1 Detailed description of functions

`LL_DMA_EnableChannel`

Function name

__STATIC_INLINE void LL_DMA_EnableChannel (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Enable DMA channel.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR EN LL_DMA_EnableChannel

`LL_DMA_DisableChannel`

Function name

__STATIC_INLINE void LL_DMA_DisableChannel (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Disable DMA channel.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR EN LL_DMA_DisableChannel

LL_DMA_IsEnabledChannel

Function name

__STATIC_INLINE uint32_t LL_DMA_IsEnabledChannel (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Check if DMA channel is enabled or disabled.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCR EN LL_DMA_IsEnabledChannel

LL_DMA_ConfigTransfer

Function name

__STATIC_INLINE void LL_DMA_ConfigTransfer (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t Configuration)

Function description

Configure all parameters link to DMA transfer.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **Configuration:** This parameter must be a combination of all the following values:
  - LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH or LL_DMA_DIRECTION_MEMORY_TO_MEMORY
  - LL_DMA_MODE_NORMAL or LL_DMA_MODE_CIRCULAR
  - LL_DMA_PERIPH_INCREMENT or LL_DMA_PERIPH_NOINCREMENT
  - LL_DMA_MEMORY_INCREMENT or LL_DMA_MEMORY_NOINCREMENT
  - LL_DMA_PDATAALIGN_BYTE or LL_DMA_PDATAALIGN_HALFWORD or LL_DMA_PDATAALIGN_WORD
  - LL_DMA_MDATAALIGN_BYTE or LL_DMA_MDATAALIGN_HALFWORD or LL_DMA_MDATAALIGN_WORD
  - LL_DMA_PRIORITY_LOW or LL_DMA_PRIORITY_MEDIUM or LL_DMA_PRIORITY_HIGH or LL_DMA_PRIORITY_VERYHIGH

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR DIR LL_DMA_ConfigTransfer
- CCR MEM2MEM LL_DMA_ConfigTransfer
- CCR CIRC LL_DMA_ConfigTransfer
- CCR PINC LL_DMA_ConfigTransfer
- CCR MINC LL_DMA_ConfigTransfer
- CCR PSIZE LL_DMA_ConfigTransfer
- CCR MSIZE LL_DMA_ConfigTransfer
- CCR PL LL_DMA_ConfigTransfer

LL_DMA_SetDataTransferDirection

Function name

__STATIC_INLINE void LL_DMA_SetDataTransferDirection (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t Direction)

Function description

Set Data transfer direction (read from peripheral or from memory).

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **Direction:** This parameter can be one of the following values:
  - LL_DMA_DIRECTION_PERIPH_TO_MEMORY
  - LL_DMA_DIRECTION_MEMORY_TO_PERIPH
  - LL_DMA_DIRECTION_MEMORY_TO_MEMORY

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR DIR LL_DMA_SetDataTransferDirection
- CCR MEM2MEM LL_DMA_SetDataTransferDirection

LL_DMA_GetDataTransferDirection

Function name

__STATIC_INLINE uint32_t LL_DMA_GetDataTransferDirection (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Data transfer direction (read from peripheral or from memory).

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_DIRECTION_PERIPH_TO_MEMORY
  - LL_DMA_DIRECTION_MEMORY_TO_PERIPH
  - LL_DMA_DIRECTION_MEMORY_TO_MEMORY

Reference Manual to LL API cross reference:

- CCR DIR LL_DMA_GetDataTransferDirection
- CCR MEM2MEM LL_DMA_GetDataTransferDirection

`LL_DMA_SetMode`

Function name

__STATIC_INLINE void LL_DMA_SetMode (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t Mode)

Function description

Set DMA mode circular or normal.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **Mode:** This parameter can be one of the following values:
  - LL_DMA_MODE_NORMAL
  - LL_DMA_MODE_CIRCULAR

Return values

- **None:**

Notes

- The circular buffer mode cannot be used if the memory-to-memory data transfer is configured on the selected Channel.

Reference Manual to LL API cross reference:

- CCR CIRC LL_DMA_SetMode

`LL_DMA_GetMode`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetMode (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get DMA mode circular or normal.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_MODE_NORMAL
  - LL_DMA_MODE_CIRCULAR

Reference Manual to LL API cross reference:

- CCR CIRC LL_DMA_GetMode

LL_DMA_SetPeriphIncMode

Function name

__STATIC_INLINE void LL_DMA_SetPeriphIncMode (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t PeriphOrM2MSrcIncMode)

Function description

Set Peripheral increment mode.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **PeriphOrM2MSrcIncMode:** This parameter can be one of the following values:
  - LL_DMA_PERIPH_INCREMENT
  - LL_DMA_PERIPH_NOINCREMENT

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR PINC LL_DMA_SetPeriphIncMode

LL_DMA_GetPeriphIncMode

Function name

__STATIC_INLINE uint32_t LL_DMA_GetPeriphIncMode (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Peripheral increment mode.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_PERIPH_INCREMENT
  - LL_DMA_PERIPH_NOINCREMENT

Reference Manual to LL API cross reference:

- CCR PINC LL_DMA_GetPeriphIncMode

`LL_DMA_SetMemoryIncMode`

Function name

__STATIC_INLINE void LL_DMA_SetMemoryIncMode (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t MemoryOrM2MDstIncMode)

Function description

Set Memory increment mode.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **MemoryOrM2MDstIncMode:** This parameter can be one of the following values:
  - LL_DMA_MEMORY_INCREMENT
  - LL_DMA_MEMORY_NOINCREMENT

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR MINC LL_DMA_SetMemoryIncMode

`LL_DMA_GetMemoryIncMode`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetMemoryIncMode (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Memory increment mode.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_MEMORY_INCREMENT
  - LL_DMA_MEMORY_NOINCREMENT

Reference Manual to LL API cross reference:

- CCR MINC LL_DMA_GetMemoryIncMode

LL_DMA_SetPeriphSize

Function name

__STATIC_INLINE void LL_DMA_SetPeriphSize (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t PeriphOrM2MSrcDataSize)

Function description

Set Peripheral size.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **PeriphOrM2MSrcDataSize:** This parameter can be one of the following values:
  - LL_DMA_PDATAALIGN_BYTE
  - LL_DMA_PDATAALIGN_HALFWORD
  - LL_DMA_PDATAALIGN_WORD

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR PSIZE LL_DMA_SetPeriphSize

`LL_DMA_GetPeriphSize`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetPeriphSize (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Peripheral size.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_PDATAALIGN_BYTE
  - LL_DMA_PDATAALIGN_HALFWORD
  - LL_DMA_PDATAALIGN_WORD

Reference Manual to LL API cross reference:

- CCR PSIZE LL_DMA_GetPeriphSize

`LL_DMA_SetMemorySize`

Function name

__STATIC_INLINE void LL_DMA_SetMemorySize (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t MemoryOrM2MDstDataSize)

Function description

Set Memory size.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **MemoryOrM2MDstDataSize:** This parameter can be one of the following values:
  - LL_DMA_MDATAALIGN_BYTE
  - LL_DMA_MDATAALIGN_HALFWORD
  - LL_DMA_MDATAALIGN_WORD

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR MSIZE LL_DMA_SetMemorySize

LL_DMA_GetMemorySize

Function name

__STATIC_INLINE uint32_t LL_DMA_GetMemorySize (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Memory size.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_MDATAALIGN_BYTE
  - LL_DMA_MDATAALIGN_HALFWORD
  - LL_DMA_MDATAALIGN_WORD

Reference Manual to LL API cross reference:

- CCR MSIZE LL_DMA_GetMemorySize

LL_DMA_SetChannelPriorityLevel

Function name

__STATIC_INLINE void LL_DMA_SetChannelPriorityLevel (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t Priority)

Function description

Set Channel priority level.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **Priority:** This parameter can be one of the following values:
  - LL_DMA_PRIORITY_LOW
  - LL_DMA_PRIORITY_MEDIUM
  - LL_DMA_PRIORITY_HIGH
  - LL_DMA_PRIORITY_VERYHIGH

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR PL LL_DMA_SetChannelPriorityLevel

LL_DMA_GetChannelPriorityLevel

Function name

__STATIC_INLINE uint32_t LL_DMA_GetChannelPriorityLevel (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Channel priority level.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMA_PRIORITY_LOW
  - LL_DMA_PRIORITY_MEDIUM
  - LL_DMA_PRIORITY_HIGH
  - LL_DMA_PRIORITY_VERYHIGH

Reference Manual to LL API cross reference:

- CCR PL LL_DMA_GetChannelPriorityLevel

`LL_DMA_SetDataLength`

Function name

__STATIC_INLINE void LL_DMA_SetDataLength (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t NbData)

Function description

Set Number of data to transfer.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **NbData:** Between Min_Data = 0 and Max_Data = 0x0000FFFF

Return values

- **None:**

Notes

- This action has no effect if channel is enabled.

Reference Manual to LL API cross reference:

- CNDTR NDT LL_DMA_SetDataLength

`LL_DMA_GetDataLength`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetDataLength (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Number of data to transfer.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Between:** Min_Data = 0 and Max_Data = 0xFFFFFFFF

Notes

- Once the channel is enabled, the return value indicate the remaining bytes to be transmitted.

Reference Manual to LL API cross reference:

- CNDTR NDT LL_DMA_GetDataLength

LL_DMA_ConfigAddresses

Function name

__STATIC_INLINE void LL_DMA_ConfigAddresses (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t SrcAddress, uint32_t DstAddress, uint32_t Direction)

Function description

Configure the Source and Destination addresses.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **SrcAddress:** Between Min_Data = 0 and Max_Data = 0xFFFFFFFF
- **DstAddress:** Between Min_Data = 0 and Max_Data = 0xFFFFFFFF
- **Direction:** This parameter can be one of the following values:
  - LL_DMA_DIRECTION_PERIPH_TO_MEMORY
  - LL_DMA_DIRECTION_MEMORY_TO_PERIPH
  - LL_DMA_DIRECTION_MEMORY_TO_MEMORY

Return values

- **None:**

Notes

- This API must not be called when the DMA channel is enabled.
- Each IP using DMA provides an API to get directly the register adress (LL_PPP_DMA_GetRegAddr).

Reference Manual to LL API cross reference:

- CPAR PA LL_DMA_ConfigAddresses
- CMAR MA LL_DMA_ConfigAddresses

LL_DMA_SetMemoryAddress

Function name

__STATIC_INLINE void LL_DMA_SetMemoryAddress (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t MemoryAddress)

Function description

Set the Memory address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **MemoryAddress:** Between Min_Data = 0 and Max_Data = 0xFFFFFFFF

Return values

- **None:**

Notes

- Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only.
- This API must not be called when the DMA channel is enabled.

Reference Manual to LL API cross reference:

- CMAR MA LL_DMA_SetMemoryAddress

LL_DMA_SetPeriphAddress

Function name

__STATIC_INLINE void LL_DMA_SetPeriphAddress (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t PeriphAddress)

Function description

Set the Peripheral address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **PeriphAddress:** Between Min_Data = 0 and Max_Data = 0xFFFFFFFF

Return values

- **None:**

Notes

- Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only.
- This API must not be called when the DMA channel is enabled.

Reference Manual to LL API cross reference:

- CPAR PA LL_DMA_SetPeriphAddress

`LL_DMA_GetMemoryAddress`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetMemoryAddress (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Memory address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Between:** Min_Data = 0 and Max_Data = 0xFFFFFFFF

Notes

- Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only.

Reference Manual to LL API cross reference:

- CMAR MA LL_DMA_GetMemoryAddress

`LL_DMA_GetPeriphAddress`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetPeriphAddress (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get Peripheral address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Between:** Min_Data = 0 and Max_Data = 0xFFFFFFFF

Notes

- Interface used for direction LL_DMA_DIRECTION_PERIPH_TO_MEMORY or LL_DMA_DIRECTION_MEMORY_TO_PERIPH only.

Reference Manual to LL API cross reference:

- CPAR PA LL_DMA_GetPeriphAddress

`LL_DMA_SetM2MSrcAddress`

Function name

__STATIC_INLINE void LL_DMA_SetM2MSrcAddress (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t MemoryAddress)

Function description

Set the Memory to Memory Source address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **MemoryAddress:** Between Min_Data = 0 and Max_Data = 0xFFFFFFFF

Return values

- **None:**

Notes

- Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only.
- This API must not be called when the DMA channel is enabled.

Reference Manual to LL API cross reference:

- CPAR PA LL_DMA_SetM2MSrcAddress

`LL_DMA_SetM2MDstAddress`

Function name

__STATIC_INLINE void LL_DMA_SetM2MDstAddress (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t MemoryAddress)

Function description

Set the Memory to Memory Destination address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **MemoryAddress:** Between Min_Data = 0 and Max_Data = 0xFFFFFFFF

Return values

- **None:**

Notes

- Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only.
- This API must not be called when the DMA channel is enabled.

Reference Manual to LL API cross reference:

- CMAR MA LL_DMA_SetM2MDstAddress

`LL_DMA_GetM2MSrcAddress`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetM2MSrcAddress (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get the Memory to Memory Source address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Between:** Min_Data = 0 and Max_Data = 0xFFFFFFFF

Notes

- Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only.

Reference Manual to LL API cross reference:

- CPAR PA LL_DMA_GetM2MSrcAddress

`LL_DMA_GetM2MDstAddress`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetM2MDstAddress (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get the Memory to Memory Destination address.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Between:** Min_Data = 0 and Max_Data = 0xFFFFFFFF

Notes

- Interface used for direction LL_DMA_DIRECTION_MEMORY_TO_MEMORY only.

Reference Manual to LL API cross reference:

- CMAR MA LL_DMA_GetM2MDstAddress

LL_DMA_SetPeriphRequest

Function name

__STATIC_INLINE void LL_DMA_SetPeriphRequest (DMA_TypeDef * DMAx, uint32_t Channel, uint32_t Request)

Function description

Set DMA request for DMA Channels on DMAMUX Channel x.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **Request:** This parameter can be one of the following values:
  - LL_DMAMUX_REQ_MEM2MEM
  - LL_DMAMUX_REQ_GENERATOR0
  - LL_DMAMUX_REQ_GENERATOR1
  - LL_DMAMUX_REQ_GENERATOR2
  - LL_DMAMUX_REQ_GENERATOR3
  - LL_DMAMUX_REQ_ADC1
  - LL_DMAMUX_REQ_DAC1_CH1
  - LL_DMAMUX_REQ_DAC1_CH2
  - LL_DMAMUX_REQ_TIM6_UP
  - LL_DMAMUX_REQ_TIM7_UP
  - LL_DMAMUX_REQ_SPI1_RX
  - LL_DMAMUX_REQ_SPI1_TX
  - LL_DMAMUX_REQ_SPI2_RX
  - LL_DMAMUX_REQ_SPI2_TX
  - LL_DMAMUX_REQ_SPI3_RX
  - LL_DMAMUX_REQ_SPI3_TX
  - LL_DMAMUX_REQ_I2C1_RX
  - LL_DMAMUX_REQ_I2C1_TX
  - LL_DMAMUX_REQ_I2C2_RX
  - LL_DMAMUX_REQ_I2C2_TX
  - LL_DMAMUX_REQ_I2C3_RX
  - LL_DMAMUX_REQ_I2C3_TX
  - LL_DMAMUX_REQ_I2C4_RX
  - LL_DMAMUX_REQ_I2C4_TX
  - LL_DMAMUX_REQ_USART1_RX
  - LL_DMAMUX_REQ_USART1_TX
  - LL_DMAMUX_REQ_USART2_RX
  - LL_DMAMUX_REQ_USART2_TX
  - LL_DMAMUX_REQ_USART3_RX
  - LL_DMAMUX_REQ_USART3_TX
  - LL_DMAMUX_REQ_UART4_RX
  - LL_DMAMUX_REQ_UART4_TX
  - LL_DMAMUX_REQ_UART5_RX
  - LL_DMAMUX_REQ_UART5_TX
  - LL_DMAMUX_REQ_LPUART1_RX
  - LL_DMAMUX_REQ_LPUART1_TX
  - LL_DMAMUX_REQ_SAI1_A
  - LL_DMAMUX_REQ_SAI1_B

- LL_DMAMUX_REQ_SAI2_A
- LL_DMAMUX_REQ_SAI2_B
- LL_DMAMUX_REQ_OSPI1
- LL_DMAMUX_REQ_OSPI2
- LL_DMAMUX_REQ_TIM1_CH1
- LL_DMAMUX_REQ_TIM1_CH2
- LL_DMAMUX_REQ_TIM1_CH3
- LL_DMAMUX_REQ_TIM1_CH4
- LL_DMAMUX_REQ_TIM1_UP
- LL_DMAMUX_REQ_TIM1_TRIG
- LL_DMAMUX_REQ_TIM1_COM
- LL_DMAMUX_REQ_TIM8_CH1
- LL_DMAMUX_REQ_TIM8_CH2
- LL_DMAMUX_REQ_TIM8_CH3
- LL_DMAMUX_REQ_TIM8_CH4
- LL_DMAMUX_REQ_TIM8_UP
- LL_DMAMUX_REQ_TIM8_TRIG
- LL_DMAMUX_REQ_TIM8_COM
- LL_DMAMUX_REQ_TIM2_CH1
- LL_DMAMUX_REQ_TIM2_CH2
- LL_DMAMUX_REQ_TIM2_CH3
- LL_DMAMUX_REQ_TIM2_CH4
- LL_DMAMUX_REQ_TIM2_UP
- LL_DMAMUX_REQ_TIM3_CH1
- LL_DMAMUX_REQ_TIM3_CH2
- LL_DMAMUX_REQ_TIM3_CH3
- LL_DMAMUX_REQ_TIM3_CH4
- LL_DMAMUX_REQ_TIM3_UP
- LL_DMAMUX_REQ_TIM3_TRIG
- LL_DMAMUX_REQ_TIM4_CH1
- LL_DMAMUX_REQ_TIM4_CH2
- LL_DMAMUX_REQ_TIM4_CH3
- LL_DMAMUX_REQ_TIM4_CH4
- LL_DMAMUX_REQ_TIM4_UP
- LL_DMAMUX_REQ_TIM5_CH1
- LL_DMAMUX_REQ_TIM5_CH2
- LL_DMAMUX_REQ_TIM5_CH3
- LL_DMAMUX_REQ_TIM5_CH4
- LL_DMAMUX_REQ_TIM5_UP
- LL_DMAMUX_REQ_TIM5_TRIG
- LL_DMAMUX_REQ_TIM15_CH1
- LL_DMAMUX_REQ_TIM15_UP
- LL_DMAMUX_REQ_TIM15_TRIG
- LL_DMAMUX_REQ_TIM15_COM
- LL_DMAMUX_REQ_TIM16_CH1
- LL_DMAMUX_REQ_TIM16_UP
- LL_DMAMUX_REQ_TIM17_CH1
- LL_DMAMUX_REQ_TIM17_UP
- LL_DMAMUX_REQ_DFSDM1_FLT0

  - LL_DMAMUX_REQ_DFSDM1_FLT1
  - LL_DMAMUX_REQ_DFSDM1_FLT2
  - LL_DMAMUX_REQ_DFSDM1_FLT3
  - LL_DMAMUX_REQ_DCMI
  - LL_DMAMUX_REQ_AES_IN
  - LL_DMAMUX_REQ_AES_OUT
  - LL_DMAMUX_REQ_HASH_IN

Return values

- **None:**

Notes

- DMAMUX channel 0 to 6 are mapped to DMA1 channel 1 to 7. DMAMUX channel 7 to 13 are mapped to DMA2 channel 1 to 7.

Reference Manual to LL API cross reference:

- CxCR DMAREQ_ID LL_DMA_SetPeriphRequest

`LL_DMA_GetPeriphRequest`

Function name

__STATIC_INLINE uint32_t LL_DMA_GetPeriphRequest (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Get DMA request for DMA Channels on DMAMUX Channel x.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **Returned:** value can be one of the following values:
  - LL_DMAMUX_REQ_MEM2MEM
  - LL_DMAMUX_REQ_GENERATOR0
  - LL_DMAMUX_REQ_GENERATOR1
  - LL_DMAMUX_REQ_GENERATOR2
  - LL_DMAMUX_REQ_GENERATOR3
  - LL_DMAMUX_REQ_ADC1
  - LL_DMAMUX_REQ_DAC1_CH1
  - LL_DMAMUX_REQ_DAC1_CH2
  - LL_DMAMUX_REQ_TIM6_UP
  - LL_DMAMUX_REQ_TIM7_UP
  - LL_DMAMUX_REQ_SPI1_RX
  - LL_DMAMUX_REQ_SPI1_TX
  - LL_DMAMUX_REQ_SPI2_RX
  - LL_DMAMUX_REQ_SPI2_TX
  - LL_DMAMUX_REQ_SPI3_RX
  - LL_DMAMUX_REQ_SPI3_TX
  - LL_DMAMUX_REQ_I2C1_RX
  - LL_DMAMUX_REQ_I2C1_TX
  - LL_DMAMUX_REQ_I2C2_RX
  - LL_DMAMUX_REQ_I2C2_TX
  - LL_DMAMUX_REQ_I2C3_RX
  - LL_DMAMUX_REQ_I2C3_TX
  - LL_DMAMUX_REQ_I2C4_RX
  - LL_DMAMUX_REQ_I2C4_TX
  - LL_DMAMUX_REQ_USART1_RX
  - LL_DMAMUX_REQ_USART1_TX
  - LL_DMAMUX_REQ_USART2_RX
  - LL_DMAMUX_REQ_USART2_TX
  - LL_DMAMUX_REQ_USART3_RX
  - LL_DMAMUX_REQ_USART3_TX
  - LL_DMAMUX_REQ_UART4_RX
  - LL_DMAMUX_REQ_UART4_TX
  - LL_DMAMUX_REQ_UART5_RX
  - LL_DMAMUX_REQ_UART5_TX
  - LL_DMAMUX_REQ_LPUART1_RX
  - LL_DMAMUX_REQ_LPUART1_TX
  - LL_DMAMUX_REQ_SAI1_A
  - LL_DMAMUX_REQ_SAI1_B
  - LL_DMAMUX_REQ_SAI2_A
  - LL_DMAMUX_REQ_SAI2_B
  - LL_DMAMUX_REQ_OSPI1
  - LL_DMAMUX_REQ_OSPI2
  - LL_DMAMUX_REQ_TIM1_CH1
  - LL_DMAMUX_REQ_TIM1_CH2
  - LL_DMAMUX_REQ_TIM1_CH3
  - LL_DMAMUX_REQ_TIM1_CH4
  - LL_DMAMUX_REQ_TIM1_UP

- LL_DMAMUX_REQ_TIM1_TRIG
- LL_DMAMUX_REQ_TIM1_COM
- LL_DMAMUX_REQ_TIM8_CH1
- LL_DMAMUX_REQ_TIM8_CH2
- LL_DMAMUX_REQ_TIM8_CH3
- LL_DMAMUX_REQ_TIM8_CH4
- LL_DMAMUX_REQ_TIM8_UP
- LL_DMAMUX_REQ_TIM8_TRIG
- LL_DMAMUX_REQ_TIM8_COM
- LL_DMAMUX_REQ_TIM2_CH1
- LL_DMAMUX_REQ_TIM2_CH2
- LL_DMAMUX_REQ_TIM2_CH3
- LL_DMAMUX_REQ_TIM2_CH4
- LL_DMAMUX_REQ_TIM2_UP
- LL_DMAMUX_REQ_TIM3_CH1
- LL_DMAMUX_REQ_TIM3_CH2
- LL_DMAMUX_REQ_TIM3_CH3
- LL_DMAMUX_REQ_TIM3_CH4
- LL_DMAMUX_REQ_TIM3_UP
- LL_DMAMUX_REQ_TIM3_TRIG
- LL_DMAMUX_REQ_TIM4_CH1
- LL_DMAMUX_REQ_TIM4_CH2
- LL_DMAMUX_REQ_TIM4_CH3
- LL_DMAMUX_REQ_TIM4_CH4
- LL_DMAMUX_REQ_TIM4_UP
- LL_DMAMUX_REQ_TIM5_CH1
- LL_DMAMUX_REQ_TIM5_CH2
- LL_DMAMUX_REQ_TIM5_CH3
- LL_DMAMUX_REQ_TIM5_CH4
- LL_DMAMUX_REQ_TIM5_UP
- LL_DMAMUX_REQ_TIM5_TRIG
- LL_DMAMUX_REQ_TIM15_CH1
- LL_DMAMUX_REQ_TIM15_UP
- LL_DMAMUX_REQ_TIM15_TRIG
- LL_DMAMUX_REQ_TIM15_COM
- LL_DMAMUX_REQ_TIM16_CH1
- LL_DMAMUX_REQ_TIM16_UP
- LL_DMAMUX_REQ_TIM17_CH1
- LL_DMAMUX_REQ_TIM17_UP
- LL_DMAMUX_REQ_DFSDM1_FLT0
- LL_DMAMUX_REQ_DFSDM1_FLT1
- LL_DMAMUX_REQ_DFSDM1_FLT2
- LL_DMAMUX_REQ_DFSDM1_FLT3
- LL_DMAMUX_REQ_DCMI
- LL_DMAMUX_REQ_AES_IN
- LL_DMAMUX_REQ_AES_OUT
- LL_DMAMUX_REQ_HASH_IN

Notes

- DMAMUX channel 0 to 6 are mapped to DMA1 channel 1 to 7. DMAMUX channel 7 to 13 are mapped to DMA2 channel 1 to 7.

Reference Manual to LL API cross reference:

- CxCR DMAREQ_ID LL_DMA_GetPeriphRequest

`LL_DMA_IsActiveFlag_GI1`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI1 (DMA_TypeDef * DMAx)

Function description

Get Channel 1 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF1 LL_DMA_IsActiveFlag_GI1

`LL_DMA_IsActiveFlag_GI2`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI2 (DMA_TypeDef * DMAx)

Function description

Get Channel 2 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF2 LL_DMA_IsActiveFlag_GI2

`LL_DMA_IsActiveFlag_GI3`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI3 (DMA_TypeDef * DMAx)

Function description

Get Channel 3 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF3 LL_DMA_IsActiveFlag_GI3

`LL_DMA_IsActiveFlag_GI4`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI4 (DMA_TypeDef * DMAx)

Function description

Get Channel 4 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF4 LL_DMA_IsActiveFlag_GI4

`LL_DMA_IsActiveFlag_GI5`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI5 (DMA_TypeDef * DMAx)

Function description

Get Channel 5 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF5 LL_DMA_IsActiveFlag_GI5

`LL_DMA_IsActiveFlag_GI6`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI6 (DMA_TypeDef * DMAx)

Function description

Get Channel 6 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF6 LL_DMA_IsActiveFlag_GI6

`LL_DMA_IsActiveFlag_GI7`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_GI7 (DMA_TypeDef * DMAx)

Function description

Get Channel 7 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR GIF7 LL_DMA_IsActiveFlag_GI7

`LL_DMA_IsActiveFlag_TC1`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC1 (DMA_TypeDef * DMAx)

Function description

Get Channel 1 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF1 LL_DMA_IsActiveFlag_TC1

`LL_DMA_IsActiveFlag_TC2`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC2 (DMA_TypeDef * DMAx)

Function description

Get Channel 2 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF2 LL_DMA_IsActiveFlag_TC2

`LL_DMA_IsActiveFlag_TC3`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC3 (DMA_TypeDef * DMAx)

Function description

Get Channel 3 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF3 LL_DMA_IsActiveFlag_TC3

`LL_DMA_IsActiveFlag_TC4`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC4 (DMA_TypeDef * DMAx)

Function description

Get Channel 4 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF4 LL_DMA_IsActiveFlag_TC4

`LL_DMA_IsActiveFlag_TC5`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC5 (DMA_TypeDef * DMAx)

Function description

Get Channel 5 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF5 LL_DMA_IsActiveFlag_TC5

`LL_DMA_IsActiveFlag_TC6`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC6 (DMA_TypeDef * DMAx)

Function description

Get Channel 6 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF6 LL_DMA_IsActiveFlag_TC6

`LL_DMA_IsActiveFlag_TC7`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TC7 (DMA_TypeDef * DMAx)

Function description

Get Channel 7 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCIF7 LL_DMA_IsActiveFlag_TC7

`LL_DMA_IsActiveFlag_HT1`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT1 (DMA_TypeDef * DMAx)

Function description

Get Channel 1 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF1 LL_DMA_IsActiveFlag_HT1

`LL_DMA_IsActiveFlag_HT2`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT2 (DMA_TypeDef * DMAx)

Function description

Get Channel 2 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF2 LL_DMA_IsActiveFlag_HT2

`LL_DMA_IsActiveFlag_HT3`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT3 (DMA_TypeDef * DMAx)

Function description

Get Channel 3 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF3 LL_DMA_IsActiveFlag_HT3

`LL_DMA_IsActiveFlag_HT4`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT4 (DMA_TypeDef * DMAx)

Function description

Get Channel 4 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF4 LL_DMA_IsActiveFlag_HT4

`LL_DMA_IsActiveFlag_HT5`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT5 (DMA_TypeDef * DMAx)

Function description

Get Channel 5 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF5 LL_DMA_IsActiveFlag_HT5

`LL_DMA_IsActiveFlag_HT6`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT6 (DMA_TypeDef * DMAx)

Function description

Get Channel 6 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF6 LL_DMA_IsActiveFlag_HT6

`LL_DMA_IsActiveFlag_HT7`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_HT7 (DMA_TypeDef * DMAx)

Function description

Get Channel 7 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR HTIF7 LL_DMA_IsActiveFlag_HT7

`LL_DMA_IsActiveFlag_TE1`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE1 (DMA_TypeDef * DMAx)

Function description

Get Channel 1 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF1 LL_DMA_IsActiveFlag_TE1

`LL_DMA_IsActiveFlag_TE2`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE2 (DMA_TypeDef * DMAx)

Function description

Get Channel 2 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF2 LL_DMA_IsActiveFlag_TE2

`LL_DMA_IsActiveFlag_TE3`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE3 (DMA_TypeDef * DMAx)

Function description

Get Channel 3 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF3 LL_DMA_IsActiveFlag_TE3

`LL_DMA_IsActiveFlag_TE4`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE4 (DMA_TypeDef * DMAx)

Function description

Get Channel 4 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF4 LL_DMA_IsActiveFlag_TE4

`LL_DMA_IsActiveFlag_TE5`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE5 (DMA_TypeDef * DMAx)

Function description

Get Channel 5 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF5 LL_DMA_IsActiveFlag_TE5

`LL_DMA_IsActiveFlag_TE6`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE6 (DMA_TypeDef * DMAx)

Function description

Get Channel 6 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF6 LL_DMA_IsActiveFlag_TE6

`LL_DMA_IsActiveFlag_TE7`

Function name

__STATIC_INLINE uint32_t LL_DMA_IsActiveFlag_TE7 (DMA_TypeDef * DMAx)

Function description

Get Channel 7 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEIF7 LL_DMA_IsActiveFlag_TE7

`LL_DMA_ClearFlag_GI1`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI1 (DMA_TypeDef * DMAx)

Function description

Clear Channel 1 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF1 LL_DMA_ClearFlag_GI1

`LL_DMA_ClearFlag_GI2`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI2 (DMA_TypeDef * DMAx)

Function description

Clear Channel 2 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF2 LL_DMA_ClearFlag_GI2

`LL_DMA_ClearFlag_GI3`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI3 (DMA_TypeDef * DMAx)

Function description

Clear Channel 3 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF3 LL_DMA_ClearFlag_GI3

`LL_DMA_ClearFlag_GI4`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI4 (DMA_TypeDef * DMAx)

Function description

Clear Channel 4 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF4 LL_DMA_ClearFlag_GI4

`LL_DMA_ClearFlag_GI5`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI5 (DMA_TypeDef * DMAx)

Function description

Clear Channel 5 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF5 LL_DMA_ClearFlag_GI5

`LL_DMA_ClearFlag_GI6`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI6 (DMA_TypeDef * DMAx)

Function description

Clear Channel 6 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF6 LL_DMA_ClearFlag_GI6

`LL_DMA_ClearFlag_GI7`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_GI7 (DMA_TypeDef * DMAx)

Function description

Clear Channel 7 global interrupt flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CGIF7 LL_DMA_ClearFlag_GI7

`LL_DMA_ClearFlag_TC1`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC1 (DMA_TypeDef * DMAx)

Function description

Clear Channel 1 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF1 LL_DMA_ClearFlag_TC1

`LL_DMA_ClearFlag_TC2`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC2 (DMA_TypeDef * DMAx)

Function description

Clear Channel 2 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF2 LL_DMA_ClearFlag_TC2

`LL_DMA_ClearFlag_TC3`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC3 (DMA_TypeDef * DMAx)

Function description

Clear Channel 3 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF3 LL_DMA_ClearFlag_TC3

`LL_DMA_ClearFlag_TC4`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC4 (DMA_TypeDef * DMAx)

Function description

Clear Channel 4 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF4 LL_DMA_ClearFlag_TC4

`LL_DMA_ClearFlag_TC5`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC5 (DMA_TypeDef * DMAx)

Function description

Clear Channel 5 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF5 LL_DMA_ClearFlag_TC5

`LL_DMA_ClearFlag_TC6`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC6 (DMA_TypeDef * DMAx)

Function description

Clear Channel 6 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF6 LL_DMA_ClearFlag_TC6

`LL_DMA_ClearFlag_TC7`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TC7 (DMA_TypeDef * DMAx)

Function description

Clear Channel 7 transfer complete flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTCIF7 LL_DMA_ClearFlag_TC7

`LL_DMA_ClearFlag_HT1`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT1 (DMA_TypeDef * DMAx)

Function description

Clear Channel 1 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF1 LL_DMA_ClearFlag_HT1

`LL_DMA_ClearFlag_HT2`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT2 (DMA_TypeDef * DMAx)

Function description

Clear Channel 2 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF2 LL_DMA_ClearFlag_HT2

`LL_DMA_ClearFlag_HT3`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT3 (DMA_TypeDef * DMAx)

Function description

Clear Channel 3 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF3 LL_DMA_ClearFlag_HT3

`LL_DMA_ClearFlag_HT4`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT4 (DMA_TypeDef * DMAx)

Function description

Clear Channel 4 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF4 LL_DMA_ClearFlag_HT4

`LL_DMA_ClearFlag_HT5`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT5 (DMA_TypeDef * DMAx)

Function description

Clear Channel 5 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF5 LL_DMA_ClearFlag_HT5

`LL_DMA_ClearFlag_HT6`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT6 (DMA_TypeDef * DMAx)

Function description

Clear Channel 6 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF6 LL_DMA_ClearFlag_HT6

`LL_DMA_ClearFlag_HT7`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_HT7 (DMA_TypeDef * DMAx)

Function description

Clear Channel 7 half transfer flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CHTIF7 LL_DMA_ClearFlag_HT7

`LL_DMA_ClearFlag_TE1`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE1 (DMA_TypeDef * DMAx)

Function description

Clear Channel 1 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF1 LL_DMA_ClearFlag_TE1

`LL_DMA_ClearFlag_TE2`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE2 (DMA_TypeDef * DMAx)

Function description

Clear Channel 2 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF2 LL_DMA_ClearFlag_TE2

`LL_DMA_ClearFlag_TE3`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE3 (DMA_TypeDef * DMAx)

Function description

Clear Channel 3 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF3 LL_DMA_ClearFlag_TE3

`LL_DMA_ClearFlag_TE4`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE4 (DMA_TypeDef * DMAx)

Function description

Clear Channel 4 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF4 LL_DMA_ClearFlag_TE4

`LL_DMA_ClearFlag_TE5`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE5 (DMA_TypeDef * DMAx)

Function description

Clear Channel 5 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF5 LL_DMA_ClearFlag_TE5

`LL_DMA_ClearFlag_TE6`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE6 (DMA_TypeDef * DMAx)

Function description

Clear Channel 6 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF6 LL_DMA_ClearFlag_TE6

`LL_DMA_ClearFlag_TE7`

Function name

__STATIC_INLINE void LL_DMA_ClearFlag_TE7 (DMA_TypeDef * DMAx)

Function description

Clear Channel 7 transfer error flag.

Parameters

- **DMAx:** DMAx Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IFCR CTEIF7 LL_DMA_ClearFlag_TE7

`LL_DMA_EnableIT_TC`

Function name

__STATIC_INLINE void LL_DMA_EnableIT_TC (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Enable Transfer complete interrupt.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR TCIE LL_DMA_EnableIT_TC

LL_DMA_EnableIT_HT

Function name

__STATIC_INLINE void LL_DMA_EnableIT_HT (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Enable Half transfer interrupt.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR HTIE LL_DMA_EnableIT_HT

LL_DMA_EnableIT_TE

Function name

__STATIC_INLINE void LL_DMA_EnableIT_TE (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Enable Transfer error interrupt.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR TEIE LL_DMA_EnableIT_TE

LL_DMA_DisableIT_TC

Function name

__STATIC_INLINE void LL_DMA_DisableIT_TC (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Disable Transfer complete interrupt.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR TCIE LL_DMA_DisableIT_TC

LL_DMA_DisableIT_HT

Function name

__STATIC_INLINE void LL_DMA_DisableIT_HT (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Disable Half transfer interrupt.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR HTIE LL_DMA_DisableIT_HT

LL_DMA_DisableIT_TE

Function name

__STATIC_INLINE void LL_DMA_DisableIT_TE (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Disable Transfer error interrupt.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCR TEIE LL_DMA_DisableIT_TE

LL_DMA_IsEnabledIT_TC

Function name

__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_TC (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Check if Transfer complete Interrupt is enabled.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCR TCIE LL_DMA_IsEnabledIT_TC

LL_DMA_IsEnabledIT_HT

Function name

__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_HT (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Check if Half transfer Interrupt is enabled.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCR HTIE LL_DMA_IsEnabledIT_HT

LL_DMA_IsEnabledIT_TE

Function name

__STATIC_INLINE uint32_t LL_DMA_IsEnabledIT_TE (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

Check if Transfer error Interrupt is enabled.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCR TEIE LL_DMA_IsEnabledIT_TE

LL_DMA_Init

Function name

ErrorStatus LL_DMA_Init (DMA_TypeDef * DMAx, uint32_t Channel, LL_DMA_InitTypeDef * DMA_InitStruct)

Function description

Initialize the DMA registers according to the specified parameters in DMA_InitStruct.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
- **DMA_InitStruct:** pointer to a LL_DMA_InitTypeDef structure.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: DMA registers are initialized
  - ERROR: Not applicable

Notes

- To convert DMAx_Channely Instance to DMAx Instance and Channely, use helper macros : __LL_DMA_GET_INSTANCE __LL_DMA_GET_CHANNEL

LL_DMA_DeInit

Function name

ErrorStatus LL_DMA_DeInit (DMA_TypeDef * DMAx, uint32_t Channel)

Function description

De-initialize the DMA registers to their default reset values.

Parameters

- **DMAx:** DMAx Instance
- **Channel:** This parameter can be one of the following values:
  - LL_DMA_CHANNEL_1
  - LL_DMA_CHANNEL_2
  - LL_DMA_CHANNEL_3
  - LL_DMA_CHANNEL_4
  - LL_DMA_CHANNEL_5
  - LL_DMA_CHANNEL_6
  - LL_DMA_CHANNEL_7
  - LL_DMA_CHANNEL_ALL

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: DMA registers are de-initialized
  - ERROR: DMA registers are not de-initialized

`LL_DMA_StructInit`

Function name

void LL_DMA_StructInit (LL_DMA_InitTypeDef * DMA_InitStruct)

Function description

Set each LL_DMA_InitTypeDef field to default value.

Parameters

- **DMA_InitStruct:** Pointer to a LL_DMA_InitTypeDef structure.

Return values

- **None:**

89.3 DMA Firmware driver defines

The following section lists the various define and macros of the module.

89.3.1 DMA

DMA

CHANNEL

LL_DMA_CHANNEL_1

DMA Channel 1

LL_DMA_CHANNEL_2

DMA Channel 2

LL_DMA_CHANNEL_3

DMA Channel 3

LL_DMA_CHANNEL_4

DMA Channel 4

LL_DMA_CHANNEL_5

DMA Channel 5

LL_DMA_CHANNEL_6

DMA Channel 6

LL_DMA_CHANNEL_7

DMA Channel 7

LL_DMA_CHANNEL_ALL

DMA Channel all (used only for function

Clear Flags Defines

LL_DMA_IFCR_CGIF1

Channel 1 global flag

LL_DMA_IFCR_CTCIF1

Channel 1 transfer complete flag

LL_DMA_IFCR_CHTIF1

Channel 1 half transfer flag

LL_DMA_IFCR_CTEIF1

Channel 1 transfer error flag

LL_DMA_IFCR_CGIF2

Channel 2 global flag

LL_DMA_IFCR_CTCIF2

Channel 2 transfer complete flag

LL_DMA_IFCR_CHTIF2

Channel 2 half transfer flag

LL_DMA_IFCR_CTEIF2

Channel 2 transfer error flag

LL_DMA_IFCR_CGIF3

Channel 3 global flag

LL_DMA_IFCR_CTCIF3

Channel 3 transfer complete flag

LL_DMA_IFCR_CHTIF3

Channel 3 half transfer flag

LL_DMA_IFCR_CTEIF3

Channel 3 transfer error flag

LL_DMA_IFCR_CGIF4

Channel 4 global flag

LL_DMA_IFCR_CTCIF4

Channel 4 transfer complete flag

LL_DMA_IFCR_CHTIF4

Channel 4 half transfer flag

LL_DMA_IFCR_CTEIF4

Channel 4 transfer error flag

LL_DMA_IFCR_CGIF5

Channel 5 global flag

LL_DMA_IFCR_CTCIF5

Channel 5 transfer complete flag

LL_DMA_IFCR_CHTIF5

Channel 5 half transfer flag

LL_DMA_IFCR_CTEIF5

Channel 5 transfer error flag

LL_DMA_IFCR_CGIF6

Channel 6 global flag

LL_DMA_IFCR_CTCIF6

Channel 6 transfer complete flag

LL_DMA_IFCR_CHTIF6

Channel 6 half transfer flag

LL_DMA_IFCR_CTEIF6

Channel 6 transfer error flag

LL_DMA_IFCR_CGIF7

Channel 7 global flag

LL_DMA_IFCR_CTCIF7

Channel 7 transfer complete flag

LL_DMA_IFCR_CHTIF7

Channel 7 half transfer flag

LL_DMA_IFCR_CTEIF7

Channel 7 transfer error flag

Transfer Direction

LL_DMA_DIRECTION_PERIPH_TO_MEMORY

Peripheral to memory direction

LL_DMA_DIRECTION_MEMORY_TO_PERIPH

Memory to peripheral direction

LL_DMA_DIRECTION_MEMORY_TO_MEMORY

Memory to memory direction

Get Flags Defines

LL_DMA_ISR_GIF1

Channel 1 global flag

LL_DMA_ISR_TCIF1

Channel 1 transfer complete flag

LL_DMA_ISR_HTIF1

Channel 1 half transfer flag

LL_DMA_ISR_TEIF1

Channel 1 transfer error flag

LL_DMA_ISR_GIF2

Channel 2 global flag

LL_DMA_ISR_TCIF2

Channel 2 transfer complete flag

LL_DMA_ISR_HTIF2

Channel 2 half transfer flag

LL_DMA_ISR_TEIF2

Channel 2 transfer error flag

LL_DMA_ISR_GIF3

Channel 3 global flag

LL_DMA_ISR_TCIF3

Channel 3 transfer complete flag

LL_DMA_ISR_HTIF3

Channel 3 half transfer flag

LL_DMA_ISR_TEIF3

Channel 3 transfer error flag

LL_DMA_ISR_GIF4

Channel 4 global flag

LL_DMA_ISR_TCIF4

Channel 4 transfer complete flag

LL_DMA_ISR_HTIF4

Channel 4 half transfer flag

LL_DMA_ISR_TEIF4

Channel 4 transfer error flag

LL_DMA_ISR_GIF5

Channel 5 global flag

LL_DMA_ISR_TCIF5

Channel 5 transfer complete flag

LL_DMA_ISR_HTIF5

Channel 5 half transfer flag

LL_DMA_ISR_TEIF5

Channel 5 transfer error flag

LL_DMA_ISR_GIF6

Channel 6 global flag

LL_DMA_ISR_TCIF6

Channel 6 transfer complete flag

LL_DMA_ISR_HTIF6

Channel 6 half transfer flag

LL_DMA_ISR_TEIF6

Channel 6 transfer error flag

LL_DMA_ISR_GIF7

Channel 7 global flag

LL_DMA_ISR_TCIF7

Channel 7 transfer complete flag

LL_DMA_ISR_HTIF7

Channel 7 half transfer flag

LL_DMA_ISR_TEIF7

Channel 7 transfer error flag

IT Defines

LL_DMA_CCR_TCIE

Transfer complete interrupt

LL_DMA_CCR_HTIE

Half Transfer interrupt

LL_DMA_CCR_TEIE

Transfer error interrupt

Memory data alignment

LL_DMA_MDATAALIGN_BYTE

Memory data alignment : Byte

LL_DMA_MDATAALIGN_HALFWORD

Memory data alignment : HalfWord

LL_DMA_MDATAALIGN_WORD

Memory data alignment : Word

Memory increment mode

LL_DMA_MEMORY_INCREMENT

Memory increment mode Enable

LL_DMA_MEMORY_NOINCREMENT

Memory increment mode Disable

Transfer mode

LL_DMA_MODE_NORMAL

Normal Mode

LL_DMA_MODE_CIRCULAR

Circular Mode

Peripheral data alignment

LL_DMA_PDATAALIGN_BYTE

Peripheral data alignment : Byte

LL_DMA_PDATAALIGN_HALFWORD

Peripheral data alignment : HalfWord

LL_DMA_PDATAALIGN_WORD

Peripheral data alignment : Word

Peripheral increment mode

LL_DMA_PERIPH_INCREMENT

Peripheral increment mode Enable

LL_DMA_PERIPH_NOINCREMENT

Peripheral increment mode Disable

Transfer Priority level

LL_DMA_PRIORITY_LOW

Priority level : Low

LL_DMA_PRIORITY_MEDIUM

Priority level : Medium

LL_DMA_PRIORITY_HIGH

Priority level : High

LL_DMA_PRIORITY_VERYHIGH

Priority level : Very_High

Convert DMAxChannely

__LL_DMA_GET_INSTANCE

Description:

- Convert DMAx_Channely into DMAx.

Parameters:

- __CHANNEL_INSTANCE__: DMAx_Channely

Return value:

- DMAx

__LL_DMA_GET_CHANNEL

Description:

- Convert DMAx_Channely into LL_DMA_CHANNEL_y.

Parameters:

- __CHANNEL_INSTANCE__: DMAx_Channely

Return value:

- LL_DMA_CHANNEL_y

__LL_DMA_GET_CHANNEL_INSTANCE

Description:

- Convert DMA Instance DMAx and LL_DMA_CHANNEL_y into DMAx_Channely.

Parameters:

- __DMA_INSTANCE__: DMAx
- __CHANNEL__: LL_DMA_CHANNEL_y

Return value:

- DMAx_Channely

Common Write and read registers macros

LL_DMA_WriteReg

Description:

- Write a value in DMA register.

Parameters:

- __INSTANCE__: DMA Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_DMA_ReadReg

Description:

- Read a value in DMA register.

Parameters:

- __INSTANCE__: DMA Instance
- __REG__: Register to be read

Return value:

- Register: value

90 LL EXTI Generic Driver

90.1 EXTI Firmware driver registers structures

90.1.1 LL_EXTI_InitTypeDef

LL_EXTI_InitTypeDef is defined in the stm32l4xx_ll_exti.h

Data Fields

- ***uint32_t Line_0_31***
- ***uint32_t Line_32_63***
- ***FunctionalState LineCommand***
- ***uint8_t Mode***
- ***uint8_t Trigger***

Field Documentation

- ***uint32_t LL_EXTI_InitTypeDef::Line_0_31***
  Specifies the EXTI lines to be enabled or disabled for Lines in range 0 to 31 This parameter can be any combination of ***EXTI_LL_EC_LINE***
- ***uint32_t LL_EXTI_InitTypeDef::Line_32_63***
  Specifies the EXTI lines to be enabled or disabled for Lines in range 32 to 63 This parameter can be any combination of ***EXTI_LL_EC_LINE***
- ***FunctionalState LL_EXTI_InitTypeDef::LineCommand***
  Specifies the new state of the selected EXTI lines. This parameter can be set either to ENABLE or DISABLE
- ***uint8_t LL_EXTI_InitTypeDef::Mode***
  Specifies the mode for the EXTI lines. This parameter can be a value of ***EXTI_LL_EC_MODE***.
- ***uint8_t LL_EXTI_InitTypeDef::Trigger***
  Specifies the trigger signal active edge for the EXTI lines. This parameter can be a value of ***EXTI_LL_EC_TRIGGER***.

90.2 EXTI Firmware driver API description

The following section lists the various functions of the EXTI library.

90.2.1 Detailed description of functions

`LL_EXTI_EnableIT_0_31`

Function name

__STATIC_INLINE void LL_EXTI_EnableIT_0_31 (uint32_t ExtiLine)

Function description

Enable ExtiLine Interrupt request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_17
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_23
  - LL_EXTI_LINE_24
  - LL_EXTI_LINE_25
  - LL_EXTI_LINE_26
  - LL_EXTI_LINE_27
  - LL_EXTI_LINE_28
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31
  - LL_EXTI_LINE_ALL_0_31

Return values

- **None:**

Notes

- The reset value for the direct or internal lines (see RM) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- IMR1 IMx LL_EXTI_EnableIT_0_31

LL_EXTI_EnableIT_32_63

Function name

__STATIC_INLINE void LL_EXTI_EnableIT_32_63 (uint32_t ExtiLine)

Function description

Enable ExtiLine Interrupt request for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_32
  - LL_EXTI_LINE_33
  - LL_EXTI_LINE_34(*)
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38
  - LL_EXTI_LINE_39(*)
  - LL_EXTI_LINE_40(*)
  - LL_EXTI_LINE_ALL_32_63

Return values

- **None:**

Notes

- The reset value for the direct lines (lines from 32 to 34, line 39) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- (*): Available in some devices

Reference Manual to LL API cross reference:

- IMR2 IMx LL_EXTI_EnableIT_32_63

LL_EXTI_DisableIT_0_31

Function name

__STATIC_INLINE void LL_EXTI_DisableIT_0_31 (uint32_t ExtiLine)

Function description

Disable ExtiLine Interrupt request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_17
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_23
  - LL_EXTI_LINE_24
  - LL_EXTI_LINE_25
  - LL_EXTI_LINE_26
  - LL_EXTI_LINE_27
  - LL_EXTI_LINE_28
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31
  - LL_EXTI_LINE_ALL_0_31

Return values

- **None:**

Notes

- The reset value for the direct or internal lines (see RM) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- IMR1 IMx LL_EXTI_DisableIT_0_31

`LL_EXTI_DisableIT_32_63`

Function name

__STATIC_INLINE void LL_EXTI_DisableIT_32_63 (uint32_t ExtiLine)

Function description

Disable ExtiLine Interrupt request for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_32
  - LL_EXTI_LINE_33
  - LL_EXTI_LINE_34(*)
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38
  - LL_EXTI_LINE_39(*)
  - LL_EXTI_LINE_40(*)
  - LL_EXTI_LINE_ALL_32_63

Return values

- **None:**

Notes

- The reset value for the direct lines (lines from 32 to 34, line 39) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- (*): Available in some devices

Reference Manual to LL API cross reference:

- IMR2 IMx LL_EXTI_DisableIT_32_63

LL_EXTI_IsEnabledIT_0_31

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledIT_0_31 (uint32_t ExtiLine)

Function description

Indicate if ExtiLine Interrupt request is enabled for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_17
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_23
  - LL_EXTI_LINE_24
  - LL_EXTI_LINE_25
  - LL_EXTI_LINE_26
  - LL_EXTI_LINE_27
  - LL_EXTI_LINE_28
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31
  - LL_EXTI_LINE_ALL_0_31

Return values

- **State:** of bit (1 or 0).

Notes

- The reset value for the direct or internal lines (see RM) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- IMR1 IMx LL_EXTI_IsEnabledIT_0_31

`LL_EXTI_IsEnabledIT_32_63`

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledIT_32_63 (uint32_t ExtiLine)

Function description

Indicate if ExtiLine Interrupt request is enabled for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_32
  - LL_EXTI_LINE_33
  - LL_EXTI_LINE_34(*)
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38
  - LL_EXTI_LINE_39(*)
  - LL_EXTI_LINE_40(*)
  - LL_EXTI_LINE_ALL_32_63

Return values

- **State:** of bit (1 or 0).

Notes

- The reset value for the direct lines (lines from 32 to 34, line 39) is set to 1 in order to enable the interrupt by default. Bits are set automatically at Power on.
- (*): Available in some devices

Reference Manual to LL API cross reference:

- IMR2 IMx LL_EXTI_IsEnabledIT_32_63

LL_EXTI_EnableEvent_0_31

Function name

__STATIC_INLINE void LL_EXTI_EnableEvent_0_31 (uint32_t ExtiLine)

Function description

Enable ExtiLine Event request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_17
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_23
  - LL_EXTI_LINE_24
  - LL_EXTI_LINE_25
  - LL_EXTI_LINE_26
  - LL_EXTI_LINE_27
  - LL_EXTI_LINE_28
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31
  - LL_EXTI_LINE_ALL_0_31

Return values

- **None:**

Notes

- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- EMR1 EMx LL_EXTI_EnableEvent_0_31

`LL_EXTI_EnableEvent_32_63`

Function name

__STATIC_INLINE void LL_EXTI_EnableEvent_32_63 (uint32_t ExtiLine)

Function description

Enable ExtiLine Event request for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_32
  - LL_EXTI_LINE_33
  - LL_EXTI_LINE_34(*)
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38
  - LL_EXTI_LINE_39(*)
  - LL_EXTI_LINE_40(*)
  - LL_EXTI_LINE_ALL_32_63

Return values

- **None:**

Notes

- (*): Available in some devices

Reference Manual to LL API cross reference:

- EMR2 EMx LL_EXTI_EnableEvent_32_63

LL_EXTI_DisableEvent_0_31

Function name

__STATIC_INLINE void LL_EXTI_DisableEvent_0_31 (uint32_t ExtiLine)

Function description

Disable ExtiLine Event request for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_17
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_23
  - LL_EXTI_LINE_24
  - LL_EXTI_LINE_25
  - LL_EXTI_LINE_26
  - LL_EXTI_LINE_27
  - LL_EXTI_LINE_28
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31
  - LL_EXTI_LINE_ALL_0_31

Return values

- **None:**

Notes

- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- EMR1 EMx LL_EXTI_DisableEvent_0_31

`LL_EXTI_DisableEvent_32_63`

Function name

__STATIC_INLINE void LL_EXTI_DisableEvent_32_63 (uint32_t ExtiLine)

Function description

Disable ExtiLine Event request for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_32
  - LL_EXTI_LINE_33
  - LL_EXTI_LINE_34(*)
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38
  - LL_EXTI_LINE_39(*)
  - LL_EXTI_LINE_40(*)
  - LL_EXTI_LINE_ALL_32_63

Return values

- **None:**

Notes

- (*): Available in some devices

Reference Manual to LL API cross reference:

- EMR2 EMx LL_EXTI_DisableEvent_32_63

LL_EXTI_IsEnabledEvent_0_31

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledEvent_0_31 (uint32_t ExtiLine)

Function description

Indicate if ExtiLine Event request is enabled for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be one of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_17
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_23
  - LL_EXTI_LINE_24
  - LL_EXTI_LINE_25
  - LL_EXTI_LINE_26
  - LL_EXTI_LINE_27
  - LL_EXTI_LINE_28
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31
  - LL_EXTI_LINE_ALL_0_31

Return values

- **State:** of bit (1 or 0).

Notes

- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- EMR1 EMx LL_EXTI_IsEnabledEvent_0_31

`LL_EXTI_IsEnabledEvent_32_63`

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledEvent_32_63 (uint32_t ExtiLine)

Function description

Indicate if ExtiLine Event request is enabled for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_32
  - LL_EXTI_LINE_33
  - LL_EXTI_LINE_34(*)
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38
  - LL_EXTI_LINE_39(*)
  - LL_EXTI_LINE_40(*)
  - LL_EXTI_LINE_ALL_32_63

Return values

- **State:** of bit (1 or 0).

Notes

- (*): Available in some devices

Reference Manual to LL API cross reference:

- EMR2 EMx LL_EXTI_IsEnabledEvent_32_63

LL_EXTI_EnableRisingTrig_0_31

Function name

__STATIC_INLINE void LL_EXTI_EnableRisingTrig_0_31 (uint32_t ExtiLine)

Function description

Enable ExtiLine Rising Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a rising edge on a configurable interrupt line occurs during a write operation in the EXTI_RTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- RTSR1 RTx LL_EXTI_EnableRisingTrig_0_31

LL_EXTI_EnableRisingTrig_32_63

Function name

__STATIC_INLINE void LL_EXTI_EnableRisingTrig_32_63 (uint32_t ExtiLine)

Function description

Enable ExtiLine Rising Edge Trigger for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a rising edge on a configurable interrupt line occurs during a write operation in the EXTI_RTSR register, the pending bit is not set.Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.

Reference Manual to LL API cross reference:

- RTSR2 RTx LL_EXTI_EnableRisingTrig_32_63

`LL_EXTI_DisableRisingTrig_0_31`

Function name

__STATIC_INLINE void LL_EXTI_DisableRisingTrig_0_31 (uint32_t ExtiLine)

Function description

Disable ExtiLine Rising Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a rising edge on a configurable interrupt line occurs during a write operation in the EXTI_RTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- RTSR1 RTx LL_EXTI_DisableRisingTrig_0_31

LL_EXTI_DisableRisingTrig_32_63

Function name

__STATIC_INLINE void LL_EXTI_DisableRisingTrig_32_63 (uint32_t ExtiLine)

Function description

Disable ExtiLine Rising Edge Trigger for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a rising edge on a configurable interrupt line occurs during a write operation in the EXTI_RTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.

Reference Manual to LL API cross reference:

- RTSR2 RTx LL_EXTI_DisableRisingTrig_32_63

LL_EXTI_IsEnabledRisingTrig_0_31

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledRisingTrig_0_31 (uint32_t ExtiLine)

Function description

Check if rising edge trigger is enabled for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **State:** of bit (1 or 0).

Notes

- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- RTSR1 RTx LL_EXTI_IsEnabledRisingTrig_0_31

LL_EXTI_IsEnabledRisingTrig_32_63

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledRisingTrig_32_63 (uint32_t ExtiLine)

Function description

Check if rising edge trigger is enabled for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RTSR2 RTx LL_EXTI_IsEnabledRisingTrig_32_63

LL_EXTI_EnableFallingTrig_0_31

Function name

__STATIC_INLINE void LL_EXTI_EnableFallingTrig_0_31 (uint32_t ExtiLine)

Function description

Enable ExtiLine Falling Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a falling edge on a configurable interrupt line occurs during a write operation in the EXTI_FTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- FTSR1 FTx LL_EXTI_EnableFallingTrig_0_31

LL_EXTI_EnableFallingTrig_32_63

Function name

__STATIC_INLINE void LL_EXTI_EnableFallingTrig_32_63 (uint32_t ExtiLine)

Function description

Enable ExtiLine Falling Edge Trigger for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a Falling edge on a configurable interrupt line occurs during a write operation in the EXTI_FTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.

Reference Manual to LL API cross reference:

- FTSR2 FTx LL_EXTI_EnableFallingTrig_32_63

LL_EXTI_DisableFallingTrig_0_31

Function name

__STATIC_INLINE void LL_EXTI_DisableFallingTrig_0_31 (uint32_t ExtiLine)

Function description

Disable ExtiLine Falling Edge Trigger for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a Falling edge on a configurable interrupt line occurs during a write operation in the EXTI_FTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- FTSR1 FTx LL_EXTI_DisableFallingTrig_0_31

LL_EXTI_DisableFallingTrig_32_63

Function name

__STATIC_INLINE void LL_EXTI_DisableFallingTrig_32_63 (uint32_t ExtiLine)

Function description

Disable ExtiLine Falling Edge Trigger for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **None:**

Notes

- The configurable wakeup lines are edge-triggered. No glitch must be generated on these lines. If a Falling edge on a configurable interrupt line occurs during a write operation in the EXTI_FTSR register, the pending bit is not set. Rising and falling edge triggers can be set for the same interrupt line. In this case, both generate a trigger condition.

Reference Manual to LL API cross reference:

- FTSR2 FTx LL_EXTI_DisableFallingTrig_32_63

LL_EXTI_IsEnabledFallingTrig_0_31

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledFallingTrig_0_31 (uint32_t ExtiLine)

Function description

Check if falling edge trigger is enabled for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **State:** of bit (1 or 0).

Notes

- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- FTSR1 FTx LL_EXTI_IsEnabledFallingTrig_0_31

LL_EXTI_IsEnabledFallingTrig_32_63

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsEnabledFallingTrig_32_63 (uint32_t ExtiLine)

Function description

Check if falling edge trigger is enabled for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- FTSR2 FTx LL_EXTI_IsEnabledFallingTrig_32_63

LL_EXTI_GenerateSWI_0_31

Function name

__STATIC_INLINE void LL_EXTI_GenerateSWI_0_31 (uint32_t ExtiLine)

Function description

Generate a software Interrupt Event for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **None:**

Notes

- If the interrupt is enabled on this line in the EXTI_IMR1, writing a 1 to this bit when it is at '0' sets the corresponding pending bit in EXTI_PR1 resulting in an interrupt request generation. This bit is cleared by clearing the corresponding bit in the EXTI_PR1 register (by writing a 1 into the bit)
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- SWIER1 SWIx LL_EXTI_GenerateSWI_0_31

`LL_EXTI_GenerateSWI_32_63`

Function name

__STATIC_INLINE void LL_EXTI_GenerateSWI_32_63 (uint32_t ExtiLine)

Function description

Generate a software Interrupt Event for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **None:**

Notes

- If the interrupt is enabled on this line inthe EXTI_IMR2, writing a 1 to this bit when it is at '0' sets the corresponding pending bit in EXTI_PR2 resulting in an interrupt request generation. This bit is cleared by clearing the corresponding bit in the EXTI_PR2 register (by writing a 1 into the bit)

Reference Manual to LL API cross reference:

- SWIER2 SWIx LL_EXTI_GenerateSWI_32_63

`LL_EXTI_IsActiveFlag_0_31`

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsActiveFlag_0_31 (uint32_t ExtiLine)

Function description

Check if the ExtLine Flag is set or not for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **State:** of bit (1 or 0).

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- PR1 PIFx LL_EXTI_IsActiveFlag_0_31

`LL_EXTI_IsActiveFlag_32_63`

Function name

__STATIC_INLINE uint32_t LL_EXTI_IsActiveFlag_32_63 (uint32_t ExtiLine)

Function description

Check if the ExtLine Flag is set or not for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **State:** of bit (1 or 0).

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.

Reference Manual to LL API cross reference:

- PR2 PIFx LL_EXTI_IsActiveFlag_32_63

LL_EXTI_ReadFlag_0_31

Function name

__STATIC_INLINE uint32_t LL_EXTI_ReadFlag_0_31 (uint32_t ExtiLine)

Function description

Read ExtLine Combination Flag for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **@note:** This bit is set when the selected edge event arrives on the interrupt

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- PR1 PIFx LL_EXTI_ReadFlag_0_31

LL_EXTI_ReadFlag_32_63

Function name

__STATIC_INLINE uint32_t LL_EXTI_ReadFlag_32_63 (uint32_t ExtiLine)

Function description

Read ExtLine Combination Flag for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **@note:** This bit is set when the selected edge event arrives on the interrupt

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.

Reference Manual to LL API cross reference:

- PR2 PIFx LL_EXTI_ReadFlag_32_63

LL_EXTI_ClearFlag_0_31

Function name

__STATIC_INLINE void LL_EXTI_ClearFlag_0_31 (uint32_t ExtiLine)

Function description

Clear ExtLine Flags for Lines in range 0 to 31.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_0
  - LL_EXTI_LINE_1
  - LL_EXTI_LINE_2
  - LL_EXTI_LINE_3
  - LL_EXTI_LINE_4
  - LL_EXTI_LINE_5
  - LL_EXTI_LINE_6
  - LL_EXTI_LINE_7
  - LL_EXTI_LINE_8
  - LL_EXTI_LINE_9
  - LL_EXTI_LINE_10
  - LL_EXTI_LINE_11
  - LL_EXTI_LINE_12
  - LL_EXTI_LINE_13
  - LL_EXTI_LINE_14
  - LL_EXTI_LINE_15
  - LL_EXTI_LINE_16
  - LL_EXTI_LINE_18
  - LL_EXTI_LINE_19
  - LL_EXTI_LINE_20
  - LL_EXTI_LINE_21
  - LL_EXTI_LINE_22
  - LL_EXTI_LINE_29
  - LL_EXTI_LINE_30
  - LL_EXTI_LINE_31

Return values

- **None:**

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.
- Please check each device line mapping for EXTI Line availability

Reference Manual to LL API cross reference:

- PR1 PIFx LL_EXTI_ClearFlag_0_31

`LL_EXTI_ClearFlag_32_63`

Function name

__STATIC_INLINE void LL_EXTI_ClearFlag_32_63 (uint32_t ExtiLine)

Function description

Clear ExtLine Flags for Lines in range 32 to 63.

Parameters

- **ExtiLine:** This parameter can be a combination of the following values:
  - LL_EXTI_LINE_35
  - LL_EXTI_LINE_36
  - LL_EXTI_LINE_37
  - LL_EXTI_LINE_38

Return values

- **None:**

Notes

- This bit is set when the selected edge event arrives on the interrupt line. This bit is cleared by writing a 1 to the bit.

Reference Manual to LL API cross reference:

- PR2 PIFx LL_EXTI_ClearFlag_32_63

`LL_EXTI_Init`

Function name

uint32_t LL_EXTI_Init (LL_EXTI_InitTypeDef * EXTI_InitStruct)

Function description

Initialize the EXTI registers according to the specified parameters in EXTI_InitStruct.

Parameters

- **EXTI_InitStruct:** pointer to a LL_EXTI_InitTypeDef structure.

Return values

- **An:** ErrorStatus enumeration value:
  - 0x00: EXTI registers are initialized
  - any other calue : wrong configuration

`LL_EXTI_DeInit`

Function name

uint32_t LL_EXTI_DeInit (void)

Function description

De-initialize the EXTI registers to their default reset values.

Return values

- **An:** ErrorStatus enumeration value:
  - 0x00: EXTI registers are de-initialized

`LL_EXTI_StructInit`

Function name

void LL_EXTI_StructInit (LL_EXTI_InitTypeDef * EXTI_InitStruct)

Function description

Set each LL_EXTI_InitTypeDef field to default value.

Parameters

- **EXTI_InitStruct:** Pointer to a LL_EXTI_InitTypeDef structure.

Return values

- **None:**

90.3 EXTI Firmware driver defines

The following section lists the various define and macros of the module.

90.3.1 EXTI

EXTI

LINE

LL_EXTI_LINE_0

Extended line 0

LL_EXTI_LINE_1

Extended line 1

LL_EXTI_LINE_2

Extended line 2

LL_EXTI_LINE_3

Extended line 3

LL_EXTI_LINE_4

Extended line 4

LL_EXTI_LINE_5

Extended line 5

LL_EXTI_LINE_6

Extended line 6

LL_EXTI_LINE_7

Extended line 7

LL_EXTI_LINE_8

Extended line 8

LL_EXTI_LINE_9

Extended line 9

LL_EXTI_LINE_10

Extended line 10

LL_EXTI_LINE_11

Extended line 11

LL_EXTI_LINE_12

Extended line 12

LL_EXTI_LINE_13

Extended line 13

LL_EXTI_LINE_14

Extended line 14

LL_EXTI_LINE_15

Extended line 15

LL_EXTI_LINE_16

Extended line 16

LL_EXTI_LINE_17

Extended line 17

LL_EXTI_LINE_18

Extended line 18

LL_EXTI_LINE_19

Extended line 19

LL_EXTI_LINE_20

Extended line 20

LL_EXTI_LINE_21

Extended line 21

LL_EXTI_LINE_22

Extended line 22

LL_EXTI_LINE_23

Extended line 23

LL_EXTI_LINE_24

Extended line 24

LL_EXTI_LINE_25

Extended line 25

LL_EXTI_LINE_26

Extended line 26

LL_EXTI_LINE_27

Extended line 27

LL_EXTI_LINE_28

Extended line 28

LL_EXTI_LINE_29

Extended line 29

LL_EXTI_LINE_30

Extended line 30

LL_EXTI_LINE_31

Extended line 31

LL_EXTI_LINE_ALL_0_31

All Extended line not reserved

LL_EXTI_LINE_32

Extended line 32

LL_EXTI_LINE_33

Extended line 33

LL_EXTI_LINE_35

Extended line 35

LL_EXTI_LINE_36

Extended line 36

LL_EXTI_LINE_37

Extended line 37

LL_EXTI_LINE_38

Extended line 38

LL_EXTI_LINE_40

Extended line 40

LL_EXTI_LINE_ALL_32_63

All Extended line not reserved

LL_EXTI_LINE_ALL

All Extended line

LL_EXTI_LINE_NONE

None Extended line

Mode

LL_EXTI_MODE_IT

Interrupt Mode

LL_EXTI_MODE_EVENT

Event Mode

LL_EXTI_MODE_IT_EVENT

Interrupt & Event Mode

Edge Trigger

LL_EXTI_TRIGGER_NONE

No Trigger Mode

LL_EXTI_TRIGGER_RISING

Trigger Rising Mode

LL_EXTI_TRIGGER_FALLING

Trigger Falling Mode

LL_EXTI_TRIGGER_RISING_FALLING

Trigger Rising & Falling Mode

Common Write and read registers Macros

LL_EXTI_WriteReg

Description:

- Write a value in EXTI register.

Parameters:

- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_EXTI_ReadReg

Description:

- Read a value in EXTI register.

Parameters:

- __REG__: Register to be read

Return value:

- Register: value

91 LL GPIO Generic Driver

91.1 GPIO Firmware driver registers structures

91.1.1 LL_GPIO_InitTypeDef

LL_GPIO_InitTypeDef is defined in the stm32l4xx_ll_gpio.h

Data Fields

- ***uint32_t Pin***
- ***uint32_t Mode***
- ***uint32_t Speed***
- ***uint32_t OutputType***
- ***uint32_t Pull***
- ***uint32_t Alternate***

Field Documentation

- ***uint32_t LL_GPIO_InitTypeDef::Pin***

  Specifies the GPIO pins to be configured. This parameter can be any value of *GPIO_LL_EC_PIN*
- ***uint32_t LL_GPIO_InitTypeDef::Mode***

  Specifies the operating mode for the selected pins. This parameter can be a value of *GPIO_LL_EC_MODE*.GPIO HW configuration can be modified afterwards using unitary function **LL_GPIO_SetPinMode()**.
- ***uint32_t LL_GPIO_InitTypeDef::Speed***

  Specifies the speed for the selected pins. This parameter can be a value of *GPIO_LL_EC_SPEED*.GPIO HW configuration can be modified afterwards using unitary function **LL_GPIO_SetPinSpeed()**.
- ***uint32_t LL_GPIO_InitTypeDef::OutputType***

  Specifies the operating output type for the selected pins. This parameter can be a value of *GPIO_LL_EC_OUTPUT*.GPIO HW configuration can be modified afterwards using unitary function **LL_GPIO_SetPinOutputType()**.
- ***uint32_t LL_GPIO_InitTypeDef::Pull***

  Specifies the operating Pull-up/Pull down for the selected pins. This parameter can be a value of *GPIO_LL_EC_PULL*.GPIO HW configuration can be modified afterwards using unitary function **LL_GPIO_SetPinPull()**.
- ***uint32_t LL_GPIO_InitTypeDef::Alternate***

  Specifies the Peripheral to be connected to the selected pins. This parameter can be a value of *GPIO_LL_EC_AF*.GPIO HW configuration can be modified afterwards using unitary function **LL_GPIO_SetAFPin_0_7()** and **LL_GPIO_SetAFPin_8_15()**.

91.2 GPIO Firmware driver API description

The following section lists the various functions of the GPIO library.

91.2.1 Detailed description of functions

`LL_GPIO_SetPinMode`

Function name

__STATIC_INLINE void LL_GPIO_SetPinMode (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Mode)

Function description

Configure gpio mode for a dedicated pin on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
- **Mode:** This parameter can be one of the following values:
  - LL_GPIO_MODE_INPUT
  - LL_GPIO_MODE_OUTPUT
  - LL_GPIO_MODE_ALTERNATE
  - LL_GPIO_MODE_ANALOG

Return values

- **None:**

Notes

- I/O mode can be Input mode, General purpose output, Alternate function mode or Analog.
- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- MODER MODEy LL_GPIO_SetPinMode

LL_GPIO_GetPinMode

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetPinMode (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio mode for a dedicated pin on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15

Return values

- **Returned:** value can be one of the following values:
  - LL_GPIO_MODE_INPUT
  - LL_GPIO_MODE_OUTPUT
  - LL_GPIO_MODE_ALTERNATE
  - LL_GPIO_MODE_ANALOG

Notes

- I/O mode can be Input mode, General purpose output, Alternate function mode or Analog.
- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- MODER MODEy LL_GPIO_GetPinMode

LL_GPIO_SetPinOutputType

Function name

__STATIC_INLINE void LL_GPIO_SetPinOutputType (GPIO_TypeDef * GPIOx, uint32_t PinMask, uint32_t OutputType)

Function description

Configure gpio output type for several pins on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL
- **OutputType:** This parameter can be one of the following values:
  - LL_GPIO_OUTPUT_PUSHPULL
  - LL_GPIO_OUTPUT_OPENDRAIN

Return values

- **None:**

Notes

- Output type as to be set when gpio pin is in output or alternate modes. Possible type are Push-pull or Open-drain.

Reference Manual to LL API cross reference:

- OTYPER OTy LL_GPIO_SetPinOutputType

`LL_GPIO_GetPinOutputType`

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetPinOutputType (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio output type for several pins on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **Returned:** value can be one of the following values:
  - LL_GPIO_OUTPUT_PUSHPULL
  - LL_GPIO_OUTPUT_OPENDRAIN

Notes

- Output type as to be set when gpio pin is in output or alternate modes. Possible type are Push-pull or Open-drain.
- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- OTYPER OTy LL_GPIO_GetPinOutputType

LL_GPIO_SetPinSpeed

Function name

__STATIC_INLINE void LL_GPIO_SetPinSpeed (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Speed)

Function description

Configure gpio speed for a dedicated pin on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
- **Speed:** This parameter can be one of the following values:
  - LL_GPIO_SPEED_FREQ_LOW
  - LL_GPIO_SPEED_FREQ_MEDIUM
  - LL_GPIO_SPEED_FREQ_HIGH
  - LL_GPIO_SPEED_FREQ_VERY_HIGH

Return values

- **None:**

Notes

- I/O speed can be Low, Medium, Fast or High speed.
- Warning: only one pin can be passed as parameter.
- Refer to datasheet for frequency specifications and the power supply and load conditions for each speed.

Reference Manual to LL API cross reference:

- OSPEEDR OSPEEDy LL_GPIO_SetPinSpeed

`LL_GPIO_GetPinSpeed`

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetPinSpeed (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio speed for a dedicated pin on dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15

Return values

- **Returned:** value can be one of the following values:
  - LL_GPIO_SPEED_FREQ_LOW
  - LL_GPIO_SPEED_FREQ_MEDIUM
  - LL_GPIO_SPEED_FREQ_HIGH
  - LL_GPIO_SPEED_FREQ_VERY_HIGH

Notes

- I/O speed can be Low, Medium, Fast or High speed.
- Warning: only one pin can be passed as parameter.
- Refer to datasheet for frequency specifications and the power supply and load conditions for each speed.

Reference Manual to LL API cross reference:

- OSPEEDR OSPEEDy LL_GPIO_GetPinSpeed

`LL_GPIO_SetPinPull`

Function name

__STATIC_INLINE void LL_GPIO_SetPinPull (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Pull)

Function description

Configure gpio pull-up or pull-down for a dedicated pin on a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
- **Pull:** This parameter can be one of the following values:
  - LL_GPIO_PULL_NO
  - LL_GPIO_PULL_UP
  - LL_GPIO_PULL_DOWN

Return values

- **None:**

Notes

- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- PUPDR PUPDy LL_GPIO_SetPinPull

`LL_GPIO_GetPinPull`

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetPinPull (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio pull-up or pull-down for a dedicated pin on a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15

Return values

- **Returned:** value can be one of the following values:
  - LL_GPIO_PULL_NO
  - LL_GPIO_PULL_UP
  - LL_GPIO_PULL_DOWN

Notes

- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- PUPDR PUPDy LL_GPIO_GetPinPull

LL_GPIO_SetAFPin_0_7

Function name

__STATIC_INLINE void LL_GPIO_SetAFPin_0_7 (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Alternate)

Function description

Configure gpio alternate function of a dedicated pin from 0 to 7 for a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
- **Alternate:** This parameter can be one of the following values:
  - LL_GPIO_AF_0
  - LL_GPIO_AF_1
  - LL_GPIO_AF_2
  - LL_GPIO_AF_3
  - LL_GPIO_AF_4
  - LL_GPIO_AF_5
  - LL_GPIO_AF_6
  - LL_GPIO_AF_7
  - LL_GPIO_AF_8
  - LL_GPIO_AF_9
  - LL_GPIO_AF_10
  - LL_GPIO_AF_11
  - LL_GPIO_AF_12
  - LL_GPIO_AF_13
  - LL_GPIO_AF_14
  - LL_GPIO_AF_15

Return values

- **None:**

Notes

- Possible values are from AF0 to AF15 depending on target.
- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- AFRL AFSELy LL_GPIO_SetAFPin_0_7

`LL_GPIO_GetAFPin_0_7`

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetAFPin_0_7 (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio alternate function of a dedicated pin from 0 to 7 for a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7

Return values

- **Returned:** value can be one of the following values:
  - LL_GPIO_AF_0
  - LL_GPIO_AF_1
  - LL_GPIO_AF_2
  - LL_GPIO_AF_3
  - LL_GPIO_AF_4
  - LL_GPIO_AF_5
  - LL_GPIO_AF_6
  - LL_GPIO_AF_7
  - LL_GPIO_AF_8
  - LL_GPIO_AF_9
  - LL_GPIO_AF_10
  - LL_GPIO_AF_11
  - LL_GPIO_AF_12
  - LL_GPIO_AF_13
  - LL_GPIO_AF_14
  - LL_GPIO_AF_15

Reference Manual to LL API cross reference:

- AFRL AFSELy LL_GPIO_GetAFPin_0_7

LL_GPIO_SetAFPin_8_15

Function name

__STATIC_INLINE void LL_GPIO_SetAFPin_8_15 (GPIO_TypeDef * GPIOx, uint32_t Pin, uint32_t Alternate)

Function description

Configure gpio alternate function of a dedicated pin from 8 to 15 for a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
- **Alternate:** This parameter can be one of the following values:
  - LL_GPIO_AF_0
  - LL_GPIO_AF_1
  - LL_GPIO_AF_2
  - LL_GPIO_AF_3
  - LL_GPIO_AF_4
  - LL_GPIO_AF_5
  - LL_GPIO_AF_6
  - LL_GPIO_AF_7
  - LL_GPIO_AF_8
  - LL_GPIO_AF_9
  - LL_GPIO_AF_10
  - LL_GPIO_AF_11
  - LL_GPIO_AF_12
  - LL_GPIO_AF_13
  - LL_GPIO_AF_14
  - LL_GPIO_AF_15

Return values

- **None:**

Notes

- Possible values are from AF0 to AF15 depending on target.
- Warning: only one pin can be passed as parameter.

Reference Manual to LL API cross reference:

- AFRH AFSELy LL_GPIO_SetAFPin_8_15

`LL_GPIO_GetAFPin_8_15`

Function name

__STATIC_INLINE uint32_t LL_GPIO_GetAFPin_8_15 (GPIO_TypeDef * GPIOx, uint32_t Pin)

Function description

Return gpio alternate function of a dedicated pin from 8 to 15 for a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **Pin:** This parameter can be one of the following values:
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15

Return values

- **Returned:** value can be one of the following values:
  - LL_GPIO_AF_0
  - LL_GPIO_AF_1
  - LL_GPIO_AF_2
  - LL_GPIO_AF_3
  - LL_GPIO_AF_4
  - LL_GPIO_AF_5
  - LL_GPIO_AF_6
  - LL_GPIO_AF_7
  - LL_GPIO_AF_8
  - LL_GPIO_AF_9
  - LL_GPIO_AF_10
  - LL_GPIO_AF_11
  - LL_GPIO_AF_12
  - LL_GPIO_AF_13
  - LL_GPIO_AF_14
  - LL_GPIO_AF_15

Notes

- Possible values are from AF0 to AF15 depending on target.

Reference Manual to LL API cross reference:

- AFRH AFSELy LL_GPIO_GetAFPin_8_15

LL_GPIO_LockPin

Function name

__STATIC_INLINE void LL_GPIO_LockPin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Lock configuration of several pins for a dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **None:**

Notes

- When the lock sequence has been applied on a port bit, the value of this port bit can no longer be modified until the next reset.
- Each lock bit freezes a specific configuration register (control and alternate function registers).

Reference Manual to LL API cross reference:

- LCKR LCKK LL_GPIO_LockPin

LL_GPIO_IsPinLocked

Function name

__STATIC_INLINE uint32_t LL_GPIO_IsPinLocked (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Return 1 if all pins passed as parameter, of a dedicated port, are locked.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- LCKR LCKy LL_GPIO_IsPinLocked

LL_GPIO_IsAnyPinLocked

Function name

__STATIC_INLINE uint32_t LL_GPIO_IsAnyPinLocked (GPIO_TypeDef * GPIOx)

Function description

Return 1 if one of the pin of a dedicated port is locked.

Parameters

- **GPIOx:** GPIO Port

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- LCKR LCKK LL_GPIO_IsAnyPinLocked

LL_GPIO_ReadInputPort

Function name

__STATIC_INLINE uint32_t LL_GPIO_ReadInputPort (GPIO_TypeDef * GPIOx)

Function description

Return full input data register value for a dedicated port.

Parameters

- **GPIOx:** GPIO Port

Return values

- **Input:** data register value of port

Reference Manual to LL API cross reference:

- IDR IDy LL_GPIO_ReadInputPort

LL_GPIO_IsInputPinSet

Function name

__STATIC_INLINE uint32_t LL_GPIO_IsInputPinSet (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Return if input data level for several pins of dedicated port is high or low.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IDR IDy LL_GPIO_IsInputPinSet

LL_GPIO_WriteOutputPort

Function name

__STATIC_INLINE void LL_GPIO_WriteOutputPort (GPIO_TypeDef * GPIOx, uint32_t PortValue)

Function description

Write output data register for the port.

Parameters

- **GPIOx:** GPIO Port
- **PortValue:** Level value for each pin of the port

Return values

- **None:**

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_WriteOutputPort

`LL_GPIO_ReadOutputPort`

Function name

__STATIC_INLINE uint32_t LL_GPIO_ReadOutputPort (GPIO_TypeDef * GPIOx)

Function description

Return full output data register value for a dedicated port.

Parameters

- **GPIOx:** GPIO Port

Return values

- **Output:** data register value of port

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_ReadOutputPort

`LL_GPIO_IsOutputPinSet`

Function name

__STATIC_INLINE uint32_t LL_GPIO_IsOutputPinSet (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Return if input data level for several pins of dedicated port is high or low.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_IsOutputPinSet

`LL_GPIO_SetOutputPin`

Function name

__STATIC_INLINE void LL_GPIO_SetOutputPin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Set several pins to high level on dedicated gpio port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- BSRR BSy LL_GPIO_SetOutputPin

`LL_GPIO_ResetOutputPin`

Function name

__STATIC_INLINE void LL_GPIO_ResetOutputPin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Set several pins to low level on dedicated gpio port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- BRR BRy LL_GPIO_ResetOutputPin

LL_GPIO_TogglePin

Function name

__STATIC_INLINE void LL_GPIO_TogglePin (GPIO_TypeDef * GPIOx, uint32_t PinMask)

Function description

Toggle data value for several pin of dedicated port.

Parameters

- **GPIOx:** GPIO Port
- **PinMask:** This parameter can be a combination of the following values:
  - LL_GPIO_PIN_0
  - LL_GPIO_PIN_1
  - LL_GPIO_PIN_2
  - LL_GPIO_PIN_3
  - LL_GPIO_PIN_4
  - LL_GPIO_PIN_5
  - LL_GPIO_PIN_6
  - LL_GPIO_PIN_7
  - LL_GPIO_PIN_8
  - LL_GPIO_PIN_9
  - LL_GPIO_PIN_10
  - LL_GPIO_PIN_11
  - LL_GPIO_PIN_12
  - LL_GPIO_PIN_13
  - LL_GPIO_PIN_14
  - LL_GPIO_PIN_15
  - LL_GPIO_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- ODR ODy LL_GPIO_TogglePin

`LL_GPIO_DeInit`

Function name

ErrorStatus LL_GPIO_DeInit (GPIO_TypeDef * GPIOx)

Function description

De-initialize GPIO registers (Registers restored to their default values).

Parameters

- **GPIOx:** GPIO Port

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: GPIO registers are de-initialized
  - ERROR: Wrong GPIO Port

`LL_GPIO_Init`

Function name

ErrorStatus LL_GPIO_Init (GPIO_TypeDef * GPIOx, LL_GPIO_InitTypeDef * GPIO_InitStruct)

Function description

Initialize GPIO registers according to the specified parameters in GPIO_InitStruct.

Parameters

- **GPIOx:** GPIO Port
- **GPIO_InitStruct:** pointer to a LL_GPIO_InitTypeDef structure that contains the configuration information for the specified GPIO peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: GPIO registers are initialized according to GPIO_InitStruct content
  - ERROR: Not applicable

`LL_GPIO_StructInit`

Function name

void LL_GPIO_StructInit (LL_GPIO_InitTypeDef * GPIO_InitStruct)

Function description

Set each LL_GPIO_InitTypeDef field to default value.

Parameters

- **GPIO_InitStruct:** pointer to a LL_GPIO_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

91.3 GPIO Firmware driver defines

The following section lists the various define and macros of the module.

91.3.1 GPIO

GPIO

Alternate Function

LL_GPIO_AF_0

Select alternate function 0

LL_GPIO_AF_1

Select alternate function 1

LL_GPIO_AF_2

Select alternate function 2

LL_GPIO_AF_3

Select alternate function 3

LL_GPIO_AF_4

Select alternate function 4

LL_GPIO_AF_5

Select alternate function 5

LL_GPIO_AF_6

Select alternate function 6

LL_GPIO_AF_7

Select alternate function 7

LL_GPIO_AF_8

Select alternate function 8

LL_GPIO_AF_9

Select alternate function 9

LL_GPIO_AF_10

Select alternate function 10

LL_GPIO_AF_11

Select alternate function 11

LL_GPIO_AF_12

Select alternate function 12

LL_GPIO_AF_13

Select alternate function 13

LL_GPIO_AF_14

Select alternate function 14

LL_GPIO_AF_15

Select alternate function 15

Mode

LL_GPIO_MODE_INPUT

Select input mode

LL_GPIO_MODE_OUTPUT

Select output mode

LL_GPIO_MODE_ALTERNATE

Select alternate function mode

LL_GPIO_MODE_ANALOG

Select analog mode

Output Type

LL_GPIO_OUTPUT_PUSHPULL

Select push-pull as output type

LL_GPIO_OUTPUT_OPENDRAIN

Select open-drain as output type

PIN

LL_GPIO_PIN_0

Select pin 0

LL_GPIO_PIN_1

Select pin 1

LL_GPIO_PIN_2

Select pin 2

LL_GPIO_PIN_3

Select pin 3

LL_GPIO_PIN_4

Select pin 4

LL_GPIO_PIN_5

Select pin 5

LL_GPIO_PIN_6

Select pin 6

LL_GPIO_PIN_7

Select pin 7

LL_GPIO_PIN_8

Select pin 8

LL_GPIO_PIN_9

Select pin 9

LL_GPIO_PIN_10

Select pin 10

LL_GPIO_PIN_11

Select pin 11

LL_GPIO_PIN_12

Select pin 12

LL_GPIO_PIN_13

Select pin 13

LL_GPIO_PIN_14

Select pin 14

LL_GPIO_PIN_15

Select pin 15

LL_GPIO_PIN_ALL

Select all pins

Pull Up Pull Down

LL_GPIO_PULL_NO

Select I/O no pull

LL_GPIO_PULL_UP

Select I/O pull up

LL_GPIO_PULL_DOWN

Select I/O pull down

Output Speed

LL_GPIO_SPEED_FREQ_LOW

Select I/O low output speed

LL_GPIO_SPEED_FREQ_MEDIUM

Select I/O medium output speed

LL_GPIO_SPEED_FREQ_HIGH

Select I/O fast output speed

LL_GPIO_SPEED_FREQ_VERY_HIGH

Select I/O high output speed

Common Write and read registers Macros

LL_GPIO_WriteReg

Description:

- Write a value in GPIO register.

Parameters:

- __INSTANCE__: GPIO Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_GPIO_ReadReg

Description:

- Read a value in GPIO register.

Parameters:

- __INSTANCE__: GPIO Instance
- __REG__: Register to be read

Return value:

- Register: value

GPIO Exported Constants

LL_GPIO_SPEED_LOW

LL_GPIO_SPEED_MEDIUM

LL_GPIO_SPEED_FAST

LL_GPIO_SPEED_HIGH

92 LL I2C Generic Driver

92.1 I2C Firmware driver registers structures

92.1.1 LL_I2C_InitTypeDef

LL_I2C_InitTypeDef is defined in the stm32l4xx_ll_i2c.h

Data Fields

- ***uint32_t PeripheralMode***
- ***uint32_t Timing***
- ***uint32_t AnalogFilter***
- ***uint32_t DigitalFilter***
- ***uint32_t OwnAddress1***
- ***uint32_t TypeAcknowledge***
- ***uint32_t OwnAddrSize***

Field Documentation

- ***uint32_t LL_I2C_InitTypeDef::PeripheralMode***

  Specifies the peripheral mode. This parameter can be a value of *I2C_LL_EC_PERIPHERAL_MODE*This feature can be modified afterwards using unitary function **LL_I2C_SetMode()**.
- ***uint32_t LL_I2C_InitTypeDef::Timing***

  Specifies the SDA setup, hold time and the SCL high, low period values. This parameter must be set by referring to the STM32CubeMX Tool and the helper macro **__LL_I2C_CONVERT_TIMINGS()**This feature can be modified afterwards using unitary function **LL_I2C_SetTiming()**.
- ***uint32_t LL_I2C_InitTypeDef::AnalogFilter***

  Enables or disables analog noise filter. This parameter can be a value of *I2C_LL_EC_ANALOGFILTER_SELECTION*This feature can be modified afterwards using unitary functions **LL_I2C_EnableAnalogFilter()** or **LL_I2C_DisableAnalogFilter()**.
- ***uint32_t LL_I2C_InitTypeDef::DigitalFilter***

  Configures the digital noise filter. This parameter can be a number between Min_Data = 0x00 and Max_Data = 0x0FThis feature can be modified afterwards using unitary function **LL_I2C_SetDigitalFilter()**.
- ***uint32_t LL_I2C_InitTypeDef::OwnAddress1***

  Specifies the device own address 1. This parameter must be a value between Min_Data = 0x00 and Max_Data = 0x3FFThis feature can be modified afterwards using unitary function **LL_I2C_SetOwnAddress1()**.
- ***uint32_t LL_I2C_InitTypeDef::TypeAcknowledge***

  Specifies the ACKnowledge or Non ACKnowledge condition after the address receive match code or next received byte. This parameter can be a value of *I2C_LL_EC_I2C_ACKNOWLEDGE*This feature can be modified afterwards using unitary function **LL_I2C_AcknowledgeNextData()**.
- ***uint32_t LL_I2C_InitTypeDef::OwnAddrSize***

  Specifies the device own address 1 size (7-bit or 10-bit). This parameter can be a value of *I2C_LL_EC_OWNADDRESS1*This feature can be modified afterwards using unitary function **LL_I2C_SetOwnAddress1()**.

92.2 I2C Firmware driver API description

The following section lists the various functions of the I2C library.

92.2.1 Detailed description of functions

`LL_I2C_Enable`

Function name

__STATIC_INLINE void LL_I2C_Enable (I2C_TypeDef * I2Cx)

Function description

Enable I2C peripheral (PE = 1).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PE LL_I2C_Enable

`LL_I2C_Disable`

Function name

__STATIC_INLINE void LL_I2C_Disable (I2C_TypeDef * I2Cx)

Function description

Disable I2C peripheral (PE = 0).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- When PE = 0, the I2C SCL and SDA lines are released. Internal state machines and status bits are put back to their reset value. When cleared, PE must be kept low for at least 3 APB clock cycles.

Reference Manual to LL API cross reference:

- CR1 PE LL_I2C_Disable

`LL_I2C_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabled (I2C_TypeDef * I2Cx)

Function description

Check if the I2C peripheral is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 PE LL_I2C_IsEnabled

LL_I2C_ConfigFilters

Function name

__STATIC_INLINE void LL_I2C_ConfigFilters (I2C_TypeDef * I2Cx, uint32_t AnalogFilter, uint32_t DigitalFilter)

Function description

Configure Noise Filters (Analog and Digital).

Parameters

- **I2Cx:** I2C Instance.
- **AnalogFilter:** This parameter can be one of the following values:
  - LL_I2C_ANALOGFILTER_ENABLE
  - LL_I2C_ANALOGFILTER_DISABLE
- **DigitalFilter:** This parameter must be a value between Min_Data=0x00 (Digital filter disabled) and Max_Data=0x0F (Digital filter enabled and filtering capability up to 15*ti2cclk). This parameter is used to configure the digital noise filter on SDA and SCL input. The digital filter will filter spikes with a length of up to DNF[3:0]*ti2cclk.

Return values

- **None:**

Notes

- If the analog filter is also enabled, the digital filter is added to analog filter. The filters can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 ANFOFF LL_I2C_ConfigFilters
- CR1 DNF LL_I2C_ConfigFilters

LL_I2C_SetDigitalFilter

Function name

__STATIC_INLINE void LL_I2C_SetDigitalFilter (I2C_TypeDef * I2Cx, uint32_t DigitalFilter)

Function description

Configure Digital Noise Filter.

Parameters

- **I2Cx:** I2C Instance.
- **DigitalFilter:** This parameter must be a value between Min_Data=0x00 (Digital filter disabled) and Max_Data=0x0F (Digital filter enabled and filtering capability up to 15*ti2cclk). This parameter is used to configure the digital noise filter on SDA and SCL input. The digital filter will filter spikes with a length of up to DNF[3:0]*ti2cclk.

Return values

- **None:**

Notes

- If the analog filter is also enabled, the digital filter is added to analog filter. This filter can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 DNF LL_I2C_SetDigitalFilter

LL_I2C_GetDigitalFilter

Function name

__STATIC_INLINE uint32_t LL_I2C_GetDigitalFilter (I2C_TypeDef * I2Cx)

Function description

Get the current Digital Noise Filter configuration.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x0 and Max_Data=0xF

Reference Manual to LL API cross reference:

- CR1 DNF LL_I2C_GetDigitalFilter

LL_I2C_EnableAnalogFilter

Function name

__STATIC_INLINE void LL_I2C_EnableAnalogFilter (I2C_TypeDef * I2Cx)

Function description

Enable Analog Noise Filter.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- This filter can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 ANFOFF LL_I2C_EnableAnalogFilter

LL_I2C_DisableAnalogFilter

Function name

__STATIC_INLINE void LL_I2C_DisableAnalogFilter (I2C_TypeDef * I2Cx)

Function description

Disable Analog Noise Filter.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- This filter can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 ANFOFF LL_I2C_DisableAnalogFilter

`LL_I2C_IsEnabledAnalogFilter`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledAnalogFilter (I2C_TypeDef * I2Cx)

Function description

Check if Analog Noise Filter is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 ANFOFF LL_I2C_IsEnabledAnalogFilter

`LL_I2C_EnableDMAReq_TX`

Function name

__STATIC_INLINE void LL_I2C_EnableDMAReq_TX (I2C_TypeDef * I2Cx)

Function description

Enable DMA transmission requests.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXDMAEN LL_I2C_EnableDMAReq_TX

`LL_I2C_DisableDMAReq_TX`

Function name

__STATIC_INLINE void LL_I2C_DisableDMAReq_TX (I2C_TypeDef * I2Cx)

Function description

Disable DMA transmission requests.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXDMAEN LL_I2C_DisableDMAReq_TX

`LL_I2C_IsEnabledDMAReq_TX`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledDMAReq_TX (I2C_TypeDef * I2Cx)

Function description

Check if DMA transmission requests are enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TXDMAEN LL_I2C_IsEnabledDMAReq_TX

`LL_I2C_EnableDMAReq_RX`

Function name

__STATIC_INLINE void LL_I2C_EnableDMAReq_RX (I2C_TypeDef * I2Cx)

Function description

Enable DMA reception requests.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXDMAEN LL_I2C_EnableDMAReq_RX

`LL_I2C_DisableDMAReq_RX`

Function name

__STATIC_INLINE void LL_I2C_DisableDMAReq_RX (I2C_TypeDef * I2Cx)

Function description

Disable DMA reception requests.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXDMAEN LL_I2C_DisableDMAReq_RX

`LL_I2C_IsEnabledDMAReq_RX`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledDMAReq_RX (I2C_TypeDef * I2Cx)

Function description

Check if DMA reception requests are enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RXDMAEN LL_I2C_IsEnabledDMAReq_RX

`LL_I2C_DMA_GetRegAddr`

Function name

__STATIC_INLINE uint32_t LL_I2C_DMA_GetRegAddr (I2C_TypeDef * I2Cx, uint32_t Direction)

Function description

Get the data register address used for DMA transfer.

Parameters

- **I2Cx:** I2C Instance
- **Direction:** This parameter can be one of the following values:
  - LL_I2C_DMA_REG_DATA_TRANSMIT
  - LL_I2C_DMA_REG_DATA_RECEIVE

Return values

- **Address:** of data register

Reference Manual to LL API cross reference:

- TXDR TXDATA LL_I2C_DMA_GetRegAddr
- RXDR RXDATA LL_I2C_DMA_GetRegAddr

`LL_I2C_EnableClockStretching`

Function name

__STATIC_INLINE void LL_I2C_EnableClockStretching (I2C_TypeDef * I2Cx)

Function description

Enable Clock stretching.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- This bit can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 NOSTRETCH LL_I2C_EnableClockStretching

`LL_I2C_DisableClockStretching`

Function name

__STATIC_INLINE void LL_I2C_DisableClockStretching (I2C_TypeDef * I2Cx)

Function description

Disable Clock stretching.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- This bit can only be programmed when the I2C is disabled (PE = 0).

Reference Manual to LL API cross reference:

- CR1 NOSTRETCH LL_I2C_DisableClockStretching

`LL_I2C_IsEnabledClockStretching`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledClockStretching (I2C_TypeDef * I2Cx)

Function description

Check if Clock stretching is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 NOSTRETCH LL_I2C_IsEnabledClockStretching

`LL_I2C_EnableSlaveByteControl`

Function name

__STATIC_INLINE void LL_I2C_EnableSlaveByteControl (I2C_TypeDef * I2Cx)

Function description

Enable hardware byte control in slave mode.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 SBC LL_I2C_EnableSlaveByteControl

`LL_I2C_DisableSlaveByteControl`

Function name

__STATIC_INLINE void LL_I2C_DisableSlaveByteControl (I2C_TypeDef * I2Cx)

Function description

Disable hardware byte control in slave mode.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 SBC LL_I2C_DisableSlaveByteControl

`LL_I2C_IsEnabledSlaveByteControl`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledSlaveByteControl (I2C_TypeDef * I2Cx)

Function description

Check if hardware byte control in slave mode is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 SBC LL_I2C_IsEnabledSlaveByteControl

`LL_I2C_EnableWakeUpFromStop`

Function name

__STATIC_INLINE void LL_I2C_EnableWakeUpFromStop (I2C_TypeDef * I2Cx)

Function description

Enable Wakeup from STOP.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_I2C_WAKEUP_FROMSTOP_INSTANCE(I2Cx) can be used to check whether or not WakeUpFromStop feature is supported by the I2Cx Instance.
- This bit can only be programmed when Digital Filter is disabled.

Reference Manual to LL API cross reference:

- CR1 WUPEN LL_I2C_EnableWakeUpFromStop

`LL_I2C_DisableWakeUpFromStop`

Function name

__STATIC_INLINE void LL_I2C_DisableWakeUpFromStop (I2C_TypeDef * I2Cx)

Function description

Disable Wakeup from STOP.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_I2C_WAKEUP_FROMSTOP_INSTANCE(I2Cx) can be used to check whether or not WakeUpFromStop feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 WUPEN LL_I2C_DisableWakeUpFromStop

`LL_I2C_IsEnabledWakeUpFromStop`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledWakeUpFromStop (I2C_TypeDef * I2Cx)

Function description

Check if Wakeup from STOP is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_I2C_WAKEUP_FROMSTOP_INSTANCE(I2Cx) can be used to check whether or not WakeUpFromStop feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 WUPEN LL_I2C_IsEnabledWakeUpFromStop

`LL_I2C_EnableGeneralCall`

Function name

__STATIC_INLINE void LL_I2C_EnableGeneralCall (I2C_TypeDef * I2Cx)

Function description

Enable General Call.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- When enabled the Address 0x00 is ACKed.

Reference Manual to LL API cross reference:

- CR1 GCEN LL_I2C_EnableGeneralCall

`LL_I2C_DisableGeneralCall`

Function name

__STATIC_INLINE void LL_I2C_DisableGeneralCall (I2C_TypeDef * I2Cx)

Function description

Disable General Call.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- When disabled the Address 0x00 is NACKed.

Reference Manual to LL API cross reference:

- CR1 GCEN LL_I2C_DisableGeneralCall

LL_I2C_IsEnabledGeneralCall

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledGeneralCall (I2C_TypeDef * I2Cx)

Function description

Check if General Call is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 GCEN LL_I2C_IsEnabledGeneralCall

LL_I2C_SetMasterAddressingMode

Function name

__STATIC_INLINE void LL_I2C_SetMasterAddressingMode (I2C_TypeDef * I2Cx, uint32_t AddressingMode)

Function description

Configure the Master to operate in 7-bit or 10-bit addressing mode.

Parameters

- **I2Cx:** I2C Instance.
- **AddressingMode:** This parameter can be one of the following values:
  - LL_I2C_ADDRESSING_MODE_7BIT
  - LL_I2C_ADDRESSING_MODE_10BIT

Return values

- **None:**

Notes

- Changing this bit is not allowed, when the START bit is set.

Reference Manual to LL API cross reference:

- CR2 ADD10 LL_I2C_SetMasterAddressingMode

`LL_I2C_GetMasterAddressingMode`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetMasterAddressingMode (I2C_TypeDef * I2Cx)

Function description

Get the Master addressing mode.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Returned:** value can be one of the following values:
  - LL_I2C_ADDRESSING_MODE_7BIT
  - LL_I2C_ADDRESSING_MODE_10BIT

Reference Manual to LL API cross reference:

- CR2 ADD10 LL_I2C_GetMasterAddressingMode

`LL_I2C_SetOwnAddress1`

Function name

__STATIC_INLINE void LL_I2C_SetOwnAddress1 (I2C_TypeDef * I2Cx, uint32_t OwnAddress1, uint32_t OwnAddrSize)

Function description

Set the Own Address1.

Parameters

- **I2Cx:** I2C Instance.
- **OwnAddress1:** This parameter must be a value between Min_Data=0 and Max_Data=0x3FF.
- **OwnAddrSize:** This parameter can be one of the following values:
  - LL_I2C_OWNADDRESS1_7BIT
  - LL_I2C_OWNADDRESS1_10BIT

Return values

- **None:**

Reference Manual to LL API cross reference:

- OAR1 OA1 LL_I2C_SetOwnAddress1
- OAR1 OA1MODE LL_I2C_SetOwnAddress1

`LL_I2C_EnableOwnAddress1`

Function name

__STATIC_INLINE void LL_I2C_EnableOwnAddress1 (I2C_TypeDef * I2Cx)

Function description

Enable acknowledge on Own Address1 match address.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- OAR1 OA1EN LL_I2C_EnableOwnAddress1

`LL_I2C_DisableOwnAddress1`

Function name

__STATIC_INLINE void LL_I2C_DisableOwnAddress1 (I2C_TypeDef * I2Cx)

Function description

Disable acknowledge on Own Address1 match address.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- OAR1 OA1EN LL_I2C_DisableOwnAddress1

`LL_I2C_IsEnabledOwnAddress1`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledOwnAddress1 (I2C_TypeDef * I2Cx)

Function description

Check if Own Address1 acknowledge is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- OAR1 OA1EN LL_I2C_IsEnabledOwnAddress1

`LL_I2C_SetOwnAddress2`

Function name

__STATIC_INLINE void LL_I2C_SetOwnAddress2 (I2C_TypeDef * I2Cx, uint32_t OwnAddress2, uint32_t OwnAddrMask)

Function description

Set the 7bits Own Address2.

Parameters

- **I2Cx:** I2C Instance.
- **OwnAddress2:** Value between Min_Data=0 and Max_Data=0x7F.
- **OwnAddrMask:** This parameter can be one of the following values:
  - LL_I2C_OWNADDRESS2_NOMASK
  - LL_I2C_OWNADDRESS2_MASK01
  - LL_I2C_OWNADDRESS2_MASK02
  - LL_I2C_OWNADDRESS2_MASK03
  - LL_I2C_OWNADDRESS2_MASK04
  - LL_I2C_OWNADDRESS2_MASK05
  - LL_I2C_OWNADDRESS2_MASK06
  - LL_I2C_OWNADDRESS2_MASK07

Return values

- **None:**

Notes

- This action has no effect if own address2 is enabled.

Reference Manual to LL API cross reference:

- OAR2 OA2 LL_I2C_SetOwnAddress2
- OAR2 OA2MSK LL_I2C_SetOwnAddress2

`LL_I2C_EnableOwnAddress2`

Function name

__STATIC_INLINE void LL_I2C_EnableOwnAddress2 (I2C_TypeDef * I2Cx)

Function description

Enable acknowledge on Own Address2 match address.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- OAR2 OA2EN LL_I2C_EnableOwnAddress2

`LL_I2C_DisableOwnAddress2`

Function name

__STATIC_INLINE void LL_I2C_DisableOwnAddress2 (I2C_TypeDef * I2Cx)

Function description

Disable acknowledge on Own Address2 match address.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- OAR2 OA2EN LL_I2C_DisableOwnAddress2

`LL_I2C_IsEnabledOwnAddress2`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledOwnAddress2 (I2C_TypeDef * I2Cx)

Function description

Check if Own Address1 acknowledge is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- OAR2 OA2EN LL_I2C_IsEnabledOwnAddress2

`LL_I2C_SetTiming`

Function name

__STATIC_INLINE void LL_I2C_SetTiming (I2C_TypeDef * I2Cx, uint32_t Timing)

Function description

Configure the SDA setup, hold time and the SCL high, low period.

Parameters

- **I2Cx:** I2C Instance.
- **Timing:** This parameter must be a value between Min_Data=0 and Max_Data=0xFFFFFFFF.

Return values

- **None:**

Notes

- This bit can only be programmed when the I2C is disabled (PE = 0).
- This parameter is computed with the STM32CubeMX Tool.

Reference Manual to LL API cross reference:

- TIMINGR TIMINGR LL_I2C_SetTiming

`LL_I2C_GetTimingPrescaler`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetTimingPrescaler (I2C_TypeDef * I2Cx)

Function description

Get the Timing Prescaler setting.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x0 and Max_Data=0xF

Reference Manual to LL API cross reference:

- TIMINGR PRESC LL_I2C_GetTimingPrescaler

`LL_I2C_GetClockLowPeriod`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetClockLowPeriod (I2C_TypeDef * I2Cx)

Function description

Get the SCL low period setting.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- TIMINGR SCLL LL_I2C_GetClockLowPeriod

`LL_I2C_GetClockHighPeriod`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetClockHighPeriod (I2C_TypeDef * I2Cx)

Function description

Get the SCL high period setting.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- TIMINGR SCLH LL_I2C_GetClockHighPeriod

`LL_I2C_GetDataHoldTime`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetDataHoldTime (I2C_TypeDef * I2Cx)

Function description

Get the SDA hold time.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x0 and Max_Data=0xF

Reference Manual to LL API cross reference:

- TIMINGR SDADEL LL_I2C_GetDataHoldTime

`LL_I2C_GetDataSetupTime`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetDataSetupTime (I2C_TypeDef * I2Cx)

Function description

Get the SDA setup time.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x0 and Max_Data=0xF

Reference Manual to LL API cross reference:

- TIMINGR SCLDEL LL_I2C_GetDataSetupTime

`LL_I2C_SetMode`

Function name

__STATIC_INLINE void LL_I2C_SetMode (I2C_TypeDef * I2Cx, uint32_t PeripheralMode)

Function description

Configure peripheral mode.

Parameters

- **I2Cx:** I2C Instance.
- **PeripheralMode:** This parameter can be one of the following values:
  - LL_I2C_MODE_I2C
  - LL_I2C_MODE_SMBUS_HOST
  - LL_I2C_MODE_SMBUS_DEVICE
  - LL_I2C_MODE_SMBUS_DEVICE_ARP

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 SMBHEN LL_I2C_SetMode
- CR1 SMBDEN LL_I2C_SetMode

`LL_I2C_GetMode`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetMode (I2C_TypeDef * I2Cx)

Function description

Get peripheral mode.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Returned:** value can be one of the following values:
  - LL_I2C_MODE_I2C
  - LL_I2C_MODE_SMBUS_HOST
  - LL_I2C_MODE_SMBUS_DEVICE
  - LL_I2C_MODE_SMBUS_DEVICE_ARP

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 SMBHEN LL_I2C_GetMode
- CR1 SMBDEN LL_I2C_GetMode

`LL_I2C_EnableSMBusAlert`

Function name

__STATIC_INLINE void LL_I2C_EnableSMBusAlert (I2C_TypeDef * I2Cx)

Function description

Enable SMBus alert (Host or Device mode)

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- SMBus Device mode: SMBus Alert pin is drived low and Alert Response Address Header acknowledge is enabled. SMBus Host mode:SMBus Alert pin management is supported.

Reference Manual to LL API cross reference:

- CR1 ALERTEN LL_I2C_EnableSMBusAlert

`LL_I2C_DisableSMBusAlert`

Function name

__STATIC_INLINE void LL_I2C_DisableSMBusAlert (I2C_TypeDef * I2Cx)

Function description

Disable SMBus alert (Host or Device mode)

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- SMBus Device mode: SMBus Alert pin is not drived (can be used as a standard GPIO) and Alert Response Address Header acknowledge is disabled. SMBus Host mode:SMBus Alert pin management is not supported.

Reference Manual to LL API cross reference:

- CR1 ALERTEN LL_I2C_DisableSMBusAlert

`LL_I2C_IsEnabledSMBusAlert`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusAlert (I2C_TypeDef * I2Cx)

Function description

Check if SMBus alert (Host or Device mode) is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 ALERTEN LL_I2C_IsEnabledSMBusAlert

`LL_I2C_EnableSMBusPEC`

Function name

__STATIC_INLINE void LL_I2C_EnableSMBusPEC (I2C_TypeDef * I2Cx)

Function description

Enable SMBus Packet Error Calculation (PEC).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 PECEN LL_I2C_EnableSMBusPEC

`LL_I2C_DisableSMBusPEC`

Function name

__STATIC_INLINE void LL_I2C_DisableSMBusPEC (I2C_TypeDef * I2Cx)

Function description

Disable SMBus Packet Error Calculation (PEC).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 PECEN LL_I2C_DisableSMBusPEC

LL_I2C_IsEnabledSMBusPEC

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusPEC (I2C_TypeDef * I2Cx)

Function description

Check if SMBus Packet Error Calculation (PEC) is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR1 PECEN LL_I2C_IsEnabledSMBusPEC

LL_I2C_ConfigSMBusTimeout

Function name

__STATIC_INLINE void LL_I2C_ConfigSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t TimeoutA, uint32_t TimeoutAMode, uint32_t TimeoutB)

Function description

Configure the SMBus Clock Timeout.

Parameters

- **I2Cx:** I2C Instance.
- **TimeoutA:** This parameter must be a value between Min_Data=0 and Max_Data=0xFFF.
- **TimeoutAMode:** This parameter can be one of the following values:
  - LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW
  - LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH
- **TimeoutB:**

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- This configuration can only be programmed when associated Timeout is disabled (TimeoutA and/ orTimeoutB).

Reference Manual to LL API cross reference:

- TIMEOUTR TIMEOUTA LL_I2C_ConfigSMBusTimeout
- TIMEOUTR TIDLE LL_I2C_ConfigSMBusTimeout
- TIMEOUTR TIMEOUTB LL_I2C_ConfigSMBusTimeout

`LL_I2C_SetSMBusTimeoutA`

Function name

__STATIC_INLINE void LL_I2C_SetSMBusTimeoutA (I2C_TypeDef * I2Cx, uint32_t TimeoutA)

Function description

Configure the SMBus Clock TimeoutA (SCL low timeout or SCL and SDA high timeout depends on TimeoutA mode).

Parameters

- **I2Cx:** I2C Instance.
- **TimeoutA:** This parameter must be a value between Min_Data=0 and Max_Data=0xFFF.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- These bits can only be programmed when TimeoutA is disabled.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMEOUTA LL_I2C_SetSMBusTimeoutA

`LL_I2C_GetSMBusTimeoutA`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetSMBusTimeoutA (I2C_TypeDef * I2Cx)

Function description

Get the SMBus Clock TimeoutA setting.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0 and Max_Data=0xFFF

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMEOUTA LL_I2C_GetSMBusTimeoutA

`LL_I2C_SetSMBusTimeoutAMode`

Function name

__STATIC_INLINE void LL_I2C_SetSMBusTimeoutAMode (I2C_TypeDef * I2Cx, uint32_t TimeoutAMode)

Function description

Set the SMBus Clock TimeoutA mode.

Parameters

- **I2Cx:** I2C Instance.
- **TimeoutAMode:** This parameter can be one of the following values:
  - LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW
  - LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- This bit can only be programmed when TimeoutA is disabled.

Reference Manual to LL API cross reference:

- TIMEOUTR TIDLE LL_I2C_SetSMBusTimeoutAMode

`LL_I2C_GetSMBusTimeoutAMode`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetSMBusTimeoutAMode (I2C_TypeDef * I2Cx)

Function description

Get the SMBus Clock TimeoutA mode.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Returned:** value can be one of the following values:
  - LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW
  - LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- TIMEOUTR TIDLE LL_I2C_GetSMBusTimeoutAMode

`LL_I2C_SetSMBusTimeoutB`

Function name

__STATIC_INLINE void LL_I2C_SetSMBusTimeoutB (I2C_TypeDef * I2Cx, uint32_t TimeoutB)

Function description

Configure the SMBus Extended Cumulative Clock TimeoutB (Master or Slave mode).

Parameters

- **I2Cx:** I2C Instance.
- **TimeoutB:** This parameter must be a value between Min_Data=0 and Max_Data=0xFFF.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- These bits can only be programmed when TimeoutB is disabled.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMEOUTB LL_I2C_SetSMBusTimeoutB

LL_I2C_GetSMBusTimeoutB

Function name

__STATIC_INLINE uint32_t LL_I2C_GetSMBusTimeoutB (I2C_TypeDef * I2Cx)

Function description

Get the SMBus Extented Cumulative Clock TimeoutB setting.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0 and Max_Data=0xFFF

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMEOUTB LL_I2C_GetSMBusTimeoutB

LL_I2C_EnableSMBusTimeout

Function name

__STATIC_INLINE void LL_I2C_EnableSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t ClockTimeout)

Function description

Enable the SMBus Clock Timeout.

Parameters

- **I2Cx:** I2C Instance.
- **ClockTimeout:** This parameter can be one of the following values:
  - LL_I2C_SMBUS_TIMEOUTA
  - LL_I2C_SMBUS_TIMEOUTB
  - LL_I2C_SMBUS_ALL_TIMEOUT

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMOUTEN LL_I2C_EnableSMBusTimeout
- TIMEOUTR TEXTEN LL_I2C_EnableSMBusTimeout

LL_I2C_DisableSMBusTimeout

Function name

__STATIC_INLINE void LL_I2C_DisableSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t ClockTimeout)

Function description

Disable the SMBus Clock Timeout.

Parameters

- **I2Cx:** I2C Instance.
- **ClockTimeout:** This parameter can be one of the following values:
  - LL_I2C_SMBUS_TIMEOUTA
  - LL_I2C_SMBUS_TIMEOUTB
  - LL_I2C_SMBUS_ALL_TIMEOUT

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMOUTEN LL_I2C_DisableSMBusTimeout
- TIMEOUTR TEXTEN LL_I2C_DisableSMBusTimeout

LL_I2C_IsEnabledSMBusTimeout

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusTimeout (I2C_TypeDef * I2Cx, uint32_t ClockTimeout)

Function description

Check if the SMBus Clock Timeout is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.
- **ClockTimeout:** This parameter can be one of the following values:
  - LL_I2C_SMBUS_TIMEOUTA
  - LL_I2C_SMBUS_TIMEOUTB
  - LL_I2C_SMBUS_ALL_TIMEOUT

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- TIMEOUTR TIMOUTEN LL_I2C_IsEnabledSMBusTimeout
- TIMEOUTR TEXTEN LL_I2C_IsEnabledSMBusTimeout

`LL_I2C_EnableIT_TX`

Function name

__STATIC_INLINE void LL_I2C_EnableIT_TX (I2C_TypeDef * I2Cx)

Function description

Enable TXIS interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXIE LL_I2C_EnableIT_TX

`LL_I2C_DisableIT_TX`

Function name

__STATIC_INLINE void LL_I2C_DisableIT_TX (I2C_TypeDef * I2Cx)

Function description

Disable TXIS interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXIE LL_I2C_DisableIT_TX

`LL_I2C_IsEnabledIT_TX`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_TX (I2C_TypeDef * I2Cx)

Function description

Check if the TXIS Interrupt is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TXIE LL_I2C_IsEnabledIT_TX

`LL_I2C_EnableIT_RX`

Function name

__STATIC_INLINE void LL_I2C_EnableIT_RX (I2C_TypeDef * I2Cx)

Function description

Enable RXNE interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXIE LL_I2C_EnableIT_RX

`LL_I2C_DisableIT_RX`

Function name

__STATIC_INLINE void LL_I2C_DisableIT_RX (I2C_TypeDef * I2Cx)

Function description

Disable RXNE interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXIE LL_I2C_DisableIT_RX

`LL_I2C_IsEnabledIT_RX`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_RX (I2C_TypeDef * I2Cx)

Function description

Check if the RXNE Interrupt is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RXIE LL_I2C_IsEnabledIT_RX

`LL_I2C_EnableIT_ADDR`

Function name

__STATIC_INLINE void LL_I2C_EnableIT_ADDR (I2C_TypeDef * I2Cx)

Function description

Enable Address match interrupt (slave mode only).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 ADDRIE LL_I2C_EnableIT_ADDR

`LL_I2C_DisableIT_ADDR`

Function name

__STATIC_INLINE void LL_I2C_DisableIT_ADDR (I2C_TypeDef * I2Cx)

Function description

Disable Address match interrupt (slave mode only).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 ADDRIE LL_I2C_DisableIT_ADDR

`LL_I2C_IsEnabledIT_ADDR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_ADDR (I2C_TypeDef * I2Cx)

Function description

Check if Address match interrupt is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 ADDRIE LL_I2C_IsEnabledIT_ADDR

`LL_I2C_EnableIT_NACK`

Function name

__STATIC_INLINE void LL_I2C_EnableIT_NACK (I2C_TypeDef * I2Cx)

Function description

Enable Not acknowledge received interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 NACKIE LL_I2C_EnableIT_NACK

LL_I2C_DisableIT_NACK

Function name

__STATIC_INLINE void LL_I2C_DisableIT_NACK (I2C_TypeDef * I2Cx)

Function description

Disable Not acknowledge received interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 NACKIE LL_I2C_DisableIT_NACK

LL_I2C_IsEnabledIT_NACK

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_NACK (I2C_TypeDef * I2Cx)

Function description

Check if Not acknowledge received interrupt is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 NACKIE LL_I2C_IsEnabledIT_NACK

LL_I2C_EnableIT_STOP

Function name

__STATIC_INLINE void LL_I2C_EnableIT_STOP (I2C_TypeDef * I2Cx)

Function description

Enable STOP detection interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 STOPIE LL_I2C_EnableIT_STOP

`LL_I2C_DisableIT_STOP`

Function name

__STATIC_INLINE void LL_I2C_DisableIT_STOP (I2C_TypeDef * I2Cx)

Function description

Disable STOP detection interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 STOPIE LL_I2C_DisableIT_STOP

`LL_I2C_IsEnabledIT_STOP`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_STOP (I2C_TypeDef * I2Cx)

Function description

Check if STOP detection interrupt is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 STOPIE LL_I2C_IsEnabledIT_STOP

`LL_I2C_EnableIT_TC`

Function name

__STATIC_INLINE void LL_I2C_EnableIT_TC (I2C_TypeDef * I2Cx)

Function description

Enable Transfer Complete interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Any of these events will generate interrupt : Transfer Complete (TC) Transfer Complete Reload (TCR)

Reference Manual to LL API cross reference:

- CR1 TCIE LL_I2C_EnableIT_TC

`LL_I2C_DisableIT_TC`

Function name

__STATIC_INLINE void LL_I2C_DisableIT_TC (I2C_TypeDef * I2Cx)

Function description

Disable Transfer Complete interrupt.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Any of these events will generate interrupt : Transfer Complete (TC) Transfer Complete Reload (TCR)

Reference Manual to LL API cross reference:

- CR1 TCIE LL_I2C_DisableIT_TC

`LL_I2C_IsEnabledIT_TC`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_TC (I2C_TypeDef * I2Cx)

Function description

Check if Transfer Complete interrupt is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TCIE LL_I2C_IsEnabledIT_TC

`LL_I2C_EnableIT_ERR`

Function name

__STATIC_INLINE void LL_I2C_EnableIT_ERR (I2C_TypeDef * I2Cx)

Function description

Enable Error interrupts.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- Any of these errors will generate interrupt : Arbitration Loss (ARLO) Bus Error detection (BERR) Overrun/ Underrun (OVR) SMBus Timeout detection (TIMEOUT) SMBus PEC error detection (PECERR) SMBus Alert pin event detection (ALERT)

Reference Manual to LL API cross reference:

- CR1 ERRIE LL_I2C_EnableIT_ERR

`LL_I2C_DisableIT_ERR`

Function name

__STATIC_INLINE void LL_I2C_DisableIT_ERR (I2C_TypeDef * I2Cx)

Function description

Disable Error interrupts.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- Any of these errors will generate interrupt : Arbitration Loss (ARLO) Bus Error detection (BERR) Overrun/ Underrun (OVR) SMBus Timeout detection (TIMEOUT) SMBus PEC error detection (PECERR) SMBus Alert pin event detection (ALERT)

Reference Manual to LL API cross reference:

- CR1 ERRIE LL_I2C_DisableIT_ERR

`LL_I2C_IsEnabledIT_ERR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_ERR (I2C_TypeDef * I2Cx)

Function description

Check if Error interrupts are enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 ERRIE LL_I2C_IsEnabledIT_ERR

`LL_I2C_IsActiveFlag_TXE`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TXE (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Transmit data register empty flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: When next data is written in Transmit data register. SET: When Transmit data register is empty.

Reference Manual to LL API cross reference:

- ISR TXE LL_I2C_IsActiveFlag_TXE

LL_I2C_IsActiveFlag_TXIS

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TXIS (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Transmit interrupt flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: When next data is written in Transmit data register. SET: When Transmit data register is empty.

Reference Manual to LL API cross reference:

- ISR TXIS LL_I2C_IsActiveFlag_TXIS

LL_I2C_IsActiveFlag_RXNE

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_RXNE (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Receive data register not empty flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: When Receive data register is read. SET: When the received data is copied in Receive data register.

Reference Manual to LL API cross reference:

- ISR RXNE LL_I2C_IsActiveFlag_RXNE

`LL_I2C_IsActiveFlag_ADDR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_ADDR (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Address matched flag (slave mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When the received slave address matched with one of the enabled slave address.

Reference Manual to LL API cross reference:

- ISR ADDR LL_I2C_IsActiveFlag_ADDR

`LL_I2C_IsActiveFlag_NACK`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_NACK (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Not Acknowledge received flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When a NACK is received after a byte transmission.

Reference Manual to LL API cross reference:

- ISR NACKF LL_I2C_IsActiveFlag_NACK

`LL_I2C_IsActiveFlag_STOP`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_STOP (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Stop detection flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When a Stop condition is detected.

Reference Manual to LL API cross reference:

- ISR STOPF LL_I2C_IsActiveFlag_STOP

`LL_I2C_IsActiveFlag_TC`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TC (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Transfer complete flag (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When RELOAD=0, AUTOEND=0 and NBYTES date have been transferred.

Reference Manual to LL API cross reference:

- ISR TC LL_I2C_IsActiveFlag_TC

`LL_I2C_IsActiveFlag_TCR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_TCR (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Transfer complete flag (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When RELOAD=1 and NBYTES date have been transferred.

Reference Manual to LL API cross reference:

- ISR TCR LL_I2C_IsActiveFlag_TCR

`LL_I2C_IsActiveFlag_BERR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_BERR (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Bus error flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When a misplaced Start or Stop condition is detected.

Reference Manual to LL API cross reference:

- ISR BERR LL_I2C_IsActiveFlag_BERR

`LL_I2C_IsActiveFlag_ARLO`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_ARLO (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Arbitration lost flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When arbitration lost.

Reference Manual to LL API cross reference:

- ISR ARLO LL_I2C_IsActiveFlag_ARLO

`LL_I2C_IsActiveFlag_OVR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_OVR (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Overrun/Underrun flag (slave mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When an overrun/underrun error occurs (Clock Stretching Disabled).

Reference Manual to LL API cross reference:

- ISR OVR LL_I2C_IsActiveFlag_OVR

`LL_I2C_IsActiveSMBusFlag_PECERR`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_PECERR (I2C_TypeDef * I2Cx)

Function description

Indicate the status of SMBus PEC error flag in reception.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- RESET: Clear default value. SET: When the received PEC does not match with the PEC register content.

Reference Manual to LL API cross reference:

- ISR PECERR LL_I2C_IsActiveSMBusFlag_PECERR

`LL_I2C_IsActiveSMBusFlag_TIMEOUT`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_TIMEOUT (I2C_TypeDef * I2Cx)

Function description

Indicate the status of SMBus Timeout detection flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- RESET: Clear default value. SET: When a timeout or extended clock timeout occurs.

Reference Manual to LL API cross reference:

- ISR TIMEOUT LL_I2C_IsActiveSMBusFlag_TIMEOUT

`LL_I2C_IsActiveSMBusFlag_ALERT`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_ALERT (I2C_TypeDef * I2Cx)

Function description

Indicate the status of SMBus alert flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- RESET: Clear default value. SET: When SMBus host configuration, SMBus alert enabled and a falling edge event occurs on SMBA pin.

Reference Manual to LL API cross reference:

- ISR ALERT LL_I2C_IsActiveSMBusFlag_ALERT

`LL_I2C_IsActiveFlag_BUSY`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_BUSY (I2C_TypeDef * I2Cx)

Function description

Indicate the status of Bus Busy flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- RESET: Clear default value. SET: When a Start condition is detected.

Reference Manual to LL API cross reference:

- ISR BUSY LL_I2C_IsActiveFlag_BUSY

`LL_I2C_ClearFlag_ADDR`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_ADDR (I2C_TypeDef * I2Cx)

Function description

Clear Address Matched flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ADDRCF LL_I2C_ClearFlag_ADDR

`LL_I2C_ClearFlag_NACK`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_NACK (I2C_TypeDef * I2Cx)

Function description

Clear Not Acknowledge flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR NACKCF LL_I2C_ClearFlag_NACK

`LL_I2C_ClearFlag_STOP`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_STOP (I2C_TypeDef * I2Cx)

Function description

Clear Stop detection flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR STOPCF LL_I2C_ClearFlag_STOP

`LL_I2C_ClearFlag_TXE`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_TXE (I2C_TypeDef * I2Cx)

Function description

Clear Transmit data register empty flag (TXE).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- This bit can be clear by software in order to flush the transmit data register (TXDR).

Reference Manual to LL API cross reference:

- ISR TXE LL_I2C_ClearFlag_TXE

`LL_I2C_ClearFlag_BERR`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_BERR (I2C_TypeDef * I2Cx)

Function description

Clear Bus error flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR BERRCF LL_I2C_ClearFlag_BERR

`LL_I2C_ClearFlag_ARLO`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_ARLO (I2C_TypeDef * I2Cx)

Function description

Clear Arbitration lost flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ARLOCF LL_I2C_ClearFlag_ARLO

`LL_I2C_ClearFlag_OVR`

Function name

__STATIC_INLINE void LL_I2C_ClearFlag_OVR (I2C_TypeDef * I2Cx)

Function description

Clear Overrun/Underrun flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR OVRCF LL_I2C_ClearFlag_OVR

`LL_I2C_ClearSMBusFlag_PECERR`

Function name

__STATIC_INLINE void LL_I2C_ClearSMBusFlag_PECERR (I2C_TypeDef * I2Cx)

Function description

Clear SMBus PEC error flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- ICR PECCF LL_I2C_ClearSMBusFlag_PECERR

`LL_I2C_ClearSMBusFlag_TIMEOUT`

Function name

__STATIC_INLINE void LL_I2C_ClearSMBusFlag_TIMEOUT (I2C_TypeDef * I2Cx)

Function description

Clear SMBus Timeout detection flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- ICR TIMOUTCF LL_I2C_ClearSMBusFlag_TIMEOUT

`LL_I2C_ClearSMBusFlag_ALERT`

Function name

__STATIC_INLINE void LL_I2C_ClearSMBusFlag_ALERT (I2C_TypeDef * I2Cx)

Function description

Clear SMBus Alert flag.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- ICR ALERTCF LL_I2C_ClearSMBusFlag_ALERT

`LL_I2C_EnableAutoEndMode`

Function name

__STATIC_INLINE void LL_I2C_EnableAutoEndMode (I2C_TypeDef * I2Cx)

Function description

Enable automatic STOP condition generation (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Automatic end mode : a STOP condition is automatically sent when NBYTES data are transferred. This bit has no effect in slave mode or when RELOAD bit is set.

Reference Manual to LL API cross reference:

- CR2 AUTOEND LL_I2C_EnableAutoEndMode

LL_I2C_DisableAutoEndMode

Function name

__STATIC_INLINE void LL_I2C_DisableAutoEndMode (I2C_TypeDef * I2Cx)

Function description

Disable automatic STOP condition generation (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Software end mode : TC flag is set when NBYTES data are transferre, stretching SCL low.

Reference Manual to LL API cross reference:

- CR2 AUTOEND LL_I2C_DisableAutoEndMode

LL_I2C_IsEnabledAutoEndMode

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledAutoEndMode (I2C_TypeDef * I2Cx)

Function description

Check if automatic STOP condition is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 AUTOEND LL_I2C_IsEnabledAutoEndMode

LL_I2C_EnableReloadMode

Function name

__STATIC_INLINE void LL_I2C_EnableReloadMode (I2C_TypeDef * I2Cx)

Function description

Enable reload mode (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- The transfer is not completed after the NBYTES data transfer, NBYTES will be reloaded when TCR flag is set.

Reference Manual to LL API cross reference:

- CR2 RELOAD LL_I2C_EnableReloadMode

LL_I2C_DisableReloadMode

Function name

__STATIC_INLINE void LL_I2C_DisableReloadMode (I2C_TypeDef * I2Cx)

Function description

Disable reload mode (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- The transfer is completed after the NBYTES data transfer(STOP or RESTART will follow).

Reference Manual to LL API cross reference:

- CR2 RELOAD LL_I2C_DisableReloadMode

LL_I2C_IsEnabledReloadMode

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledReloadMode (I2C_TypeDef * I2Cx)

Function description

Check if reload mode is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RELOAD LL_I2C_IsEnabledReloadMode

LL_I2C_SetTransferSize

Function name

__STATIC_INLINE void LL_I2C_SetTransferSize (I2C_TypeDef * I2Cx, uint32_t TransferSize)

Function description

Configure the number of bytes for transfer.

Parameters

- **I2Cx:** I2C Instance.
- **TransferSize:** This parameter must be a value between Min_Data=0x00 and Max_Data=0xFF.

Return values

- **None:**

Notes

- Changing these bits when START bit is set is not allowed.

Reference Manual to LL API cross reference:

- CR2 NBYTES LL_I2C_SetTransferSize

`LL_I2C_GetTransferSize`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetTransferSize (I2C_TypeDef * I2Cx)

Function description

Get the number of bytes configured for transfer.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x0 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- CR2 NBYTES LL_I2C_GetTransferSize

`LL_I2C_AcknowledgeNextData`

Function name

__STATIC_INLINE void LL_I2C_AcknowledgeNextData (I2C_TypeDef * I2Cx, uint32_t TypeAcknowledge)

Function description

Prepare the generation of a ACKnowledge or Non ACKnowledge condition after the address receive match code or next received byte.

Parameters

- **I2Cx:** I2C Instance.
- **TypeAcknowledge:** This parameter can be one of the following values:
  - LL_I2C_ACK
  - LL_I2C_NACK

Return values

- **None:**

Notes

- Usage in Slave mode only.

Reference Manual to LL API cross reference:

- CR2 NACK LL_I2C_AcknowledgeNextData

`LL_I2C_GenerateStartCondition`

Function name

__STATIC_INLINE void LL_I2C_GenerateStartCondition (I2C_TypeDef * I2Cx)

Function description

Generate a START or RESTART condition.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- The START bit can be set even if bus is BUSY or I2C is in slave mode. This action has no effect when RELOAD is set.

Reference Manual to LL API cross reference:

- CR2 START LL_I2C_GenerateStartCondition

`LL_I2C_GenerateStopCondition`

Function name

__STATIC_INLINE void LL_I2C_GenerateStopCondition (I2C_TypeDef * I2Cx)

Function description

Generate a STOP condition after the current byte transfer (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 STOP LL_I2C_GenerateStopCondition

`LL_I2C_EnableAuto10BitRead`

Function name

__STATIC_INLINE void LL_I2C_EnableAuto10BitRead (I2C_TypeDef * I2Cx)

Function description

Enable automatic RESTART Read request condition for 10bit address header (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- The master sends the complete 10bit slave address read sequence : Start + 2 bytes 10bit address in Write direction + Restart + first 7 bits of 10bit address in Read direction.

Reference Manual to LL API cross reference:

- CR2 HEAD10R LL_I2C_EnableAuto10BitRead

`LL_I2C_DisableAuto10BitRead`

Function name

__STATIC_INLINE void LL_I2C_DisableAuto10BitRead (I2C_TypeDef * I2Cx)

Function description

Disable automatic RESTART Read request condition for 10bit address header (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- The master only sends the first 7 bits of 10bit address in Read direction.

Reference Manual to LL API cross reference:

- CR2 HEAD10R LL_I2C_DisableAuto10BitRead

LL_I2C_IsEnabledAuto10BitRead

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledAuto10BitRead (I2C_TypeDef * I2Cx)

Function description

Check if automatic RESTART Read request condition for 10bit address header is enabled or disabled.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 HEAD10R LL_I2C_IsEnabledAuto10BitRead

LL_I2C_SetTransferRequest

Function name

__STATIC_INLINE void LL_I2C_SetTransferRequest (I2C_TypeDef * I2Cx, uint32_t TransferRequest)

Function description

Configure the transfer direction (master mode).

Parameters

- **I2Cx:** I2C Instance.
- **TransferRequest:** This parameter can be one of the following values:
  - LL_I2C_REQUEST_WRITE
  - LL_I2C_REQUEST_READ

Return values

- **None:**

Notes

- Changing these bits when START bit is set is not allowed.

Reference Manual to LL API cross reference:

- CR2 RD_WRN LL_I2C_SetTransferRequest

LL_I2C_GetTransferRequest

Function name

__STATIC_INLINE uint32_t LL_I2C_GetTransferRequest (I2C_TypeDef * I2Cx)

Function description

Get the transfer direction requested (master mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Returned:** value can be one of the following values:
  - LL_I2C_REQUEST_WRITE
  - LL_I2C_REQUEST_READ

Reference Manual to LL API cross reference:

- CR2 RD_WRN LL_I2C_GetTransferRequest

LL_I2C_SetSlaveAddr

Function name

__STATIC_INLINE void LL_I2C_SetSlaveAddr (I2C_TypeDef * I2Cx, uint32_t SlaveAddr)

Function description

Configure the slave address for transfer (master mode).

Parameters

- **I2Cx:** I2C Instance.
- **SlaveAddr:** This parameter must be a value between Min_Data=0x00 and Max_Data=0x3F.

Return values

- **None:**

Notes

- Changing these bits when START bit is set is not allowed.

Reference Manual to LL API cross reference:

- CR2 SADD LL_I2C_SetSlaveAddr

LL_I2C_GetSlaveAddr

Function name

__STATIC_INLINE uint32_t LL_I2C_GetSlaveAddr (I2C_TypeDef * I2Cx)

Function description

Get the slave address programmed for transfer.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x0 and Max_Data=0x3F

Reference Manual to LL API cross reference:

- CR2 SADD LL_I2C_GetSlaveAddr

`LL_I2C_HandleTransfer`

Function name

__STATIC_INLINE void LL_I2C_HandleTransfer (I2C_TypeDef * I2Cx, uint32_t SlaveAddr, uint32_t SlaveAddrSize, uint32_t TransferSize, uint32_t EndMode, uint32_t Request)

Function description

Handles I2Cx communication when starting transfer or during transfer (TC or TCR flag are set).

Parameters

- **I2Cx:** I2C Instance.
- **SlaveAddr:** Specifies the slave address to be programmed.
- **SlaveAddrSize:** This parameter can be one of the following values:
  - LL_I2C_ADDRSLAVE_7BIT
  - LL_I2C_ADDRSLAVE_10BIT
- **TransferSize:** Specifies the number of bytes to be programmed. This parameter must be a value between Min_Data=0 and Max_Data=255.
- **EndMode:** This parameter can be one of the following values:
  - LL_I2C_MODE_RELOAD
  - LL_I2C_MODE_AUTOEND
  - LL_I2C_MODE_SOFTEND
  - LL_I2C_MODE_SMBUS_RELOAD
  - LL_I2C_MODE_SMBUS_AUTOEND_NO_PEC
  - LL_I2C_MODE_SMBUS_SOFTEND_NO_PEC
  - LL_I2C_MODE_SMBUS_AUTOEND_WITH_PEC
  - LL_I2C_MODE_SMBUS_SOFTEND_WITH_PEC
- **Request:** This parameter can be one of the following values:
  - LL_I2C_GENERATE_NOSTARTSTOP
  - LL_I2C_GENERATE_STOP
  - LL_I2C_GENERATE_START_READ
  - LL_I2C_GENERATE_START_WRITE
  - LL_I2C_GENERATE_RESTART_7BIT_READ
  - LL_I2C_GENERATE_RESTART_7BIT_WRITE
  - LL_I2C_GENERATE_RESTART_10BIT_READ
  - LL_I2C_GENERATE_RESTART_10BIT_WRITE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 SADD LL_I2C_HandleTransfer
- CR2 ADD10 LL_I2C_HandleTransfer
- CR2 RD_WRN LL_I2C_HandleTransfer
- CR2 START LL_I2C_HandleTransfer
- CR2 STOP LL_I2C_HandleTransfer
- CR2 RELOAD LL_I2C_HandleTransfer
- CR2 NBYTES LL_I2C_HandleTransfer
- CR2 AUTOEND LL_I2C_HandleTransfer
- CR2 HEAD10R LL_I2C_HandleTransfer

LL_I2C_GetTransferDirection

Function name

__STATIC_INLINE uint32_t LL_I2C_GetTransferDirection (I2C_TypeDef * I2Cx)

Function description

Indicate the value of transfer direction (slave mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Returned:** value can be one of the following values:
  - LL_I2C_DIRECTION_WRITE
  - LL_I2C_DIRECTION_READ

Notes

- RESET: Write transfer, Slave enters in receiver mode. SET: Read transfer, Slave enters in transmitter mode.

Reference Manual to LL API cross reference:

- ISR DIR LL_I2C_GetTransferDirection

LL_I2C_GetAddressMatchCode

Function name

__STATIC_INLINE uint32_t LL_I2C_GetAddressMatchCode (I2C_TypeDef * I2Cx)

Function description

Return the slave matched address.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x3F

Reference Manual to LL API cross reference:

- ISR ADDCODE LL_I2C_GetAddressMatchCode

LL_I2C_EnableSMBusPECCompare

Function name

__STATIC_INLINE void LL_I2C_EnableSMBusPECCompare (I2C_TypeDef * I2Cx)

Function description

Enable internal comparison of the SMBus Packet Error byte (transmission or reception mode).

Parameters

- **I2Cx:** I2C Instance.

Return values

- **None:**

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.
- This feature is cleared by hardware when the PEC byte is transferred, or when a STOP condition or an Address Matched is received. This bit has no effect when RELOAD bit is set. This bit has no effect in device mode when SBC bit is not set.

Reference Manual to LL API cross reference:

- CR2 PECBYTE LL_I2C_EnableSMBusPECCompare

`LL_I2C_IsEnabledSMBusPECCompare`

Function name

__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusPECCompare (I2C_TypeDef * I2Cx)

Function description

Check if the SMBus Packet Error byte internal comparison is requested or not.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- CR2 PECBYTE LL_I2C_IsEnabledSMBusPECCompare

`LL_I2C_GetSMBusPEC`

Function name

__STATIC_INLINE uint32_t LL_I2C_GetSMBusPEC (I2C_TypeDef * I2Cx)

Function description

Get the SMBus Packet Error byte calculated.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Notes

- Macro IS_SMBUS_ALL_INSTANCE(I2Cx) can be used to check whether or not SMBus feature is supported by the I2Cx Instance.

Reference Manual to LL API cross reference:

- PECR PEC LL_I2C_GetSMBusPEC

`LL_I2C_ReceiveData8`

Function name

__STATIC_INLINE uint8_t LL_I2C_ReceiveData8 (I2C_TypeDef * I2Cx)

Function description

Read Receive Data register.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- RXDR RXDATA LL_I2C_ReceiveData8

`LL_I2C_TransmitData8`

Function name

__STATIC_INLINE void LL_I2C_TransmitData8 (I2C_TypeDef * I2Cx, uint8_t Data)

Function description

Write in Transmit Data Register .

Parameters

- **I2Cx:** I2C Instance.
- **Data:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- TXDR TXDATA LL_I2C_TransmitData8

`LL_I2C_Init`

Function name

ErrorStatus LL_I2C_Init (I2C_TypeDef * I2Cx, LL_I2C_InitTypeDef * I2C_InitStruct)

Function description

Initialize the I2C registers according to the specified parameters in I2C_InitStruct.

Parameters

- **I2Cx:** I2C Instance.
- **I2C_InitStruct:** pointer to a LL_I2C_InitTypeDef structure.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: I2C registers are initialized
  - ERROR: Not applicable

`LL_I2C_DeInit`

Function name

ErrorStatus LL_I2C_DeInit (I2C_TypeDef * I2Cx)

Function description

De-initialize the I2C registers to their default reset values.

Parameters

- **I2Cx:** I2C Instance.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: I2C registers are de-initialized
  - ERROR: I2C registers are not de-initialized

`LL_I2C_StructInit`

Function name

void LL_I2C_StructInit (LL_I2C_InitTypeDef * I2C_InitStruct)

Function description

Set each LL_I2C_InitTypeDef field to default value.

Parameters

- **I2C_InitStruct:** Pointer to a LL_I2C_InitTypeDef structure.

Return values

- **None:**

92.3 I2C Firmware driver defines

The following section lists the various define and macros of the module.

92.3.1 I2C

I2C

Master Addressing Mode

LL_I2C_ADDRESSING_MODE_7BIT

Master operates in 7-bit addressing mode.

LL_I2C_ADDRESSING_MODE_10BIT

Master operates in 10-bit addressing mode.

Slave Address Length

LL_I2C_ADDRSLAVE_7BIT

Slave Address in 7-bit.

LL_I2C_ADDRSLAVE_10BIT

Slave Address in 10-bit.

Analog Filter Selection

LL_I2C_ANALOGFILTER_ENABLE

Analog filter is enabled.

LL_I2C_ANALOGFILTER_DISABLE

Analog filter is disabled.

Clear Flags Defines

LL_I2C_ICR_ADDRCF

Address Matched flag

LL_I2C_ICR_NACKCF

Not Acknowledge flag

LL_I2C_ICR_STOPCF

Stop detection flag

LL_I2C_ICR_BERRCF

Bus error flag

LL_I2C_ICR_ARLOCF

Arbitration Lost flag

LL_I2C_ICR_OVRCF

Overrun/Underrun flag

LL_I2C_ICR_PECCF

PEC error flag

LL_I2C_ICR_TIMOUTCF

Timeout detection flag

LL_I2C_ICR_ALERTCF

Alert flag

Read Write Direction

LL_I2C_DIRECTION_WRITE

Write transfer request by master, slave enters receiver mode.

LL_I2C_DIRECTION_READ

Read transfer request by master, slave enters transmitter mode.

DMA Register Data

LL_I2C_DMA_REG_DATA_TRANSMIT

Get address of data register used for transmission

LL_I2C_DMA_REG_DATA_RECEIVE

Get address of data register used for reception

Start And Stop Generation

LL_I2C_GENERATE_NOSTARTSTOP

Don't Generate Stop and Start condition.

LL_I2C_GENERATE_STOP

Generate Stop condition (Size should be set to 0).

LL_I2C_GENERATE_START_READ

Generate Start for read request.

LL_I2C_GENERATE_START_WRITE

Generate Start for write request.

LL_I2C_GENERATE_RESTART_7BIT_READ

Generate Restart for read request, slave 7Bit address.

LL_I2C_GENERATE_RESTART_7BIT_WRITE

Generate Restart for write request, slave 7Bit address.

LL_I2C_GENERATE_RESTART_10BIT_READ

Generate Restart for read request, slave 10Bit address.

LL_I2C_GENERATE_RESTART_10BIT_WRITE

Generate Restart for write request, slave 10Bit address.

Get Flags Defines

LL_I2C_ISR_TXE

Transmit data register empty

LL_I2C_ISR_TXIS

Transmit interrupt status

LL_I2C_ISR_RXNE

Receive data register not empty

LL_I2C_ISR_ADDR

Address matched (slave mode)

LL_I2C_ISR_NACKF

Not Acknowledge received flag

LL_I2C_ISR_STOPF

Stop detection flag

LL_I2C_ISR_TC

Transfer Complete (master mode)

LL_I2C_ISR_TCR

Transfer Complete Reload

LL_I2C_ISR_BERR

Bus error

LL_I2C_ISR_ARLO

Arbitration lost

LL_I2C_ISR_OVR

Overrun/Underrun (slave mode)

LL_I2C_ISR_PECERR

PEC Error in reception (SMBus mode)

LL_I2C_ISR_TIMEOUT

Timeout detection flag (SMBus mode)

LL_I2C_ISR_ALERT

SMBus alert (SMBus mode)

LL_I2C_ISR_BUSY

Bus busy

Acknowledge Generation

LL_I2C_ACK

ACK is sent after current received byte.

LL_I2C_NACK

NACK is sent after current received byte.

IT Defines

LL_I2C_CR1_TXIE

TX Interrupt enable

LL_I2C_CR1_RXIE

RX Interrupt enable

LL_I2C_CR1_ADDRIE

Address match Interrupt enable (slave only)

LL_I2C_CR1_NACKIE

Not acknowledge received Interrupt enable

LL_I2C_CR1_STOPIE

STOP detection Interrupt enable

LL_I2C_CR1_TCIE

Transfer Complete interrupt enable

LL_I2C_CR1_ERRIE

Error interrupts enable

Transfer End Mode

LL_I2C_MODE_RELOAD

Enable I2C Reload mode.

LL_I2C_MODE_AUTOEND

Enable I2C Automatic end mode with no HW PEC comparison.

LL_I2C_MODE_SOFTEND

Enable I2C Software end mode with no HW PEC comparison.

LL_I2C_MODE_SMBUS_RELOAD

Enable SMBUS Automatic end mode with HW PEC comparison.

LL_I2C_MODE_SMBUS_AUTOEND_NO_PEC

Enable SMBUS Automatic end mode with HW PEC comparison.

LL_I2C_MODE_SMBUS_SOFTEND_NO_PEC

Enable SMBUS Software end mode with HW PEC comparison.

LL_I2C_MODE_SMBUS_AUTOEND_WITH_PEC

Enable SMBUS Automatic end mode with HW PEC comparison.

LL_I2C_MODE_SMBUS_SOFTEND_WITH_PEC

Enable SMBUS Software end mode with HW PEC comparison.

Own Address 1 Length

LL_I2C_OWNADDRESS1_7BIT

Own address 1 is a 7-bit address.

LL_I2C_OWNADDRESS1_10BIT

Own address 1 is a 10-bit address.

Own Address 2 Masks

LL_I2C_OWNADDRESS2_NOMASK

Own Address2 No mask.

LL_I2C_OWNADDRESS2_MASK01

Only Address2 bits[7:2] are compared.

LL_I2C_OWNADDRESS2_MASK02

Only Address2 bits[7:3] are compared.

LL_I2C_OWNADDRESS2_MASK03

Only Address2 bits[7:4] are compared.

LL_I2C_OWNADDRESS2_MASK04

Only Address2 bits[7:5] are compared.

LL_I2C_OWNADDRESS2_MASK05

Only Address2 bits[7:6] are compared.

LL_I2C_OWNADDRESS2_MASK06

Only Address2 bits[7] are compared.

LL_I2C_OWNADDRESS2_MASK07

No comparison is done. All Address2 are acknowledged.

Peripheral Mode

LL_I2C_MODE_I2C

I2C Master or Slave mode

LL_I2C_MODE_SMBUS_HOST

SMBus Host address acknowledge

LL_I2C_MODE_SMBUS_DEVICE

SMBus Device default mode (Default address not acknowledge)

LL_I2C_MODE_SMBUS_DEVICE_ARP

SMBus Device Default address acknowledge

Transfer Request Direction

LL_I2C_REQUEST_WRITE

Master request a write transfer.

LL_I2C_REQUEST_READ

Master request a read transfer.

SMBus TimeoutA Mode SCL SDA Timeout

LL_I2C_SMBUS_TIMEOUTA_MODE_SCL_LOW

TimeoutA is used to detect SCL low level timeout.

LL_I2C_SMBUS_TIMEOUTA_MODE_SDA_SCL_HIGH

TimeoutA is used to detect both SCL and SDA high level timeout.

SMBus Timeout Selection

LL_I2C_SMBUS_TIMEOUTA

TimeoutA enable bit

LL_I2C_SMBUS_TIMEOUTB

TimeoutB (extended clock) enable bit

LL_I2C_SMBUS_ALL_TIMEOUT

TimeoutA and TimeoutB (extended clock) enable bits

Convert SDA SCL timings

__LL_I2C_CONVERT_TIMINGS

Description:

- Configure the SDA setup, hold time and the SCL high, low period.

Parameters:

- __PRESCALER__: This parameter must be a value between Min_Data=0 and Max_Data=0xF.
- __DATA_SETUP_TIME__: This parameter must be a value between Min_Data=0 and Max_Data=0xF. (tscldel = (SCLDEL+1)xtpresc)
- __DATA_HOLD_TIME__: This parameter must be a value between Min_Data=0 and Max_Data=0xF. (tsdadel = SDADELxtpresc)
- __CLOCK_HIGH_PERIOD__: This parameter must be a value between Min_Data=0 and Max_Data=0xFF. (tsclh = (SCLH+1)xtpresc)
- __CLOCK_LOW_PERIOD__: This parameter must be a value between Min_Data=0 and Max_Data=0xFF. (tscll = (SCLL+1)xtpresc)

Return value:

- Value: between Min_Data=0 and Max_Data=0xFFFFFFFF

Common Write and read registers Macros

LL_I2C_WriteReg

Description:

- Write a value in I2C register.

Parameters:

- __INSTANCE__: I2C Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_I2C_ReadReg

Description:

- Read a value in I2C register.

Parameters:

- __INSTANCE__: I2C Instance
- __REG__: Register to be read

Return value:

- Register: value

93 LL IWDG Generic Driver

93.1 IWDG Firmware driver API description

The following section lists the various functions of the IWDG library.

93.1.1 Detailed description of functions

`LL_IWDG_Enable`

Function name

__STATIC_INLINE void LL_IWDG_Enable (IWDG_TypeDef * IWDGx)

Function description

Start the Independent Watchdog.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **None:**

Notes

- Except if the hardware watchdog option is selected

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_Enable

`LL_IWDG_ReloadCounter`

Function name

__STATIC_INLINE void LL_IWDG_ReloadCounter (IWDG_TypeDef * IWDGx)

Function description

Reloads IWDG counter with value defined in the reload register.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_ReloadCounter

`LL_IWDG_EnableWriteAccess`

Function name

__STATIC_INLINE void LL_IWDG_EnableWriteAccess (IWDG_TypeDef * IWDGx)

Function description

Enable write access to IWDG_PR, IWDG_RLR and IWDG_WINR registers.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_EnableWriteAccess

`LL_IWDG_DisableWriteAccess`

Function name

__STATIC_INLINE void LL_IWDG_DisableWriteAccess (IWDG_TypeDef * IWDGx)

Function description

Disable write access to IWDG_PR, IWDG_RLR and IWDG_WINR registers.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- KR KEY LL_IWDG_DisableWriteAccess

`LL_IWDG_SetPrescaler`

Function name

__STATIC_INLINE void LL_IWDG_SetPrescaler (IWDG_TypeDef * IWDGx, uint32_t Prescaler)

Function description

Select the prescaler of the IWDG.

Parameters

- **IWDGx:** IWDG Instance
- **Prescaler:** This parameter can be one of the following values:
  - LL_IWDG_PRESCALER_4
  - LL_IWDG_PRESCALER_8
  - LL_IWDG_PRESCALER_16
  - LL_IWDG_PRESCALER_32
  - LL_IWDG_PRESCALER_64
  - LL_IWDG_PRESCALER_128
  - LL_IWDG_PRESCALER_256

Return values

- **None:**

Reference Manual to LL API cross reference:

- PR PR LL_IWDG_SetPrescaler

`LL_IWDG_GetPrescaler`

Function name

__STATIC_INLINE uint32_t LL_IWDG_GetPrescaler (IWDG_TypeDef * IWDGx)

Function description

Get the selected prescaler of the IWDG.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_IWDG_PRESCALER_4
  - LL_IWDG_PRESCALER_8
  - LL_IWDG_PRESCALER_16
  - LL_IWDG_PRESCALER_32
  - LL_IWDG_PRESCALER_64
  - LL_IWDG_PRESCALER_128
  - LL_IWDG_PRESCALER_256

Reference Manual to LL API cross reference:

- PR PR LL_IWDG_GetPrescaler

`LL_IWDG_SetReloadCounter`

Function name

__STATIC_INLINE void LL_IWDG_SetReloadCounter (IWDG_TypeDef * IWDGx, uint32_t Counter)

Function description

Specify the IWDG down-counter reload value.

Parameters

- **IWDGx:** IWDG Instance
- **Counter:** Value between Min_Data=0 and Max_Data=0x0FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- RLR RL LL_IWDG_SetReloadCounter

`LL_IWDG_GetReloadCounter`

Function name

__STATIC_INLINE uint32_t LL_IWDG_GetReloadCounter (IWDG_TypeDef * IWDGx)

Function description

Get the specified IWDG down-counter reload value.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **Value:** between Min_Data=0 and Max_Data=0x0FFF

Reference Manual to LL API cross reference:

- RLR RL LL_IWDG_GetReloadCounter

`LL_IWDG_SetWindow`

Function name

__STATIC_INLINE void LL_IWDG_SetWindow (IWDG_TypeDef * IWDGx, uint32_t Window)

Function description

Specify high limit of the window value to be compared to the down-counter.

Parameters

- **IWDGx:** IWDG Instance
- **Window:** Value between Min_Data=0 and Max_Data=0x0FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- WINR WIN LL_IWDG_SetWindow

LL_IWDG_GetWindow

Function name

__STATIC_INLINE uint32_t LL_IWDG_GetWindow (IWDG_TypeDef * IWDGx)

Function description

Get the high limit of the window value specified.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **Value:** between Min_Data=0 and Max_Data=0x0FFF

Reference Manual to LL API cross reference:

- WINR WIN LL_IWDG_GetWindow

LL_IWDG_IsActiveFlag_PVU

Function name

__STATIC_INLINE uint32_t LL_IWDG_IsActiveFlag_PVU (IWDG_TypeDef * IWDGx)

Function description

Check if flag Prescaler Value Update is set or not.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR PVU LL_IWDG_IsActiveFlag_PVU

LL_IWDG_IsActiveFlag_RVU

Function name

__STATIC_INLINE uint32_t LL_IWDG_IsActiveFlag_RVU (IWDG_TypeDef * IWDGx)

Function description

Check if flag Reload Value Update is set or not.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR RVU LL_IWDG_IsActiveFlag_RVU

`LL_IWDG_IsActiveFlag_WVU`

Function name

__STATIC_INLINE uint32_t LL_IWDG_IsActiveFlag_WVU (IWDG_TypeDef * IWDGx)

Function description

Check if flag Window Value Update is set or not.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR WVU LL_IWDG_IsActiveFlag_WVU

`LL_IWDG_IsReady`

Function name

__STATIC_INLINE uint32_t LL_IWDG_IsReady (IWDG_TypeDef * IWDGx)

Function description

Check if all flags Prescaler, Reload & Window Value Update are reset or not.

Parameters

- **IWDGx:** IWDG Instance

Return values

- **State:** of bits (1 or 0).

Reference Manual to LL API cross reference:

- SR PVU LL_IWDG_IsReady
- SR WVU LL_IWDG_IsReady
- SR RVU LL_IWDG_IsReady

93.2 IWDG Firmware driver defines

The following section lists the various define and macros of the module.

93.2.1 IWDG

IWDG

Get Flags Defines

LL_IWDG_SR_PVU

Watchdog prescaler value update

LL_IWDG_SR_RVU

Watchdog counter reload value update

LL_IWDG_SR_WVU

Watchdog counter window value update

Prescaler Divider

LL_IWDG_PRESCALER_4

Divider by 4

LL_IWDG_PRESCALER_8

Divider by 8

LL_IWDG_PRESCALER_16

Divider by 16

LL_IWDG_PRESCALER_32

Divider by 32

LL_IWDG_PRESCALER_64

Divider by 64

LL_IWDG_PRESCALER_128

Divider by 128

LL_IWDG_PRESCALER_256

Divider by 256

Common Write and read registers Macros

LL_IWDG_WriteReg

Description:

- Write a value in IWDG register.

Parameters:

- __INSTANCE__: IWDG Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_IWDG_ReadReg

Description:

- Read a value in IWDG register.

Parameters:

- __INSTANCE__: IWDG Instance
- __REG__: Register to be read

Return value:

- Register: value

94 LL LPTIM Generic Driver

94.1 LPTIM Firmware driver registers structures

94.1.1 LL_LPTIM_InitTypeDef

LL_LPTIM_InitTypeDef is defined in the stm32l4xx_ll_lptim.h

Data Fields

- ***uint32_t ClockSource***
- ***uint32_t Prescaler***
- ***uint32_t Waveform***
- ***uint32_t Polarity***

Field Documentation

- ***uint32_t LL_LPTIM_InitTypeDef::ClockSource***

  Specifies the source of the clock used by the LPTIM instance. This parameter can be a value of ***LPTIM_LL_EC_CLK_SOURCE***.This feature can be modified afterwards using unitary function **LL_LPTIM_SetClockSource()**.
- ***uint32_t LL_LPTIM_InitTypeDef::Prescaler***

  Specifies the prescaler division ratio. This parameter can be a value of ***LPTIM_LL_EC_PRESCALER***.This feature can be modified afterwards using using unitary function **LL_LPTIM_SetPrescaler()**.
- ***uint32_t LL_LPTIM_InitTypeDef::Waveform***

  Specifies the waveform shape. This parameter can be a value of ***LPTIM_LL_EC_OUTPUT_WAVEFORM***.This feature can be modified afterwards using unitary function **LL_LPTIM_ConfigOutput()**.
- ***uint32_t LL_LPTIM_InitTypeDef::Polarity***

  Specifies waveform polarity. This parameter can be a value of ***LPTIM_LL_EC_OUTPUT_POLARITY***.This feature can be modified afterwards using unitary function **LL_LPTIM_ConfigOutput()**.

94.2 LPTIM Firmware driver API description

The following section lists the various functions of the LPTIM library.

94.2.1 Detailed description of functions

`LL_LPTIM_DeInit`

Function name

ErrorStatus LL_LPTIM_DeInit (LPTIM_TypeDef * LPTIMx)

Function description

Set LPTIMx registers to their reset values.

Parameters

- **LPTIMx:** LP Timer instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: LPTIMx registers are de-initialized
  - ERROR: invalid LPTIMx instance

LL_LPTIM_StructInit

Function name

void LL_LPTIM_StructInit (LL_LPTIM_InitTypeDef * LPTIM_InitStruct)

Function description

Set each fields of the LPTIM_InitStruct structure to its default value.

Parameters

- **LPTIM_InitStruct:** pointer to a LL_LPTIM_InitTypeDef structure

Return values

- **None:**

LL_LPTIM_Init

Function name

ErrorStatus LL_LPTIM_Init (LPTIM_TypeDef * LPTIMx, LL_LPTIM_InitTypeDef * LPTIM_InitStruct)

Function description

Configure the LPTIMx peripheral according to the specified parameters.

Parameters

- **LPTIMx:** LP Timer Instance
- **LPTIM_InitStruct:** pointer to a LL_LPTIM_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: LPTIMx instance has been initialized
  - ERROR: LPTIMx instance hasn't been initialized

Notes

- LL_LPTIM_Init can only be called when the LPTIM instance is disabled.
- LPTIMx can be disabled using unitary function LL_LPTIM_Disable().

LL_LPTIM_Disable

Function name

void LL_LPTIM_Disable (LPTIM_TypeDef * LPTIMx)

Function description

Disable the LPTIM instance.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- The following sequence is required to solve LPTIM disable HW limitation. Please check Errata Sheet ES0335 for more details under "MCU may remain stuck in LPTIM interrupt when entering Stop mode" section.

Reference Manual to LL API cross reference:

- CR ENABLE LL_LPTIM_Disable

`LL_LPTIM_Enable`

Function name

__STATIC_INLINE void LL_LPTIM_Enable (LPTIM_TypeDef * LPTIMx)

Function description

Enable the LPTIM instance.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- After setting the ENABLE bit, a delay of two counter clock is needed before the LPTIM instance is actually enabled.

Reference Manual to LL API cross reference:

- CR ENABLE LL_LPTIM_Enable

`LL_LPTIM_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabled (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the LPTIM instance is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR ENABLE LL_LPTIM_IsEnabled

`LL_LPTIM_StartCounter`

Function name

__STATIC_INLINE void LL_LPTIM_StartCounter (LPTIM_TypeDef * LPTIMx, uint32_t OperatingMode)

Function description

Starts the LPTIM counter in the desired mode.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **OperatingMode:** This parameter can be one of the following values:
  - LL_LPTIM_OPERATING_MODE_CONTINUOUS
  - LL_LPTIM_OPERATING_MODE_ONESHOT

Return values

- **None:**

Notes

- LPTIM instance must be enabled before starting the counter.
- It is possible to change on the fly from One Shot mode to Continuous mode.

Reference Manual to LL API cross reference:

- CR CNTSTRT LL_LPTIM_StartCounter
- CR SNGSTRT LL_LPTIM_StartCounter

`LL_LPTIM_SetUpdateMode`

Function name

__STATIC_INLINE void LL_LPTIM_SetUpdateMode (LPTIM_TypeDef * LPTIMx, uint32_t UpdateMode)

Function description

Set the LPTIM registers update mode (enable/disable register preload)

Parameters

- **LPTIMx:** Low-Power Timer instance
- **UpdateMode:** This parameter can be one of the following values:
  - LL_LPTIM_UPDATE_MODE_IMMEDIATE
  - LL_LPTIM_UPDATE_MODE_ENDOFPERIOD

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR PRELOAD LL_LPTIM_SetUpdateMode

`LL_LPTIM_GetUpdateMode`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetUpdateMode (LPTIM_TypeDef * LPTIMx)

Function description

Get the LPTIM registers update mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_UPDATE_MODE_IMMEDIATE
  - LL_LPTIM_UPDATE_MODE_ENDOFPERIOD

Reference Manual to LL API cross reference:

- CFGR PRELOAD LL_LPTIM_GetUpdateMode

`LL_LPTIM_SetAutoReload`

Function name

__STATIC_INLINE void LL_LPTIM_SetAutoReload (LPTIM_TypeDef * LPTIMx, uint32_t AutoReload)

Function description

Set the auto reload value.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **AutoReload:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Return values

- **None:**

Notes

- The LPTIMx_ARR register content must only be modified when the LPTIM is enabled
- After a write to the LPTIMx_ARR register a new write operation to the same register can only be performed when the previous write operation is completed. Any successive write before the ARROK flag be set, will lead to unpredictable results.
- autoreload value be strictly greater than the compare value.

Reference Manual to LL API cross reference:

- ARR ARR LL_LPTIM_SetAutoReload

LL_LPTIM_GetAutoReload

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetAutoReload (LPTIM_TypeDef * LPTIMx)

Function description

Get actual auto reload value.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **AutoReload:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- ARR ARR LL_LPTIM_GetAutoReload

LL_LPTIM_SetCompare

Function name

__STATIC_INLINE void LL_LPTIM_SetCompare (LPTIM_TypeDef * LPTIMx, uint32_t CompareValue)

Function description

Set the compare value.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **CompareValue:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Return values

- **None:**

Notes

- After a write to the LPTIMx_CMP register a new write operation to the same register can only be performed when the previous write operation is completed. Any successive write before the CMPOK flag be set, will lead to unpredictable results.

Reference Manual to LL API cross reference:

- CMP CMP LL_LPTIM_SetCompare

`LL_LPTIM_GetCompare`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetCompare (LPTIM_TypeDef * LPTIMx)

Function description

Get actual compare value.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **CompareValue:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- CMP CMP LL_LPTIM_GetCompare

`LL_LPTIM_GetCounter`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetCounter (LPTIM_TypeDef * LPTIMx)

Function description

Get actual counter value.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Counter:** value

Notes

- When the LPTIM instance is running with an asynchronous clock, reading the LPTIMx_CNT register may return unreliable values. So in this case it is necessary to perform two consecutive read accesses and verify that the two returned values are identical.

Reference Manual to LL API cross reference:

- CNT CNT LL_LPTIM_GetCounter

`LL_LPTIM_SetCounterMode`

Function name

__STATIC_INLINE void LL_LPTIM_SetCounterMode (LPTIM_TypeDef * LPTIMx, uint32_t CounterMode)

Function description

Set the counter mode (selection of the LPTIM counter clock source).

Parameters

- **LPTIMx:** Low-Power Timer instance
- **CounterMode:** This parameter can be one of the following values:
  - LL_LPTIM_COUNTER_MODE_INTERNAL
  - LL_LPTIM_COUNTER_MODE_EXTERNAL

Return values

- **None:**

Notes

- The counter mode can be set only when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR COUNTMODE LL_LPTIM_SetCounterMode

`LL_LPTIM_GetCounterMode`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetCounterMode (LPTIM_TypeDef * LPTIMx)

Function description

Get the counter mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_COUNTER_MODE_INTERNAL
  - LL_LPTIM_COUNTER_MODE_EXTERNAL

Reference Manual to LL API cross reference:

- CFGR COUNTMODE LL_LPTIM_GetCounterMode

`LL_LPTIM_ConfigOutput`

Function name

__STATIC_INLINE void LL_LPTIM_ConfigOutput (LPTIM_TypeDef * LPTIMx, uint32_t Waveform, uint32_t Polarity)

Function description

Configure the LPTIM instance output (LPTIMx_OUT)

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Waveform:** This parameter can be one of the following values:
  - LL_LPTIM_OUTPUT_WAVEFORM_PWM
  - LL_LPTIM_OUTPUT_WAVEFORM_SETONCE
- **Polarity:** This parameter can be one of the following values:
  - LL_LPTIM_OUTPUT_POLARITY_REGULAR
  - LL_LPTIM_OUTPUT_POLARITY_INVERSE

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- Regarding the LPTIM output polarity the change takes effect immediately, so the output default value will change immediately after the polarity is re-configured, even before the timer is enabled.

Reference Manual to LL API cross reference:

- CFGR WAVE LL_LPTIM_ConfigOutput
- CFGR WAVPOL LL_LPTIM_ConfigOutput

`LL_LPTIM_SetWaveform`

Function name

__STATIC_INLINE void LL_LPTIM_SetWaveform (LPTIM_TypeDef * LPTIMx, uint32_t Waveform)

Function description

Set waveform shape.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Waveform:** This parameter can be one of the following values:
  - LL_LPTIM_OUTPUT_WAVEFORM_PWM
  - LL_LPTIM_OUTPUT_WAVEFORM_SETONCE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR WAVE LL_LPTIM_SetWaveform

`LL_LPTIM_GetWaveform`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetWaveform (LPTIM_TypeDef * LPTIMx)

Function description

Get actual waveform shape.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_OUTPUT_WAVEFORM_PWM
  - LL_LPTIM_OUTPUT_WAVEFORM_SETONCE

Reference Manual to LL API cross reference:

- CFGR WAVE LL_LPTIM_GetWaveform

`LL_LPTIM_SetPolarity`

Function name

__STATIC_INLINE void LL_LPTIM_SetPolarity (LPTIM_TypeDef * LPTIMx, uint32_t Polarity)

Function description

Set output polarity.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Polarity:** This parameter can be one of the following values:
  - LL_LPTIM_OUTPUT_POLARITY_REGULAR
  - LL_LPTIM_OUTPUT_POLARITY_INVERSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR WAVPOL LL_LPTIM_SetPolarity

LL_LPTIM_GetPolarity

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetPolarity (LPTIM_TypeDef * LPTIMx)

Function description

Get actual output polarity.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_OUTPUT_POLARITY_REGULAR
  - LL_LPTIM_OUTPUT_POLARITY_INVERSE

Reference Manual to LL API cross reference:

- CFGR WAVPOL LL_LPTIM_GetPolarity

LL_LPTIM_SetPrescaler

Function name

__STATIC_INLINE void LL_LPTIM_SetPrescaler (LPTIM_TypeDef * LPTIMx, uint32_t Prescaler)

Function description

Set actual prescaler division ratio.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Prescaler:** This parameter can be one of the following values:
  - LL_LPTIM_PRESCALER_DIV1
  - LL_LPTIM_PRESCALER_DIV2
  - LL_LPTIM_PRESCALER_DIV4
  - LL_LPTIM_PRESCALER_DIV8
  - LL_LPTIM_PRESCALER_DIV16
  - LL_LPTIM_PRESCALER_DIV32
  - LL_LPTIM_PRESCALER_DIV64
  - LL_LPTIM_PRESCALER_DIV128

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- When the LPTIM is configured to be clocked by an internal clock source and the LPTIM counter is configured to be updated by active edges detected on the LPTIM external Input1, the internal clock provided to the LPTIM must be not be prescaled.

Reference Manual to LL API cross reference:

- CFGR PRESC LL_LPTIM_SetPrescaler

LL_LPTIM_GetPrescaler

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetPrescaler (LPTIM_TypeDef * LPTIMx)

Function description

Get actual prescaler division ratio.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_PRESCALER_DIV1
  - LL_LPTIM_PRESCALER_DIV2
  - LL_LPTIM_PRESCALER_DIV4
  - LL_LPTIM_PRESCALER_DIV8
  - LL_LPTIM_PRESCALER_DIV16
  - LL_LPTIM_PRESCALER_DIV32
  - LL_LPTIM_PRESCALER_DIV64
  - LL_LPTIM_PRESCALER_DIV128

Reference Manual to LL API cross reference:

- CFGR PRESC LL_LPTIM_GetPrescaler

LL_LPTIM_SetInput1Src

Function name

__STATIC_INLINE void LL_LPTIM_SetInput1Src (LPTIM_TypeDef * LPTIMx, uint32_t Src)

Function description

Set LPTIM input 1 source (default GPIO).

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Src:** This parameter can be one of the following values:
  - LL_LPTIM_INPUT1_SRC_GPIO
  - LL_LPTIM_INPUT1_SRC_COMP1
  - LL_LPTIM_INPUT1_SRC_COMP2
  - LL_LPTIM_INPUT1_SRC_COMP1_COMP2

Return values

- **None:**

Reference Manual to LL API cross reference:

- OR OR_0 LL_LPTIM_SetInput1Src
- OR OR_1 LL_LPTIM_SetInput1Src

`LL_LPTIM_SetInput2Src`

Function name

__STATIC_INLINE void LL_LPTIM_SetInput2Src (LPTIM_TypeDef * LPTIMx, uint32_t Src)

Function description

Set LPTIM input 2 source (default GPIO).

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Src:** This parameter can be one of the following values:
  - LL_LPTIM_INPUT2_SRC_GPIO
  - LL_LPTIM_INPUT2_SRC_COMP2

Return values

- **None:**

Reference Manual to LL API cross reference:

- OR OR_0 LL_LPTIM_SetInput2Src

`LL_LPTIM_EnableTimeout`

Function name

__STATIC_INLINE void LL_LPTIM_EnableTimeout (LPTIM_TypeDef * LPTIMx)

Function description

Enable the timeout function.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- The first trigger event will start the timer, any successive trigger event will reset the counter and the timer will restart.
- The timeout value corresponds to the compare value; if no trigger occurs within the expected time frame, the MCU is waked-up by the compare match event.

Reference Manual to LL API cross reference:

- CFGR TIMOUT LL_LPTIM_EnableTimeout

`LL_LPTIM_DisableTimeout`

Function name

__STATIC_INLINE void LL_LPTIM_DisableTimeout (LPTIM_TypeDef * LPTIMx)

Function description

Disable the timeout function.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- A trigger event arriving when the timer is already started will be ignored.

Reference Manual to LL API cross reference:

- CFGR TIMOUT LL_LPTIM_DisableTimeout

`LL_LPTIM_IsEnabledTimeout`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledTimeout (LPTIM_TypeDef * LPTIMx)

Function description

Indicate whether the timeout function is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CFGR TIMOUT LL_LPTIM_IsEnabledTimeout

`LL_LPTIM_TrigSw`

Function name

__STATIC_INLINE void LL_LPTIM_TrigSw (LPTIM_TypeDef * LPTIMx)

Function description

Start the LPTIM counter.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR TRIGEN LL_LPTIM_TrigSw

`LL_LPTIM_ConfigTrigger`

Function name

__STATIC_INLINE void LL_LPTIM_ConfigTrigger (LPTIM_TypeDef * LPTIMx, uint32_t Source, uint32_t Filter, uint32_t Polarity)

Function description

Configure the external trigger used as a trigger event for the LPTIM.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **Source:** This parameter can be one of the following values:
  - LL_LPTIM_TRIG_SOURCE_GPIO
  - LL_LPTIM_TRIG_SOURCE_RTCALARMA
  - LL_LPTIM_TRIG_SOURCE_RTCALARMB
  - LL_LPTIM_TRIG_SOURCE_RTCTAMP1 (*)
  - LL_LPTIM_TRIG_SOURCE_RTCTAMP2
  - LL_LPTIM_TRIG_SOURCE_RTCTAMP3 (*)
  - LL_LPTIM_TRIG_SOURCE_COMP1
  - LL_LPTIM_TRIG_SOURCE_COMP2
- **Filter:** This parameter can be one of the following values:
  - LL_LPTIM_TRIG_FILTER_NONE
  - LL_LPTIM_TRIG_FILTER_2
  - LL_LPTIM_TRIG_FILTER_4
  - LL_LPTIM_TRIG_FILTER_8
- **Polarity:** This parameter can be one of the following values:
  - LL_LPTIM_TRIG_POLARITY_RISING
  - LL_LPTIM_TRIG_POLARITY_FALLING
  - LL_LPTIM_TRIG_POLARITY_RISING_FALLING

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- An internal clock source must be present when a digital filter is required for the trigger.

Reference Manual to LL API cross reference:

- CFGR TRIGSEL LL_LPTIM_ConfigTrigger
- CFGR TRGFLT LL_LPTIM_ConfigTrigger
- CFGR TRIGEN LL_LPTIM_ConfigTrigger

LL_LPTIM_GetTriggerSource

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetTriggerSource (LPTIM_TypeDef * LPTIMx)

Function description

Get actual external trigger source.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_TRIG_SOURCE_GPIO
  - LL_LPTIM_TRIG_SOURCE_RTCALARMA
  - LL_LPTIM_TRIG_SOURCE_RTCALARMB
  - LL_LPTIM_TRIG_SOURCE_RTCTAMP1 (*)
  - LL_LPTIM_TRIG_SOURCE_RTCTAMP2
  - LL_LPTIM_TRIG_SOURCE_RTCTAMP3 (*)
  - LL_LPTIM_TRIG_SOURCE_COMP1
  - LL_LPTIM_TRIG_SOURCE_COMP2

Reference Manual to LL API cross reference:

- CFGR TRIGSEL LL_LPTIM_GetTriggerSource

`LL_LPTIM_GetTriggerFilter`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetTriggerFilter (LPTIM_TypeDef * LPTIMx)

Function description

Get actual external trigger filter.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_TRIG_FILTER_NONE
  - LL_LPTIM_TRIG_FILTER_2
  - LL_LPTIM_TRIG_FILTER_4
  - LL_LPTIM_TRIG_FILTER_8

Reference Manual to LL API cross reference:

- CFGR TRGFLT LL_LPTIM_GetTriggerFilter

`LL_LPTIM_GetTriggerPolarity`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetTriggerPolarity (LPTIM_TypeDef * LPTIMx)

Function description

Get actual external trigger polarity.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_TRIG_POLARITY_RISING
  - LL_LPTIM_TRIG_POLARITY_FALLING
  - LL_LPTIM_TRIG_POLARITY_RISING_FALLING

Reference Manual to LL API cross reference:

- CFGR TRIGEN LL_LPTIM_GetTriggerPolarity

`LL_LPTIM_SetClockSource`

Function name

__STATIC_INLINE void LL_LPTIM_SetClockSource (LPTIM_TypeDef * LPTIMx, uint32_t ClockSource)

Function description

Set the source of the clock used by the LPTIM instance.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **ClockSource:** This parameter can be one of the following values:
  - LL_LPTIM_CLK_SOURCE_INTERNAL
  - LL_LPTIM_CLK_SOURCE_EXTERNAL

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR CKSEL LL_LPTIM_SetClockSource

`LL_LPTIM_GetClockSource`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetClockSource (LPTIM_TypeDef * LPTIMx)

Function description

Get actual LPTIM instance clock source.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_CLK_SOURCE_INTERNAL
  - LL_LPTIM_CLK_SOURCE_EXTERNAL

Reference Manual to LL API cross reference:

- CFGR CKSEL LL_LPTIM_GetClockSource

`LL_LPTIM_ConfigClock`

Function name

__STATIC_INLINE void LL_LPTIM_ConfigClock (LPTIM_TypeDef * LPTIMx, uint32_t ClockFilter, uint32_t ClockPolarity)

Function description

Configure the active edge or edges used by the counter when the LPTIM is clocked by an external clock source.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **ClockFilter:** This parameter can be one of the following values:
  - LL_LPTIM_CLK_FILTER_NONE
  - LL_LPTIM_CLK_FILTER_2
  - LL_LPTIM_CLK_FILTER_4
  - LL_LPTIM_CLK_FILTER_8
- **ClockPolarity:** This parameter can be one of the following values:
  - LL_LPTIM_CLK_POLARITY_RISING
  - LL_LPTIM_CLK_POLARITY_FALLING
  - LL_LPTIM_CLK_POLARITY_RISING_FALLING

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- When both external clock signal edges are considered active ones, the LPTIM must also be clocked by an internal clock source with a frequency equal to at least four times the external clock frequency.
- An internal clock source must be present when a digital filter is required for external clock.

Reference Manual to LL API cross reference:

- CFGR CKFLT LL_LPTIM_ConfigClock
- CFGR CKPOL LL_LPTIM_ConfigClock

LL_LPTIM_GetClockPolarity

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetClockPolarity (LPTIM_TypeDef * LPTIMx)

Function description

Get actual clock polarity.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_CLK_POLARITY_RISING
  - LL_LPTIM_CLK_POLARITY_FALLING
  - LL_LPTIM_CLK_POLARITY_RISING_FALLING

Reference Manual to LL API cross reference:

- CFGR CKPOL LL_LPTIM_GetClockPolarity

LL_LPTIM_GetClockFilter

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetClockFilter (LPTIM_TypeDef * LPTIMx)

Function description

Get actual clock digital filter.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_CLK_FILTER_NONE
  - LL_LPTIM_CLK_FILTER_2
  - LL_LPTIM_CLK_FILTER_4
  - LL_LPTIM_CLK_FILTER_8

Reference Manual to LL API cross reference:

- CFGR CKFLT LL_LPTIM_GetClockFilter

`LL_LPTIM_SetEncoderMode`

Function name

__STATIC_INLINE void LL_LPTIM_SetEncoderMode (LPTIM_TypeDef * LPTIMx, uint32_t EncoderMode)

Function description

Configure the encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance
- **EncoderMode:** This parameter can be one of the following values:
  - LL_LPTIM_ENCODER_MODE_RISING
  - LL_LPTIM_ENCODER_MODE_FALLING
  - LL_LPTIM_ENCODER_MODE_RISING_FALLING

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR CKPOL LL_LPTIM_SetEncoderMode

`LL_LPTIM_GetEncoderMode`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_GetEncoderMode (LPTIM_TypeDef * LPTIMx)

Function description

Get actual encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPTIM_ENCODER_MODE_RISING
  - LL_LPTIM_ENCODER_MODE_FALLING
  - LL_LPTIM_ENCODER_MODE_RISING_FALLING

Reference Manual to LL API cross reference:

- CFGR CKPOL LL_LPTIM_GetEncoderMode

`LL_LPTIM_EnableEncoderMode`

Function name

__STATIC_INLINE void LL_LPTIM_EnableEncoderMode (LPTIM_TypeDef * LPTIMx)

Function description

Enable the encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.
- In this mode the LPTIM instance must be clocked by an internal clock source. Also, the prescaler division ratio must be equal to 1.
- LPTIM instance must be configured in continuous mode prior enabling the encoder mode.

Reference Manual to LL API cross reference:

- CFGR ENC LL_LPTIM_EnableEncoderMode

`LL_LPTIM_DisableEncoderMode`

Function name

__STATIC_INLINE void LL_LPTIM_DisableEncoderMode (LPTIM_TypeDef * LPTIMx)

Function description

Disable the encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Notes

- This function must be called when the LPTIM instance is disabled.

Reference Manual to LL API cross reference:

- CFGR ENC LL_LPTIM_DisableEncoderMode

`LL_LPTIM_IsEnabledEncoderMode`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledEncoderMode (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the LPTIM operates in encoder mode.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CFGR ENC LL_LPTIM_IsEnabledEncoderMode

`LL_LPTIM_ClearFLAG_CMPM`

Function name

__STATIC_INLINE void LL_LPTIM_ClearFLAG_CMPM (LPTIM_TypeDef * LPTIMx)

Function description

Clear the compare match flag (CMPMCF)

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR CMPMCF LL_LPTIM_ClearFLAG_CMPM

`LL_LPTIM_IsActiveFlag_CMPM`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_CMPM (LPTIM_TypeDef * LPTIMx)

Function description

Inform application whether a compare match interrupt has occurred.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CMPM LL_LPTIM_IsActiveFlag_CMPM

`LL_LPTIM_ClearFLAG_ARRM`

Function name

__STATIC_INLINE void LL_LPTIM_ClearFLAG_ARRM (LPTIM_TypeDef * LPTIMx)

Function description

Clear the autoreload match flag (ARRMCF)

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ARRMCF LL_LPTIM_ClearFLAG_ARRM

LL_LPTIM_IsActiveFlag_ARRM

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_ARRM (LPTIM_TypeDef * LPTIMx)

Function description

Inform application whether a autoreload match interrupt has occured.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ARRM LL_LPTIM_IsActiveFlag_ARRM

LL_LPTIM_ClearFlag_EXTTRIG

Function name

__STATIC_INLINE void LL_LPTIM_ClearFlag_EXTTRIG (LPTIM_TypeDef * LPTIMx)

Function description

Clear the external trigger valid edge flag(EXTTRIGCF).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR EXTTRIGCF LL_LPTIM_ClearFlag_EXTTRIG

LL_LPTIM_IsActiveFlag_EXTTRIG

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_EXTTRIG (LPTIM_TypeDef * LPTIMx)

Function description

Inform application whether a valid edge on the selected external trigger input has occurred.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR EXTTRIG LL_LPTIM_IsActiveFlag_EXTTRIG

LL_LPTIM_ClearFlag_CMPOK

Function name

__STATIC_INLINE void LL_LPTIM_ClearFlag_CMPOK (LPTIM_TypeDef * LPTIMx)

Function description

Clear the compare register update interrupt flag (CMPOKCF).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR CMPOKCF LL_LPTIM_ClearFlag_CMPOK

`LL_LPTIM_IsActiveFlag_CMPOK`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_CMPOK (LPTIM_TypeDef * LPTIMx)

Function description

Informs application whether the APB bus write operation to the LPTIMx_CMP register has been successfully completed.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CMPOK LL_LPTIM_IsActiveFlag_CMPOK

`LL_LPTIM_ClearFlag_ARROK`

Function name

__STATIC_INLINE void LL_LPTIM_ClearFlag_ARROK (LPTIM_TypeDef * LPTIMx)

Function description

Clear the autoreload register update interrupt flag (ARROKCF).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ARROKCF LL_LPTIM_ClearFlag_ARROK

`LL_LPTIM_IsActiveFlag_ARROK`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_ARROK (LPTIM_TypeDef * LPTIMx)

Function description

Informs application whether the APB bus write operation to the LPTIMx_ARR register has been successfully completed.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ARROK LL_LPTIM_IsActiveFlag_ARROK

`LL_LPTIM_ClearFlag_UP`

Function name

__STATIC_INLINE void LL_LPTIM_ClearFlag_UP (LPTIM_TypeDef * LPTIMx)

Function description

Clear the counter direction change to up interrupt flag (UPCF).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR UPCF LL_LPTIM_ClearFlag_UP

`LL_LPTIM_IsActiveFlag_UP`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_UP (LPTIM_TypeDef * LPTIMx)

Function description

Informs the application whether the counter direction has changed from down to up (when the LPTIM instance operates in encoder mode).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR UP LL_LPTIM_IsActiveFlag_UP

`LL_LPTIM_ClearFlag_DOWN`

Function name

__STATIC_INLINE void LL_LPTIM_ClearFlag_DOWN (LPTIM_TypeDef * LPTIMx)

Function description

Clear the counter direction change to down interrupt flag (DOWNCF).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR DOWNCF LL_LPTIM_ClearFlag_DOWN

`LL_LPTIM_IsActiveFlag_DOWN`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsActiveFlag_DOWN (LPTIM_TypeDef * LPTIMx)

Function description

Informs the application whether the counter direction has changed from up to down (when the LPTIM instance operates in encoder mode).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR DOWN LL_LPTIM_IsActiveFlag_DOWN

`LL_LPTIM_EnableIT_CMPM`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_CMPM (LPTIM_TypeDef * LPTIMx)

Function description

Enable compare match interrupt (CMPMIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER CMPMIE LL_LPTIM_EnableIT_CMPM

`LL_LPTIM_DisableIT_CMPM`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_CMPM (LPTIM_TypeDef * LPTIMx)

Function description

Disable compare match interrupt (CMPMIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER CMPMIE LL_LPTIM_DisableIT_CMPM

`LL_LPTIM_IsEnabledIT_CMPM`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_CMPM (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the compare match interrupt (CMPMIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER CMPMIE LL_LPTIM_IsEnabledIT_CMPM

`LL_LPTIM_EnableIT_ARRM`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_ARRM (LPTIM_TypeDef * LPTIMx)

Function description

Enable autoreload match interrupt (ARRMIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARRMIE LL_LPTIM_EnableIT_ARRM

`LL_LPTIM_DisableIT_ARRM`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_ARRM (LPTIM_TypeDef * LPTIMx)

Function description

Disable autoreload match interrupt (ARRMIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARRMIE LL_LPTIM_DisableIT_ARRM

`LL_LPTIM_IsEnabledIT_ARRM`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_ARRM (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the autoreload match interrupt (ARRMIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER ARRMIE LL_LPTIM_IsEnabledIT_ARRM

`LL_LPTIM_EnableIT_EXTTRIG`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_EXTTRIG (LPTIM_TypeDef * LPTIMx)

Function description

Enable external trigger valid edge interrupt (EXTTRIGIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EXTTRIGIE LL_LPTIM_EnableIT_EXTTRIG

`LL_LPTIM_DisableIT_EXTTRIG`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_EXTTRIG (LPTIM_TypeDef * LPTIMx)

Function description

Disable external trigger valid edge interrupt (EXTTRIGIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER EXTTRIGIE LL_LPTIM_DisableIT_EXTTRIG

`LL_LPTIM_IsEnabledIT_EXTTRIG`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_EXTTRIG (LPTIM_TypeDef * LPTIMx)

Function description

Indicates external trigger valid edge interrupt (EXTTRIGIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER EXTTRIGIE LL_LPTIM_IsEnabledIT_EXTTRIG

`LL_LPTIM_EnableIT_CMPOK`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_CMPOK (LPTIM_TypeDef * LPTIMx)

Function description

Enable compare register write completed interrupt (CMPOKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER CMPOKIE LL_LPTIM_EnableIT_CMPOK

`LL_LPTIM_DisableIT_CMPOK`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_CMPOK (LPTIM_TypeDef * LPTIMx)

Function description

Disable compare register write completed interrupt (CMPOKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER CMPOKIE LL_LPTIM_DisableIT_CMPOK

`LL_LPTIM_IsEnabledIT_CMPOK`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_CMPOK (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the compare register write completed interrupt (CMPOKIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER CMPOKIE LL_LPTIM_IsEnabledIT_CMPOK

`LL_LPTIM_EnableIT_ARROK`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_ARROK (LPTIM_TypeDef * LPTIMx)

Function description

Enable autoreload register write completed interrupt (ARROKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARROKIE LL_LPTIM_EnableIT_ARROK

`LL_LPTIM_DisableIT_ARROK`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_ARROK (LPTIM_TypeDef * LPTIMx)

Function description

Disable autoreload register write completed interrupt (ARROKIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER ARROKIE LL_LPTIM_DisableIT_ARROK

`LL_LPTIM_IsEnabledIT_ARROK`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_ARROK (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the autoreload register write completed interrupt (ARROKIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER ARROKIE LL_LPTIM_IsEnabledIT_ARROK

`LL_LPTIM_EnableIT_UP`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_UP (LPTIM_TypeDef * LPTIMx)

Function description

Enable direction change to up interrupt (UPIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER UPIE LL_LPTIM_EnableIT_UP

`LL_LPTIM_DisableIT_UP`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_UP (LPTIM_TypeDef * LPTIMx)

Function description

Disable direction change to up interrupt (UPIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER UPIE LL_LPTIM_DisableIT_UP

`LL_LPTIM_IsEnabledIT_UP`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_UP (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the direction change to up interrupt (UPIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER UPIE LL_LPTIM_IsEnabledIT_UP

`LL_LPTIM_EnableIT_DOWN`

Function name

__STATIC_INLINE void LL_LPTIM_EnableIT_DOWN (LPTIM_TypeDef * LPTIMx)

Function description

Enable direction change to down interrupt (DOWNIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER DOWNIE LL_LPTIM_EnableIT_DOWN

`LL_LPTIM_DisableIT_DOWN`

Function name

__STATIC_INLINE void LL_LPTIM_DisableIT_DOWN (LPTIM_TypeDef * LPTIMx)

Function description

Disable direction change to down interrupt (DOWNIE).

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- IER DOWNIE LL_LPTIM_DisableIT_DOWN

`LL_LPTIM_IsEnabledIT_DOWN`

Function name

__STATIC_INLINE uint32_t LL_LPTIM_IsEnabledIT_DOWN (LPTIM_TypeDef * LPTIMx)

Function description

Indicates whether the direction change to down interrupt (DOWNIE) is enabled.

Parameters

- **LPTIMx:** Low-Power Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- IER DOWNIE LL_LPTIM_IsEnabledIT_DOWN

94.3 LPTIM Firmware driver defines

The following section lists the various define and macros of the module.

94.3.1 LPTIM

LPTIM

Input1 Source

LL_LPTIM_INPUT1_SRC_GPIO

For LPTIM1 and LPTIM2

LL_LPTIM_INPUT1_SRC_COMP1

For LPTIM1 and LPTIM2

LL_LPTIM_INPUT1_SRC_COMP2

For LPTIM2

LL_LPTIM_INPUT1_SRC_COMP1_COMP2

For LPTIM2

Input2 Source

LL_LPTIM_INPUT2_SRC_GPIO

For LPTIM1

LL_LPTIM_INPUT2_SRC_COMP2

For LPTIM1

Clock Filter

LL_LPTIM_CLK_FILTER_NONE

Any external clock signal level change is considered as a valid transition

LL_LPTIM_CLK_FILTER_2

External clock signal level change must be stable for at least 2 clock periods before it is considered as valid transition

LL_LPTIM_CLK_FILTER_4

External clock signal level change must be stable for at least 4 clock periods before it is considered as valid transition

LL_LPTIM_CLK_FILTER_8

External clock signal level change must be stable for at least 8 clock periods before it is considered as valid transition

Clock Polarity

LL_LPTIM_CLK_POLARITY_RISING

The rising edge is the active edge used for counting

LL_LPTIM_CLK_POLARITY_FALLING

The falling edge is the active edge used for counting

LL_LPTIM_CLK_POLARITY_RISING_FALLING

Both edges are active edges

Clock Source

LL_LPTIM_CLK_SOURCE_INTERNAL

LPTIM is clocked by internal clock source (APB clock or any of the embedded oscillators)

LL_LPTIM_CLK_SOURCE_EXTERNAL

LPTIM is clocked by an external clock source through the LPTIM external Input1

Counter Mode

LL_LPTIM_COUNTER_MODE_INTERNAL

The counter is incremented following each internal clock pulse

LL_LPTIM_COUNTER_MODE_EXTERNAL

The counter is incremented following each valid clock pulse on the LPTIM external Input1

Encoder Mode

LL_LPTIM_ENCODER_MODE_RISING

The rising edge is the active edge used for counting

LL_LPTIM_ENCODER_MODE_FALLING

The falling edge is the active edge used for counting

LL_LPTIM_ENCODER_MODE_RISING_FALLING

Both edges are active edges

Get Flags Defines

LL_LPTIM_ISR_CMPM

Compare match

LL_LPTIM_ISR_ARRM

Autoreload match

LL_LPTIM_ISR_EXTTRIG

External trigger edge event

LL_LPTIM_ISR_CMPOK

Compare register update OK

LL_LPTIM_ISR_ARROK

Autoreload register update OK

LL_LPTIM_ISR_UP

Counter direction change down to up

LL_LPTIM_ISR_DOWN

Counter direction change up to down

IT Defines

LL_LPTIM_IER_CMPMIE

Compare match Interrupt Enable

LL_LPTIM_IER_ARRMIE

Autoreload match Interrupt Enable

LL_LPTIM_IER_EXTTRIGIE

External trigger valid edge Interrupt Enable

LL_LPTIM_IER_CMPOKIE

Compare register update OK Interrupt Enable

LL_LPTIM_IER_ARROKIE

Autoreload register update OK Interrupt Enable

LL_LPTIM_IER_UPIE

Direction change to UP Interrupt Enable

LL_LPTIM_IER_DOWNIE

Direction change to down Interrupt Enable

Operating Mode

LL_LPTIM_OPERATING_MODE_CONTINUOUS

LP Timer starts in continuous mode

LL_LPTIM_OPERATING_MODE_ONESHOT

LP Tilmer starts in single mode

Output Polarity

LL_LPTIM_OUTPUT_POLARITY_REGULAR

The LPTIM output reflects the compare results between LPTIMx_ARR and LPTIMx_CMP registers

LL_LPTIM_OUTPUT_POLARITY_INVERSE

The LPTIM output reflects the inverse of the compare results between LPTIMx_ARR and LPTIMx_CMP registers

Output Waveform Type

LL_LPTIM_OUTPUT_WAVEFORM_PWM

LPTIM generates either a PWM waveform or a One pulse waveform depending on chosen operating mode CONTINOUS or SINGLE

LL_LPTIM_OUTPUT_WAVEFORM_SETONCE

LPTIM generates a Set Once waveform

Prescaler Value

LL_LPTIM_PRESCALER_DIV1

Prescaler division factor is set to 1

LL_LPTIM_PRESCALER_DIV2

Prescaler division factor is set to 2

LL_LPTIM_PRESCALER_DIV4

Prescaler division factor is set to 4

LL_LPTIM_PRESCALER_DIV8

Prescaler division factor is set to 8

LL_LPTIM_PRESCALER_DIV16

Prescaler division factor is set to 16

LL_LPTIM_PRESCALER_DIV32

Prescaler division factor is set to 32

LL_LPTIM_PRESCALER_DIV64

Prescaler division factor is set to 64

LL_LPTIM_PRESCALER_DIV128

Prescaler division factor is set to 128

Trigger Filter

LL_LPTIM_TRIG_FILTER_NONE

Any trigger active level change is considered as a valid trigger

LL_LPTIM_TRIG_FILTER_2

Trigger active level change must be stable for at least 2 clock periods before it is considered as valid trigger

LL_LPTIM_TRIG_FILTER_4

Trigger active level change must be stable for at least 4 clock periods before it is considered as valid trigger

LL_LPTIM_TRIG_FILTER_8

Trigger active level change must be stable for at least 8 clock periods before it is considered as valid trigger

Trigger Polarity

LL_LPTIM_TRIG_POLARITY_RISING

LPTIM counter starts when a rising edge is detected

LL_LPTIM_TRIG_POLARITY_FALLING

LPTIM counter starts when a falling edge is detected

LL_LPTIM_TRIG_POLARITY_RISING_FALLING

LPTIM counter starts when a rising or a falling edge is detected

Trigger Source

LL_LPTIM_TRIG_SOURCE_GPIO

External input trigger is connected to TIMx_ETR input

LL_LPTIM_TRIG_SOURCE_RTCALARMA

External input trigger is connected to RTC Alarm A

LL_LPTIM_TRIG_SOURCE_RTCALARMB

External input trigger is connected to RTC Alarm B

LL_LPTIM_TRIG_SOURCE_RTCTAMP1

External input trigger is connected to RTC Tamper 1

LL_LPTIM_TRIG_SOURCE_RTCTAMP2

External input trigger is connected to RTC Tamper 2

LL_LPTIM_TRIG_SOURCE_RTCTAMP3

External input trigger is connected to RTC Tamper 3

LL_LPTIM_TRIG_SOURCE_COMP1

External input trigger is connected to COMP1 output

LL_LPTIM_TRIG_SOURCE_COMP2

External input trigger is connected to COMP2 output

Update Mode

LL_LPTIM_UPDATE_MODE_IMMEDIATE

Preload is disabled: registers are updated after each APB bus write access

LL_LPTIM_UPDATE_MODE_ENDOFPERIOD

preload is enabled: registers are updated at the end of the current LPTIM period

Common Write and read registers Macros

LL_LPTIM_WriteReg

Description:

- Write a value in LPTIM register.

Parameters:

- __INSTANCE__: LPTIM Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_LPTIM_ReadReg

Description:

- Read a value in LPTIM register.

Parameters:

- __INSTANCE__: LPTIM Instance
- __REG__: Register to be read

Return value:

- Register: value

95 LL LPUART Generic Driver

95.1 LPUART Firmware driver registers structures

95.1.1 LL_LPUART_InitTypeDef

LL_LPUART_InitTypeDef is defined in the stm32l4xx_ll_lpuart.h

Data Fields

- ***uint32_t PrescalerValue***
- ***uint32_t BaudRate***
- ***uint32_t DataWidth***
- ***uint32_t StopBits***
- ***uint32_t Parity***
- ***uint32_t TransferDirection***
- ***uint32_t HardwareFlowControl***

Field Documentation

- ***uint32_t LL_LPUART_InitTypeDef::PrescalerValue***

  Specifies the Prescaler to compute the communication baud rate. This parameter can be a value of ***LPUART_LL_EC_PRESCALER***.This feature can be modified afterwards using unitary function **LL_LPUART_SetPrescaler()**.
- ***uint32_t LL_LPUART_InitTypeDef::BaudRate***

  This field defines expected LPUART communication baud rate.This feature can be modified afterwards using unitary function **LL_LPUART_SetBaudRate()**.
- ***uint32_t LL_LPUART_InitTypeDef::DataWidth***

  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***LPUART_LL_EC_DATAWIDTH***.This feature can be modified afterwards using unitary function **LL_LPUART_SetDataWidth()**.
- ***uint32_t LL_LPUART_InitTypeDef::StopBits***

  Specifies the number of stop bits transmitted. This parameter can be a value of ***LPUART_LL_EC_STOPBITS***.This feature can be modified afterwards using unitary function **LL_LPUART_SetStopBitsLength()**.
- ***uint32_t LL_LPUART_InitTypeDef::Parity***

  Specifies the parity mode. This parameter can be a value of ***LPUART_LL_EC_PARITY***.This feature can be modified afterwards using unitary function **LL_LPUART_SetParity()**.
- ***uint32_t LL_LPUART_InitTypeDef::TransferDirection***

  Specifies whether the Receive and/or Transmit mode is enabled or disabled. This parameter can be a value of ***LPUART_LL_EC_DIRECTION***.This feature can be modified afterwards using unitary function **LL_LPUART_SetTransferDirection()**.
- ***uint32_t LL_LPUART_InitTypeDef::HardwareFlowControl***

  Specifies whether the hardware flow control mode is enabled or disabled. This parameter can be a value of ***LPUART_LL_EC_HWCONTROL***.This feature can be modified afterwards using unitary function **LL_LPUART_SetHWFlowCtrl()**.

95.2 LPUART Firmware driver API description

The following section lists the various functions of the LPUART library.

95.2.1 Detailed description of functions

`LL_LPUART_Enable`

Function name

__STATIC_INLINE void LL_LPUART_Enable (USART_TypeDef * LPUARTx)

Function description

LPUART Enable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 UE LL_LPUART_Enable

`LL_LPUART_Disable`

Function name

__STATIC_INLINE void LL_LPUART_Disable (USART_TypeDef * LPUARTx)

Function description

LPUART Disable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Notes

- When LPUART is disabled, LPUART prescalers and outputs are stopped immediately, and current operations are discarded. The configuration of the LPUART is kept, but all the status flags, in the LPUARTx_ISR are set to their default values.
- In order to go into low-power mode without generating errors on the line, the TE bit must be reset before and the software must wait for the TC bit in the LPUART_ISR to be set before resetting the UE bit. The DMA requests are also reset when UE = 0 so the DMA channel must be disabled before resetting the UE bit.

Reference Manual to LL API cross reference:

- CR1 UE LL_LPUART_Disable

`LL_LPUART_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabled (USART_TypeDef * LPUARTx)

Function description

Indicate if LPUART is enabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 UE LL_LPUART_IsEnabled

`LL_LPUART_EnableFIFO`

Function name

__STATIC_INLINE void LL_LPUART_EnableFIFO (USART_TypeDef * LPUARTx)

Function description

FIFO Mode Enable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 FIFOEN LL_LPUART_EnableFIFO

`LL_LPUART_DisableFIFO`

Function name

__STATIC_INLINE void LL_LPUART_DisableFIFO (USART_TypeDef * LPUARTx)

Function description

FIFO Mode Disable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 FIFOEN LL_LPUART_DisableFIFO

`LL_LPUART_IsEnabledFIFO`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledFIFO (USART_TypeDef * LPUARTx)

Function description

Indicate if FIFO Mode is enabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 FIFOEN LL_LPUART_IsEnabledFIFO

LL_LPUART_SetTXFIFOThreshold

Function name

__STATIC_INLINE void LL_LPUART_SetTXFIFOThreshold (USART_TypeDef * LPUARTx, uint32_t Threshold)

Function description

Configure TX FIFO Threshold.

Parameters

- **LPUARTx:** LPUART Instance
- **Threshold:** This parameter can be one of the following values:
  - LL_LPUART_FIFOTHRESHOLD_1_8
  - LL_LPUART_FIFOTHRESHOLD_1_4
  - LL_LPUART_FIFOTHRESHOLD_1_2
  - LL_LPUART_FIFOTHRESHOLD_3_4
  - LL_LPUART_FIFOTHRESHOLD_7_8
  - LL_LPUART_FIFOTHRESHOLD_8_8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 TXFTCFG LL_LPUART_SetTXFIFOThreshold

LL_LPUART_GetTXFIFOThreshold

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetTXFIFOThreshold (USART_TypeDef * LPUARTx)

Function description

Return TX FIFO Threshold Configuration.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_FIFOTHRESHOLD_1_8
  - LL_LPUART_FIFOTHRESHOLD_1_4
  - LL_LPUART_FIFOTHRESHOLD_1_2
  - LL_LPUART_FIFOTHRESHOLD_3_4
  - LL_LPUART_FIFOTHRESHOLD_7_8
  - LL_LPUART_FIFOTHRESHOLD_8_8

Reference Manual to LL API cross reference:

- CR3 TXFTCFG LL_LPUART_GetTXFIFOThreshold

LL_LPUART_SetRXFIFOThreshold

Function name

__STATIC_INLINE void LL_LPUART_SetRXFIFOThreshold (USART_TypeDef * LPUARTx, uint32_t Threshold)

Function description

Configure RX FIFO Threshold.

Parameters

- **LPUARTx:** LPUART Instance
- **Threshold:** This parameter can be one of the following values:
  - LL_LPUART_FIFOTHRESHOLD_1_8
  - LL_LPUART_FIFOTHRESHOLD_1_4
  - LL_LPUART_FIFOTHRESHOLD_1_2
  - LL_LPUART_FIFOTHRESHOLD_3_4
  - LL_LPUART_FIFOTHRESHOLD_7_8
  - LL_LPUART_FIFOTHRESHOLD_8_8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RXFTCFG LL_LPUART_SetRXFIFOThreshold

LL_LPUART_GetRXFIFOThreshold

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetRXFIFOThreshold (USART_TypeDef * LPUARTx)

Function description

Return RX FIFO Threshold Configuration.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_FIFOTHRESHOLD_1_8
  - LL_LPUART_FIFOTHRESHOLD_1_4
  - LL_LPUART_FIFOTHRESHOLD_1_2
  - LL_LPUART_FIFOTHRESHOLD_3_4
  - LL_LPUART_FIFOTHRESHOLD_7_8
  - LL_LPUART_FIFOTHRESHOLD_8_8

Reference Manual to LL API cross reference:

- CR3 RXFTCFG LL_LPUART_GetRXFIFOThreshold

LL_LPUART_ConfigFIFOsThreshold

Function name

__STATIC_INLINE void LL_LPUART_ConfigFIFOsThreshold (USART_TypeDef * LPUARTx, uint32_t TXThreshold, uint32_t RXThreshold)

Function description

Configure TX and RX FIFOs Threshold.

Parameters

- **LPUARTx:** LPUART Instance
- **TXThreshold:** This parameter can be one of the following values:
  - LL_LPUART_FIFOTHRESHOLD_1_8
  - LL_LPUART_FIFOTHRESHOLD_1_4
  - LL_LPUART_FIFOTHRESHOLD_1_2
  - LL_LPUART_FIFOTHRESHOLD_3_4
  - LL_LPUART_FIFOTHRESHOLD_7_8
  - LL_LPUART_FIFOTHRESHOLD_8_8
- **RXThreshold:** This parameter can be one of the following values:
  - LL_LPUART_FIFOTHRESHOLD_1_8
  - LL_LPUART_FIFOTHRESHOLD_1_4
  - LL_LPUART_FIFOTHRESHOLD_1_2
  - LL_LPUART_FIFOTHRESHOLD_3_4
  - LL_LPUART_FIFOTHRESHOLD_7_8
  - LL_LPUART_FIFOTHRESHOLD_8_8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 TXFTCFG LL_LPUART_ConfigFIFOsThreshold
- CR3 RXFTCFG LL_LPUART_ConfigFIFOsThreshold

`LL_LPUART_EnableInStopMode`

Function name

__STATIC_INLINE void LL_LPUART_EnableInStopMode (USART_TypeDef * LPUARTx)

Function description

LPUART enabled in STOP Mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Notes

- When this function is enabled, LPUART is able to wake up the MCU from Stop mode, provided that LPUART clock selection is HSI or LSE in RCC.

Reference Manual to LL API cross reference:

- CR1 UESM LL_LPUART_EnableInStopMode

`LL_LPUART_DisableInStopMode`

Function name

__STATIC_INLINE void LL_LPUART_DisableInStopMode (USART_TypeDef * LPUARTx)

Function description

LPUART disabled in STOP Mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Notes

- When this function is disabled, LPUART is not able to wake up the MCU from Stop mode

Reference Manual to LL API cross reference:

- CR1 UESM LL_LPUART_DisableInStopMode

`LL_LPUART_IsEnabledInStopMode`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledInStopMode (USART_TypeDef * LPUARTx)

Function description

Indicate if LPUART is enabled in STOP Mode (able to wake up MCU from Stop mode or not)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 UESM LL_LPUART_IsEnabledInStopMode

`LL_LPUART_EnableDirectionRx`

Function name

__STATIC_INLINE void LL_LPUART_EnableDirectionRx (USART_TypeDef * LPUARTx)

Function description

Receiver Enable (Receiver is enabled and begins searching for a start bit)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RE LL_LPUART_EnableDirectionRx

`LL_LPUART_DisableDirectionRx`

Function name

__STATIC_INLINE void LL_LPUART_DisableDirectionRx (USART_TypeDef * LPUARTx)

Function description

Receiver Disable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RE LL_LPUART_DisableDirectionRx

`LL_LPUART_EnableDirectionTx`

Function name

__STATIC_INLINE void LL_LPUART_EnableDirectionTx (USART_TypeDef * LPUARTx)

Function description

Transmitter Enable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TE LL_LPUART_EnableDirectionTx

`LL_LPUART_DisableDirectionTx`

Function name

__STATIC_INLINE void LL_LPUART_DisableDirectionTx (USART_TypeDef * LPUARTx)

Function description

Transmitter Disable.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TE LL_LPUART_DisableDirectionTx

`LL_LPUART_SetTransferDirection`

Function name

__STATIC_INLINE void LL_LPUART_SetTransferDirection (USART_TypeDef * LPUARTx, uint32_t TransferDirection)

Function description

Configure simultaneously enabled/disabled states of Transmitter and Receiver.

Parameters

- **LPUARTx:** LPUART Instance
- **TransferDirection:** This parameter can be one of the following values:
  - LL_LPUART_DIRECTION_NONE
  - LL_LPUART_DIRECTION_RX
  - LL_LPUART_DIRECTION_TX
  - LL_LPUART_DIRECTION_TX_RX

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RE LL_LPUART_SetTransferDirection
- CR1 TE LL_LPUART_SetTransferDirection

LL_LPUART_GetTransferDirection

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetTransferDirection (USART_TypeDef * LPUARTx)

Function description

Return enabled/disabled states of Transmitter and Receiver.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_DIRECTION_NONE
  - LL_LPUART_DIRECTION_RX
  - LL_LPUART_DIRECTION_TX
  - LL_LPUART_DIRECTION_TX_RX

Reference Manual to LL API cross reference:

- CR1 RE LL_LPUART_GetTransferDirection
- CR1 TE LL_LPUART_GetTransferDirection

LL_LPUART_SetParity

Function name

__STATIC_INLINE void LL_LPUART_SetParity (USART_TypeDef * LPUARTx, uint32_t Parity)

Function description

Configure Parity (enabled/disabled and parity mode if enabled)

Parameters

- **LPUARTx:** LPUART Instance
- **Parity:** This parameter can be one of the following values:
  - LL_LPUART_PARITY_NONE
  - LL_LPUART_PARITY_EVEN
  - LL_LPUART_PARITY_ODD

Return values

- **None:**

Notes

- This function selects if hardware parity control (generation and detection) is enabled or disabled. When the parity control is enabled (Odd or Even), computed parity bit is inserted at the MSB position (depending on data width) and parity is checked on the received data.

Reference Manual to LL API cross reference:

- CR1 PS LL_LPUART_SetParity
- CR1 PCE LL_LPUART_SetParity

LL_LPUART_GetParity

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetParity (USART_TypeDef * LPUARTx)

Function description

Return Parity configuration (enabled/disabled and parity mode if enabled)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_PARITY_NONE
  - LL_LPUART_PARITY_EVEN
  - LL_LPUART_PARITY_ODD

Reference Manual to LL API cross reference:

- CR1 PS LL_LPUART_GetParity
- CR1 PCE LL_LPUART_GetParity

LL_LPUART_SetWakeUpMethod

Function name

__STATIC_INLINE void LL_LPUART_SetWakeUpMethod (USART_TypeDef * LPUARTx, uint32_t Method)

Function description

Set Receiver Wake Up method from Mute mode.

Parameters

- **LPUARTx:** LPUART Instance
- **Method:** This parameter can be one of the following values:
  - LL_LPUART_WAKEUP_IDLELINE
  - LL_LPUART_WAKEUP_ADDRESSMARK

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 WAKE LL_LPUART_SetWakeUpMethod

LL_LPUART_GetWakeUpMethod

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetWakeUpMethod (USART_TypeDef * LPUARTx)

Function description

Return Receiver Wake Up method from Mute mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_WAKEUP_IDLELINE
  - LL_LPUART_WAKEUP_ADDRESSMARK

Reference Manual to LL API cross reference:

- CR1 WAKE LL_LPUART_GetWakeUpMethod

`LL_LPUART_SetDataWidth`

Function name

__STATIC_INLINE void LL_LPUART_SetDataWidth (USART_TypeDef * LPUARTx, uint32_t DataWidth)

Function description

Set Word length (nb of data bits, excluding start and stop bits)

Parameters

- **LPUARTx:** LPUART Instance
- **DataWidth:** This parameter can be one of the following values:
  - LL_LPUART_DATAWIDTH_7B
  - LL_LPUART_DATAWIDTH_8B
  - LL_LPUART_DATAWIDTH_9B

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 M LL_LPUART_SetDataWidth

`LL_LPUART_GetDataWidth`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetDataWidth (USART_TypeDef * LPUARTx)

Function description

Return Word length (i.e.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_DATAWIDTH_7B
  - LL_LPUART_DATAWIDTH_8B
  - LL_LPUART_DATAWIDTH_9B

Reference Manual to LL API cross reference:

- CR1 M LL_LPUART_GetDataWidth

`LL_LPUART_EnableMuteMode`

Function name

__STATIC_INLINE void LL_LPUART_EnableMuteMode (USART_TypeDef * LPUARTx)

Function description

Allow switch between Mute Mode and Active mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 MME LL_LPUART_EnableMuteMode

`LL_LPUART_DisableMuteMode`

Function name

__STATIC_INLINE void LL_LPUART_DisableMuteMode (USART_TypeDef * LPUARTx)

Function description

Prevent Mute Mode use.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 MME LL_LPUART_DisableMuteMode

`LL_LPUART_IsEnabledMuteMode`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledMuteMode (USART_TypeDef * LPUARTx)

Function description

Indicate if switch between Mute Mode and Active mode is allowed.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 MME LL_LPUART_IsEnabledMuteMode

`LL_LPUART_SetPrescaler`

Function name

__STATIC_INLINE void LL_LPUART_SetPrescaler (USART_TypeDef * LPUARTx, uint32_t PrescalerValue)

Function description

Configure Clock source prescaler for baudrate generator and oversampling.

Parameters

- **LPUARTx:** LPUART Instance
- **PrescalerValue:** This parameter can be one of the following values:
  - LL_LPUART_PRESCALER_DIV1
  - LL_LPUART_PRESCALER_DIV2
  - LL_LPUART_PRESCALER_DIV4
  - LL_LPUART_PRESCALER_DIV6
  - LL_LPUART_PRESCALER_DIV8
  - LL_LPUART_PRESCALER_DIV10
  - LL_LPUART_PRESCALER_DIV12
  - LL_LPUART_PRESCALER_DIV16
  - LL_LPUART_PRESCALER_DIV32
  - LL_LPUART_PRESCALER_DIV64
  - LL_LPUART_PRESCALER_DIV128
  - LL_LPUART_PRESCALER_DIV256

Return values

- **None:**

Reference Manual to LL API cross reference:

- PRESC PRESCALER LL_LPUART_SetPrescaler

LL_LPUART_GetPrescaler

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetPrescaler (USART_TypeDef * LPUARTx)

Function description

Retrieve the Clock source prescaler for baudrate generator and oversampling.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_PRESCALER_DIV1
  - LL_LPUART_PRESCALER_DIV2
  - LL_LPUART_PRESCALER_DIV4
  - LL_LPUART_PRESCALER_DIV6
  - LL_LPUART_PRESCALER_DIV8
  - LL_LPUART_PRESCALER_DIV10
  - LL_LPUART_PRESCALER_DIV12
  - LL_LPUART_PRESCALER_DIV16
  - LL_LPUART_PRESCALER_DIV32
  - LL_LPUART_PRESCALER_DIV64
  - LL_LPUART_PRESCALER_DIV128
  - LL_LPUART_PRESCALER_DIV256

Reference Manual to LL API cross reference:

- PRESC PRESCALER LL_LPUART_GetPrescaler

`LL_LPUART_SetStopBitsLength`

Function name

__STATIC_INLINE void LL_LPUART_SetStopBitsLength (USART_TypeDef * LPUARTx, uint32_t StopBits)

Function description

Set the length of the stop bits.

Parameters

- **LPUARTx:** LPUART Instance
- **StopBits:** This parameter can be one of the following values:
  - LL_LPUART_STOPBITS_1
  - LL_LPUART_STOPBITS_2

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 STOP LL_LPUART_SetStopBitsLength

`LL_LPUART_GetStopBitsLength`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetStopBitsLength (USART_TypeDef * LPUARTx)

Function description

Retrieve the length of the stop bits.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_STOPBITS_1
  - LL_LPUART_STOPBITS_2

Reference Manual to LL API cross reference:

- CR2 STOP LL_LPUART_GetStopBitsLength

`LL_LPUART_ConfigCharacter`

Function name

__STATIC_INLINE void LL_LPUART_ConfigCharacter (USART_TypeDef * LPUARTx, uint32_t DataWidth, uint32_t Parity, uint32_t StopBits)

Function description

Configure Character frame format (Datawidth, Parity control, Stop Bits)

Parameters

- **LPUARTx:** LPUART Instance
- **DataWidth:** This parameter can be one of the following values:
  - LL_LPUART_DATAWIDTH_7B
  - LL_LPUART_DATAWIDTH_8B
  - LL_LPUART_DATAWIDTH_9B
- **Parity:** This parameter can be one of the following values:
  - LL_LPUART_PARITY_NONE
  - LL_LPUART_PARITY_EVEN
  - LL_LPUART_PARITY_ODD
- **StopBits:** This parameter can be one of the following values:
  - LL_LPUART_STOPBITS_1
  - LL_LPUART_STOPBITS_2

Return values

- **None:**

Notes

- Call of this function is equivalent to following function call sequence : Data Width configuration using LL_LPUART_SetDataWidth() functionParity Control and mode configuration using LL_LPUART_SetParity() functionStop bits configuration using LL_LPUART_SetStopBitsLength() function

Reference Manual to LL API cross reference:

- CR1 PS LL_LPUART_ConfigCharacter
- CR1 PCE LL_LPUART_ConfigCharacter
- CR1 M LL_LPUART_ConfigCharacter
- CR2 STOP LL_LPUART_ConfigCharacter

LL_LPUART_SetTXRXSwap

Function name

__STATIC_INLINE void LL_LPUART_SetTXRXSwap (USART_TypeDef * LPUARTx, uint32_t SwapConfig)

Function description

Configure TX/RX pins swapping setting.

Parameters

- **LPUARTx:** LPUART Instance
- **SwapConfig:** This parameter can be one of the following values:
  - LL_LPUART_TXRX_STANDARD
  - LL_LPUART_TXRX_SWAPPED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 SWAP LL_LPUART_SetTXRXSwap

LL_LPUART_GetTXRXSwap

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetTXRXSwap (USART_TypeDef * LPUARTx)

Function description

Retrieve TX/RX pins swapping configuration.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_TXRX_STANDARD
  - LL_LPUART_TXRX_SWAPPED

Reference Manual to LL API cross reference:

- CR2 SWAP LL_LPUART_GetTXRXSwap

LL_LPUART_SetRXPinLevel

Function name

__STATIC_INLINE void LL_LPUART_SetRXPinLevel (USART_TypeDef * LPUARTx, uint32_t PinInvMethod)

Function description

Configure RX pin active level logic.

Parameters

- **LPUARTx:** LPUART Instance
- **PinInvMethod:** This parameter can be one of the following values:
  - LL_LPUART_RXPIN_LEVEL_STANDARD
  - LL_LPUART_RXPIN_LEVEL_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXINV LL_LPUART_SetRXPinLevel

LL_LPUART_GetRXPinLevel

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetRXPinLevel (USART_TypeDef * LPUARTx)

Function description

Retrieve RX pin active level logic configuration.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_RXPIN_LEVEL_STANDARD
  - LL_LPUART_RXPIN_LEVEL_INVERTED

Reference Manual to LL API cross reference:

- CR2 RXINV LL_LPUART_GetRXPinLevel

LL_LPUART_SetTXPinLevel

Function name

__STATIC_INLINE void LL_LPUART_SetTXPinLevel (USART_TypeDef * LPUARTx, uint32_t PinInvMethod)

Function description

Configure TX pin active level logic.

Parameters

- **LPUARTx:** LPUART Instance
- **PinInvMethod:** This parameter can be one of the following values:
  - LL_LPUART_TXPIN_LEVEL_STANDARD
  - LL_LPUART_TXPIN_LEVEL_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXINV LL_LPUART_SetTXPinLevel

LL_LPUART_GetTXPinLevel

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetTXPinLevel (USART_TypeDef * LPUARTx)

Function description

Retrieve TX pin active level logic configuration.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_TXPIN_LEVEL_STANDARD
  - LL_LPUART_TXPIN_LEVEL_INVERTED

Reference Manual to LL API cross reference:

- CR2 TXINV LL_LPUART_GetTXPinLevel

LL_LPUART_SetBinaryDataLogic

Function name

__STATIC_INLINE void LL_LPUART_SetBinaryDataLogic (USART_TypeDef * LPUARTx, uint32_t DataLogic)

Function description

Configure Binary data logic.

Parameters

- **LPUARTx:** LPUART Instance
- **DataLogic:** This parameter can be one of the following values:
  - LL_LPUART_BINARY_LOGIC_POSITIVE
  - LL_LPUART_BINARY_LOGIC_NEGATIVE

Return values

- **None:**

Notes

- Allow to define how Logical data from the data register are send/received : either in positive/direct logic (1=H, 0=L) or in negative/inverse logic (1=L, 0=H)

Reference Manual to LL API cross reference:

- CR2 DATAINV LL_LPUART_SetBinaryDataLogic

`LL_LPUART_GetBinaryDataLogic`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetBinaryDataLogic (USART_TypeDef * LPUARTx)

Function description

Retrieve Binary data configuration.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_BINARY_LOGIC_POSITIVE
  - LL_LPUART_BINARY_LOGIC_NEGATIVE

Reference Manual to LL API cross reference:

- CR2 DATAINV LL_LPUART_GetBinaryDataLogic

`LL_LPUART_SetTransferBitOrder`

Function name

__STATIC_INLINE void LL_LPUART_SetTransferBitOrder (USART_TypeDef * LPUARTx, uint32_t BitOrder)

Function description

Configure transfer bit order (either Less or Most Significant Bit First)

Parameters

- **LPUARTx:** LPUART Instance
- **BitOrder:** This parameter can be one of the following values:
  - LL_LPUART_BITORDER_LSBFIRST
  - LL_LPUART_BITORDER_MSBFIRST

Return values

- **None:**

Notes

- MSB First means data is transmitted/received with the MSB first, following the start bit. LSB First means data is transmitted/received with data bit 0 first, following the start bit.

Reference Manual to LL API cross reference:

- CR2 MSBFIRST LL_LPUART_SetTransferBitOrder

LL_LPUART_GetTransferBitOrder

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetTransferBitOrder (USART_TypeDef * LPUARTx)

Function description

Return transfer bit order (either Less or Most Significant Bit First)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_BITORDER_LSBFIRST
  - LL_LPUART_BITORDER_MSBFIRST

Notes

- MSB First means data is transmitted/received with the MSB first, following the start bit. LSB First means data is transmitted/received with data bit 0 first, following the start bit.

Reference Manual to LL API cross reference:

- CR2 MSBFIRST LL_LPUART_GetTransferBitOrder

LL_LPUART_ConfigNodeAddress

Function name

__STATIC_INLINE void LL_LPUART_ConfigNodeAddress (USART_TypeDef * LPUARTx, uint32_t AddressLen, uint32_t NodeAddress)

Function description

Set Address of the LPUART node.

Parameters

- **LPUARTx:** LPUART Instance
- **AddressLen:** This parameter can be one of the following values:
  - LL_LPUART_ADDRESS_DETECT_4B
  - LL_LPUART_ADDRESS_DETECT_7B
- **NodeAddress:** 4 or 7 bit Address of the LPUART node.

Return values

- **None:**

Notes

- This is used in multiprocessor communication during Mute mode or Stop mode, for wake up with address mark detection.
- 4bits address node is used when 4-bit Address Detection is selected in ADDM7. (b7-b4 should be set to 0) 8bits address node is used when 7-bit Address Detection is selected in ADDM7. (This is used in multiprocessor communication during Mute mode or Stop mode, for wake up with 7-bit address mark detection. The MSB of the character sent by the transmitter should be equal to 1. It may also be used for character detection during normal reception, Mute mode inactive (for example, end of block detection in ModBus protocol). In this case, the whole received character (8-bit) is compared to the ADD[7:0] value and CMF flag is set on match)

Reference Manual to LL API cross reference:

- CR2 ADD LL_LPUART_ConfigNodeAddress
- CR2 ADDM7 LL_LPUART_ConfigNodeAddress

`LL_LPUART_GetNodeAddress`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetNodeAddress (USART_TypeDef * LPUARTx)

Function description

Return 8 bit Address of the LPUART node as set in ADD field of CR2.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Address:** of the LPUART node (Value between Min_Data=0 and Max_Data=255)

Notes

- If 4-bit Address Detection is selected in ADDM7, only 4bits (b3-b0) of returned value are relevant (b31-b4 are not relevant) If 7-bit Address Detection is selected in ADDM7, only 8bits (b7-b0) of returned value are relevant (b31-b8 are not relevant)

Reference Manual to LL API cross reference:

- CR2 ADD LL_LPUART_GetNodeAddress

`LL_LPUART_GetNodeAddressLen`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetNodeAddressLen (USART_TypeDef * LPUARTx)

Function description

Return Length of Node Address used in Address Detection mode (7-bit or 4-bit)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_ADDRESS_DETECT_4B
  - LL_LPUART_ADDRESS_DETECT_7B

Reference Manual to LL API cross reference:

- CR2 ADDM7 LL_LPUART_GetNodeAddressLen

`LL_LPUART_EnableRTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_LPUART_EnableRTSHWFlowCtrl (USART_TypeDef * LPUARTx)

Function description

Enable RTS HW Flow Control.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RTSE LL_LPUART_EnableRTSHWFlowCtrl

`LL_LPUART_DisableRTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_LPUART_DisableRTSHWFlowCtrl (USART_TypeDef * LPUARTx)

Function description

Disable RTS HW Flow Control.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RTSE LL_LPUART_DisableRTSHWFlowCtrl

`LL_LPUART_EnableCTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_LPUART_EnableCTSHWFlowCtrl (USART_TypeDef * LPUARTx)

Function description

Enable CTS HW Flow Control.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 CTSE LL_LPUART_EnableCTSHWFlowCtrl

`LL_LPUART_DisableCTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_LPUART_DisableCTSHWFlowCtrl (USART_TypeDef * LPUARTx)

Function description

Disable CTS HW Flow Control.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 CTSE LL_LPUART_DisableCTSHWFlowCtrl

LL_LPUART_SetHWFlowCtrl

Function name

__STATIC_INLINE void LL_LPUART_SetHWFlowCtrl (USART_TypeDef * LPUARTx, uint32_t HardwareFlowControl)

Function description

Configure HW Flow Control mode (both CTS and RTS)

Parameters

- **LPUARTx:** LPUART Instance
- **HardwareFlowControl:** This parameter can be one of the following values:
  - LL_LPUART_HWCONTROL_NONE
  - LL_LPUART_HWCONTROL_RTS
  - LL_LPUART_HWCONTROL_CTS
  - LL_LPUART_HWCONTROL_RTS_CTS

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RTSE LL_LPUART_SetHWFlowCtrl
- CR3 CTSE LL_LPUART_SetHWFlowCtrl

LL_LPUART_GetHWFlowCtrl

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetHWFlowCtrl (USART_TypeDef * LPUARTx)

Function description

Return HW Flow Control configuration (both CTS and RTS)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_HWCONTROL_NONE
  - LL_LPUART_HWCONTROL_RTS
  - LL_LPUART_HWCONTROL_CTS
  - LL_LPUART_HWCONTROL_RTS_CTS

Reference Manual to LL API cross reference:

- CR3 RTSE LL_LPUART_GetHWFlowCtrl
- CR3 CTSE LL_LPUART_GetHWFlowCtrl

LL_LPUART_EnableOverrunDetect

Function name

__STATIC_INLINE void LL_LPUART_EnableOverrunDetect (USART_TypeDef * LPUARTx)

Function description

Enable Overrun detection.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 OVRDIS LL_LPUART_EnableOverrunDetect

`LL_LPUART_DisableOverrunDetect`

Function name

__STATIC_INLINE void LL_LPUART_DisableOverrunDetect (USART_TypeDef * LPUARTx)

Function description

Disable Overrun detection.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 OVRDIS LL_LPUART_DisableOverrunDetect

`LL_LPUART_IsEnabledOverrunDetect`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledOverrunDetect (USART_TypeDef * LPUARTx)

Function description

Indicate if Overrun detection is enabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 OVRDIS LL_LPUART_IsEnabledOverrunDetect

`LL_LPUART_SetWKUPType`

Function name

__STATIC_INLINE void LL_LPUART_SetWKUPType (USART_TypeDef * LPUARTx, uint32_t Type)

Function description

Select event type for Wake UP Interrupt Flag (WUS[1:0] bits)

Parameters

- **LPUARTx:** LPUART Instance
- **Type:** This parameter can be one of the following values:
  - LL_LPUART_WAKEUP_ON_ADDRESS
  - LL_LPUART_WAKEUP_ON_STARTBIT
  - LL_LPUART_WAKEUP_ON_RXNE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 WUS LL_LPUART_SetWKUPType

LL_LPUART_GetWKUPType

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetWKUPType (USART_TypeDef * LPUARTx)

Function description

Return event type for Wake UP Interrupt Flag (WUS[1:0] bits)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_WAKEUP_ON_ADDRESS
  - LL_LPUART_WAKEUP_ON_STARTBIT
  - LL_LPUART_WAKEUP_ON_RXNE

Reference Manual to LL API cross reference:

- CR3 WUS LL_LPUART_GetWKUPType

LL_LPUART_SetBaudRate

Function name

__STATIC_INLINE void LL_LPUART_SetBaudRate (USART_TypeDef * LPUARTx, uint32_t PeriphClk, uint32_t PrescalerValue, uint32_t BaudRate)

Function description

Configure LPUART BRR register for achieving expected Baud Rate value.

Parameters

- **LPUARTx:** LPUART Instance
- **PeriphClk:** Peripheral Clock
- **BaudRate:** Baud Rate

Return values

- **None:**

Notes

- Compute and set LPUARTDIV value in BRR Register (full BRR content) according to used Peripheral Clock and expected Baud Rate values
- Peripheral clock and Baud Rate values provided as function parameters should be valid (Baud rate value != 0).
- Provided that LPUARTx_BRR must be > = 0x300 and LPUART_BRR is 20-bit, a care should be taken when generating high baud rates using high PeriphClk values. PeriphClk must be in the range [3 x BaudRate, 4096 x BaudRate].

Reference Manual to LL API cross reference:

- BRR BRR LL_LPUART_SetBaudRate

`LL_LPUART_GetBaudRate`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetBaudRate (USART_TypeDef * LPUARTx, uint32_t PeriphClk, uint32_t PrescalerValue)

Function description

Return current Baud Rate value, according to LPUARTDIV present in BRR register (full BRR content), and to used Peripheral Clock values.

Parameters

- **LPUARTx:** LPUART Instance
- **PeriphClk:** Peripheral Clock

Return values

- **Baud:** Rate

Notes

- In case of non-initialized or invalid value stored in BRR register, value 0 will be returned.

Reference Manual to LL API cross reference:

- BRR BRR LL_LPUART_GetBaudRate

`LL_LPUART_EnableHalfDuplex`

Function name

__STATIC_INLINE void LL_LPUART_EnableHalfDuplex (USART_TypeDef * LPUARTx)

Function description

Enable Single Wire Half-Duplex mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 HDSEL LL_LPUART_EnableHalfDuplex

`LL_LPUART_DisableHalfDuplex`

Function name

__STATIC_INLINE void LL_LPUART_DisableHalfDuplex (USART_TypeDef * LPUARTx)

Function description

Disable Single Wire Half-Duplex mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 HDSEL LL_LPUART_DisableHalfDuplex

`LL_LPUART_IsEnabledHalfDuplex`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledHalfDuplex (USART_TypeDef * LPUARTx)

Function description

Indicate if Single Wire Half-Duplex mode is enabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 HDSEL LL_LPUART_IsEnabledHalfDuplex

`LL_LPUART_SetDEDeassertionTime`

Function name

__STATIC_INLINE void LL_LPUART_SetDEDeassertionTime (USART_TypeDef * LPUARTx, uint32_t Time)

Function description

Set DEDT (Driver Enable De-Assertion Time), Time value expressed on 5 bits ([4:0] bits).

Parameters

- **LPUARTx:** LPUART Instance
- **Time:** Value between Min_Data=0 and Max_Data=31

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 DEDT LL_LPUART_SetDEDeassertionTime

`LL_LPUART_GetDEDeassertionTime`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetDEDeassertionTime (USART_TypeDef * LPUARTx)

Function description

Return DEDT (Driver Enable De-Assertion Time)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Time:** value expressed on 5 bits ([4:0] bits) : c

Reference Manual to LL API cross reference:

- CR1 DEDT LL_LPUART_GetDEDeassertionTime

`LL_LPUART_SetDEAssertionTime`

Function name

__STATIC_INLINE void LL_LPUART_SetDEAssertionTime (USART_TypeDef * LPUARTx, uint32_t Time)

Function description

Set DEAT (Driver Enable Assertion Time), Time value expressed on 5 bits ([4:0] bits).

Parameters

- **LPUARTx:** LPUART Instance
- **Time:** Value between Min_Data=0 and Max_Data=31

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 DEAT LL_LPUART_SetDEAssertionTime

`LL_LPUART_GetDEAssertionTime`

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetDEAssertionTime (USART_TypeDef * LPUARTx)

Function description

Return DEAT (Driver Enable Assertion Time)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Time:** value expressed on 5 bits ([4:0] bits) : Time Value between Min_Data=0 and Max_Data=31

Reference Manual to LL API cross reference:

- CR1 DEAT LL_LPUART_GetDEAssertionTime

`LL_LPUART_EnableDEMode`

Function name

__STATIC_INLINE void LL_LPUART_EnableDEMode (USART_TypeDef * LPUARTx)

Function description

Enable Driver Enable (DE) Mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DEM LL_LPUART_EnableDEMode

`LL_LPUART_DisableDEMode`

Function name

__STATIC_INLINE void LL_LPUART_DisableDEMode (USART_TypeDef * LPUARTx)

Function description

Disable Driver Enable (DE) Mode.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DEM LL_LPUART_DisableDEMode

`LL_LPUART_IsEnabledDEMode`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledDEMode (USART_TypeDef * LPUARTx)

Function description

Indicate if Driver Enable (DE) Mode is enabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DEM LL_LPUART_IsEnabledDEMode

`LL_LPUART_SetDESignalPolarity`

Function name

__STATIC_INLINE void LL_LPUART_SetDESignalPolarity (USART_TypeDef * LPUARTx, uint32_t Polarity)

Function description

Select Driver Enable Polarity.

Parameters

- **LPUARTx:** LPUART Instance
- **Polarity:** This parameter can be one of the following values:
  - LL_LPUART_DE_POLARITY_HIGH
  - LL_LPUART_DE_POLARITY_LOW

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DEP LL_LPUART_SetDESignalPolarity

LL_LPUART_GetDESignalPolarity

Function name

__STATIC_INLINE uint32_t LL_LPUART_GetDESignalPolarity (USART_TypeDef * LPUARTx)

Function description

Return Driver Enable Polarity.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_LPUART_DE_POLARITY_HIGH
  - LL_LPUART_DE_POLARITY_LOW

Reference Manual to LL API cross reference:

- CR3 DEP LL_LPUART_GetDESignalPolarity

LL_LPUART_IsActiveFlag_PE

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_PE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Parity Error Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR PE LL_LPUART_IsActiveFlag_PE

LL_LPUART_IsActiveFlag_FE

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_FE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Framing Error Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR FE LL_LPUART_IsActiveFlag_FE

`LL_LPUART_IsActiveFlag_NE`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_NE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Noise error detected Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR NE LL_LPUART_IsActiveFlag_NE

`LL_LPUART_IsActiveFlag_ORE`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_ORE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART OverRun Error Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ORE LL_LPUART_IsActiveFlag_ORE

`LL_LPUART_IsActiveFlag_IDLE`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_IDLE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART IDLE line detected Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR IDLE LL_LPUART_IsActiveFlag_IDLE

`LL_LPUART_IsActiveFlag_RXNE_RXFNE`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_RXNE_RXFNE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Read Data Register or LPUART RX FIFO Not Empty Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RXNE_RXFNE LL_LPUART_IsActiveFlag_RXNE_RXFNE

`LL_LPUART_IsActiveFlag_TC`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_TC (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Transmission Complete Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TC LL_LPUART_IsActiveFlag_TC

`LL_LPUART_IsActiveFlag_TXE_TXFNF`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_TXE_TXFNF (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Transmit Data Register Empty or LPUART TX FIFO Not Full Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TXE_TXFNF LL_LPUART_IsActiveFlag_TXE_TXFNF

`LL_LPUART_IsActiveFlag_nCTS`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_nCTS (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART CTS interrupt Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CTSIF LL_LPUART_IsActiveFlag_nCTS

`LL_LPUART_IsActiveFlag_CTS`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_CTS (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART CTS Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CTS LL_LPUART_IsActiveFlag_CTS

`LL_LPUART_IsActiveFlag_BUSY`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_BUSY (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Busy Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR BUSY LL_LPUART_IsActiveFlag_BUSY

`LL_LPUART_IsActiveFlag_CM`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_CM (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Character Match Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CMF LL_LPUART_IsActiveFlag_CM

LL_LPUART_IsActiveFlag_SBK

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_SBK (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Send Break Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SBKF LL_LPUART_IsActiveFlag_SBK

LL_LPUART_IsActiveFlag_RWU

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_RWU (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Receive Wake Up from mute mode Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RWU LL_LPUART_IsActiveFlag_RWU

LL_LPUART_IsActiveFlag_WKUP

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_WKUP (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Wake Up from stop mode Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR WUF LL_LPUART_IsActiveFlag_WKUP

LL_LPUART_IsActiveFlag_TEACK

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_TEACK (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Transmit Enable Acknowledge Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEACK LL_LPUART_IsActiveFlag_TEACK

`LL_LPUART_IsActiveFlag_REACK`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_REACK (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Receive Enable Acknowledge Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR REACK LL_LPUART_IsActiveFlag_REACK

`LL_LPUART_IsActiveFlag_TXFE`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_TXFE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART TX FIFO Empty Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TXFE LL_LPUART_IsActiveFlag_TXFE

`LL_LPUART_IsActiveFlag_RXFF`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_RXFF (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART RX FIFO Full Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RXFF LL_LPUART_IsActiveFlag_RXFF

`LL_LPUART_IsActiveFlag_TXFT`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_TXFT (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART TX FIFO Threshold Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TXFT LL_LPUART_IsActiveFlag_TXFT

`LL_LPUART_IsActiveFlag_RXFT`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsActiveFlag_RXFT (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART RX FIFO Threshold Flag is set or not.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RXFT LL_LPUART_IsActiveFlag_RXFT

`LL_LPUART_ClearFlag_PE`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_PE (USART_TypeDef * LPUARTx)

Function description

Clear Parity Error Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR PECF LL_LPUART_ClearFlag_PE

`LL_LPUART_ClearFlag_FE`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_FE (USART_TypeDef * LPUARTx)

Function description

Clear Framing Error Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR FECF LL_LPUART_ClearFlag_FE

`LL_LPUART_ClearFlag_NE`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_NE (USART_TypeDef * LPUARTx)

Function description

Clear Noise detected Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR NECF LL_LPUART_ClearFlag_NE

`LL_LPUART_ClearFlag_ORE`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_ORE (USART_TypeDef * LPUARTx)

Function description

Clear OverRun Error Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ORECF LL_LPUART_ClearFlag_ORE

`LL_LPUART_ClearFlag_IDLE`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_IDLE (USART_TypeDef * LPUARTx)

Function description

Clear IDLE line detected Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR IDLECF LL_LPUART_ClearFlag_IDLE

`LL_LPUART_ClearFlag_TXFE`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_TXFE (USART_TypeDef * LPUARTx)

Function description

Clear TX FIFO Empty Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR TXFECF LL_LPUART_ClearFlag_TXFE

`LL_LPUART_ClearFlag_TC`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_TC (USART_TypeDef * LPUARTx)

Function description

Clear Transmission Complete Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR TCCF LL_LPUART_ClearFlag_TC

`LL_LPUART_ClearFlag_nCTS`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_nCTS (USART_TypeDef * LPUARTx)

Function description

Clear CTS Interrupt Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR CTSCF LL_LPUART_ClearFlag_nCTS

`LL_LPUART_ClearFlag_CM`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_CM (USART_TypeDef * LPUARTx)

Function description

Clear Character Match Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR CMCF LL_LPUART_ClearFlag_CM

`LL_LPUART_ClearFlag_WKUP`

Function name

__STATIC_INLINE void LL_LPUART_ClearFlag_WKUP (USART_TypeDef * LPUARTx)

Function description

Clear Wake Up from stop mode Flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR WUCF LL_LPUART_ClearFlag_WKUP

`LL_LPUART_EnableIT_IDLE`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_IDLE (USART_TypeDef * LPUARTx)

Function description

Enable IDLE Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 IDLEIE LL_LPUART_EnableIT_IDLE

LL_LPUART_EnableIT_RXNE_RXFNE

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_RXNE_RXFNE (USART_TypeDef * LPUARTx)

Function description

Enable RX Not Empty and RX FIFO Not Empty Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXNEIE_RXFNEIE LL_LPUART_EnableIT_RXNE_RXFNE

LL_LPUART_EnableIT_TC

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_TC (USART_TypeDef * LPUARTx)

Function description

Enable Transmission Complete Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TCIE LL_LPUART_EnableIT_TC

LL_LPUART_EnableIT_TXE_TXFNF

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_TXE_TXFNF (USART_TypeDef * LPUARTx)

Function description

Enable TX Empty and TX FIFO Not Full Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXEIE_TXFNFIE LL_LPUART_EnableIT_TXE_TXFNF

LL_LPUART_EnableIT_PE

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_PE (USART_TypeDef * LPUARTx)

Function description

Enable Parity Error Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PEIE LL_LPUART_EnableIT_PE

`LL_LPUART_EnableIT_CM`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_CM (USART_TypeDef * LPUARTx)

Function description

Enable Character Match Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CMIE LL_LPUART_EnableIT_CM

`LL_LPUART_EnableIT_TXFE`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_TXFE (USART_TypeDef * LPUARTx)

Function description

Enable TX FIFO Empty Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXFEIE LL_LPUART_EnableIT_TXFE

`LL_LPUART_EnableIT_RXFF`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_RXFF (USART_TypeDef * LPUARTx)

Function description

Enable RX FIFO Full Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXFFIE LL_LPUART_EnableIT_RXFF

`LL_LPUART_EnableIT_ERROR`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_ERROR (USART_TypeDef * LPUARTx)

Function description

Enable Error Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Notes

- When set, Error Interrupt Enable Bit is enabling interrupt generation in case of a framing error, overrun error or noise flag (FE=1 or ORE=1 or NF=1 in the LPUARTx_ISR register). 0: Interrupt is inhibited1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the LPUARTx_ISR register.

Reference Manual to LL API cross reference:

- CR3 EIE LL_LPUART_EnableIT_ERROR

`LL_LPUART_EnableIT_CTS`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_CTS (USART_TypeDef * LPUARTx)

Function description

Enable CTS Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 CTSIE LL_LPUART_EnableIT_CTS

`LL_LPUART_EnableIT_WKUP`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_WKUP (USART_TypeDef * LPUARTx)

Function description

Enable Wake Up from Stop Mode Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 WUFIE LL_LPUART_EnableIT_WKUP

`LL_LPUART_EnableIT_TXFT`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_TXFT (USART_TypeDef * LPUARTx)

Function description

Enable TX FIFO Threshold Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 TXFTIE LL_LPUART_EnableIT_TXFT

`LL_LPUART_EnableIT_RXFT`

Function name

__STATIC_INLINE void LL_LPUART_EnableIT_RXFT (USART_TypeDef * LPUARTx)

Function description

Enable RX FIFO Threshold Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RXFTIE LL_LPUART_EnableIT_RXFT

`LL_LPUART_DisableIT_IDLE`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_IDLE (USART_TypeDef * LPUARTx)

Function description

Disable IDLE Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 IDLEIE LL_LPUART_DisableIT_IDLE

LL_LPUART_DisableIT_RXNE_RXFNE

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_RXNE_RXFNE (USART_TypeDef * LPUARTx)

Function description

Disable RX Not Empty and RX FIFO Not Empty Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXNEIE_RXFNEIE LL_LPUART_DisableIT_RXNE_RXFNE

LL_LPUART_DisableIT_TC

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_TC (USART_TypeDef * LPUARTx)

Function description

Disable Transmission Complete Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TCIE LL_LPUART_DisableIT_TC

LL_LPUART_DisableIT_TXE_TXFNF

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_TXE_TXFNF (USART_TypeDef * LPUARTx)

Function description

Disable TX Empty and TX FIFO Not Full Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXEIE_TXFNFIE LL_LPUART_DisableIT_TXE_TXFNF

LL_LPUART_DisableIT_PE

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_PE (USART_TypeDef * LPUARTx)

Function description

Disable Parity Error Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PEIE LL_LPUART_DisableIT_PE

`LL_LPUART_DisableIT_CM`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_CM (USART_TypeDef * LPUARTx)

Function description

Disable Character Match Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CMIE LL_LPUART_DisableIT_CM

`LL_LPUART_DisableIT_TXFE`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_TXFE (USART_TypeDef * LPUARTx)

Function description

Disable TX FIFO Empty Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TXFEIE LL_LPUART_DisableIT_TXFE

`LL_LPUART_DisableIT_RXFF`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_RXFF (USART_TypeDef * LPUARTx)

Function description

Disable RX FIFO Full Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXFFIE LL_LPUART_DisableIT_RXFF

`LL_LPUART_DisableIT_ERROR`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_ERROR (USART_TypeDef * LPUARTx)

Function description

Disable Error Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Notes

- When set, Error Interrupt Enable Bit is enabling interrupt generation in case of a framing error, overrun error or noise flag (FE=1 or ORE=1 or NF=1 in the LPUARTx_ISR register). 0: Interrupt is inhibited1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the LPUARTx_ISR register.

Reference Manual to LL API cross reference:

- CR3 EIE LL_LPUART_DisableIT_ERROR

`LL_LPUART_DisableIT_CTS`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_CTS (USART_TypeDef * LPUARTx)

Function description

Disable CTS Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 CTSIE LL_LPUART_DisableIT_CTS

`LL_LPUART_DisableIT_WKUP`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_WKUP (USART_TypeDef * LPUARTx)

Function description

Disable Wake Up from Stop Mode Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 WUFIE LL_LPUART_DisableIT_WKUP

`LL_LPUART_DisableIT_TXFT`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_TXFT (USART_TypeDef * LPUARTx)

Function description

Disable TX FIFO Threshold Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 TXFTIE LL_LPUART_DisableIT_TXFT

`LL_LPUART_DisableIT_RXFT`

Function name

__STATIC_INLINE void LL_LPUART_DisableIT_RXFT (USART_TypeDef * LPUARTx)

Function description

Disable RX FIFO Threshold Interrupt.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RXFTIE LL_LPUART_DisableIT_RXFT

`LL_LPUART_IsEnabledIT_IDLE`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_IDLE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART IDLE Interrupt source is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 IDLEIE LL_LPUART_IsEnabledIT_IDLE

LL_LPUART_IsEnabledIT_RXNE_RXFNE

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_RXNE_RXFNE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART RX Not Empty and LPUART RX FIFO Not Empty Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RXNEIE_RXFNEIE LL_LPUART_IsEnabledIT_RXNE_RXFNE

LL_LPUART_IsEnabledIT_TC

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_TC (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Transmission Complete Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TCIE LL_LPUART_IsEnabledIT_TC

LL_LPUART_IsEnabledIT_TXE_TXFNF

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_TXE_TXFNF (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART TX Empty and LPUART TX FIFO Not Full Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TXEIE_TXFNFIE LL_LPUART_IsEnabledIT_TXE_TXFNF

LL_LPUART_IsEnabledIT_PE

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_PE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Parity Error Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 PEIE LL_LPUART_IsEnabledIT_PE

LL_LPUART_IsEnabledIT_CM

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_CM (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Character Match Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 CMIE LL_LPUART_IsEnabledIT_CM

LL_LPUART_IsEnabledIT_TXFE

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_TXFE (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART TX FIFO Empty Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TXFEIE LL_LPUART_IsEnabledIT_TXFE

LL_LPUART_IsEnabledIT_RXFF

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_RXFF (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART RX FIFO Full Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RXFFIE LL_LPUART_IsEnabledIT_RXFF

`LL_LPUART_IsEnabledIT_ERROR`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_ERROR (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Error Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 EIE LL_LPUART_IsEnabledIT_ERROR

`LL_LPUART_IsEnabledIT_CTS`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_CTS (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART CTS Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 CTSIE LL_LPUART_IsEnabledIT_CTS

`LL_LPUART_IsEnabledIT_WKUP`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_WKUP (USART_TypeDef * LPUARTx)

Function description

Check if the LPUART Wake Up from Stop Mode Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 WUFIE LL_LPUART_IsEnabledIT_WKUP

LL_LPUART_IsEnabledIT_TXFT

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_TXFT (USART_TypeDef * LPUARTx)

Function description

Check if LPUART TX FIFO Threshold Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 TXFTIE LL_LPUART_IsEnabledIT_TXFT

LL_LPUART_IsEnabledIT_RXFT

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledIT_RXFT (USART_TypeDef * LPUARTx)

Function description

Check if LPUART RX FIFO Threshold Interrupt is enabled or disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 RXFTIE LL_LPUART_IsEnabledIT_RXFT

LL_LPUART_EnableDMAReq_RX

Function name

__STATIC_INLINE void LL_LPUART_EnableDMAReq_RX (USART_TypeDef * LPUARTx)

Function description

Enable DMA Mode for reception.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAR LL_LPUART_EnableDMAReq_RX

LL_LPUART_DisableDMAReq_RX

Function name

__STATIC_INLINE void LL_LPUART_DisableDMAReq_RX (USART_TypeDef * LPUARTx)

Function description

Disable DMA Mode for reception.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAR LL_LPUART_DisableDMAReq_RX

`LL_LPUART_IsEnabledDMAReq_RX`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledDMAReq_RX (USART_TypeDef * LPUARTx)

Function description

Check if DMA Mode is enabled for reception.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DMAR LL_LPUART_IsEnabledDMAReq_RX

`LL_LPUART_EnableDMAReq_TX`

Function name

__STATIC_INLINE void LL_LPUART_EnableDMAReq_TX (USART_TypeDef * LPUARTx)

Function description

Enable DMA Mode for transmission.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAT LL_LPUART_EnableDMAReq_TX

`LL_LPUART_DisableDMAReq_TX`

Function name

__STATIC_INLINE void LL_LPUART_DisableDMAReq_TX (USART_TypeDef * LPUARTx)

Function description

Disable DMA Mode for transmission.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAT LL_LPUART_DisableDMAReq_TX

`LL_LPUART_IsEnabledDMAReq_TX`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledDMAReq_TX (USART_TypeDef * LPUARTx)

Function description

Check if DMA Mode is enabled for transmission.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DMAT LL_LPUART_IsEnabledDMAReq_TX

`LL_LPUART_EnableDMADeactOnRxErr`

Function name

__STATIC_INLINE void LL_LPUART_EnableDMADeactOnRxErr (USART_TypeDef * LPUARTx)

Function description

Enable DMA Disabling on Reception Error.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DDRE LL_LPUART_EnableDMADeactOnRxErr

`LL_LPUART_DisableDMADeactOnRxErr`

Function name

__STATIC_INLINE void LL_LPUART_DisableDMADeactOnRxErr (USART_TypeDef * LPUARTx)

Function description

Disable DMA Disabling on Reception Error.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DDRE LL_LPUART_DisableDMADeactOnRxErr

`LL_LPUART_IsEnabledDMADeactOnRxErr`

Function name

__STATIC_INLINE uint32_t LL_LPUART_IsEnabledDMADeactOnRxErr (USART_TypeDef * LPUARTx)

Function description

Indicate if DMA Disabling on Reception Error is disabled.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DDRE LL_LPUART_IsEnabledDMADeactOnRxErr

`LL_LPUART_DMA_GetRegAddr`

Function name

__STATIC_INLINE uint32_t LL_LPUART_DMA_GetRegAddr (USART_TypeDef * LPUARTx, uint32_t Direction)

Function description

Get the LPUART data register address used for DMA transfer.

Parameters

- **LPUARTx:** LPUART Instance
- **Direction:** This parameter can be one of the following values:
  - LL_LPUART_DMA_REG_DATA_TRANSMIT
  - LL_LPUART_DMA_REG_DATA_RECEIVE

Return values

- **Address:** of data register

Reference Manual to LL API cross reference:

- RDR RDR LL_LPUART_DMA_GetRegAddr
-
- TDR TDR LL_LPUART_DMA_GetRegAddr

`LL_LPUART_ReceiveData8`

Function name

__STATIC_INLINE uint8_t LL_LPUART_ReceiveData8 (USART_TypeDef * LPUARTx)

Function description

Read Receiver Data register (Receive Data value, 8 bits)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Time:** Value between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- RDR RDR LL_LPUART_ReceiveData8

`LL_LPUART_ReceiveData9`

Function name

__STATIC_INLINE uint16_t LL_LPUART_ReceiveData9 (USART_TypeDef * LPUARTx)

Function description

Read Receiver Data register (Receive Data value, 9 bits)

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **Time:** Value between Min_Data=0x00 and Max_Data=0x1FF

Reference Manual to LL API cross reference:

- RDR RDR LL_LPUART_ReceiveData9

`LL_LPUART_TransmitData8`

Function name

__STATIC_INLINE void LL_LPUART_TransmitData8 (USART_TypeDef * LPUARTx, uint8_t Value)

Function description

Write in Transmitter Data Register (Transmit Data value, 8 bits)

Parameters

- **LPUARTx:** LPUART Instance
- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- TDR TDR LL_LPUART_TransmitData8

`LL_LPUART_TransmitData9`

Function name

__STATIC_INLINE void LL_LPUART_TransmitData9 (USART_TypeDef * LPUARTx, uint16_t Value)

Function description

Write in Transmitter Data Register (Transmit Data value, 9 bits)

Parameters

- **LPUARTx:** LPUART Instance
- **Value:** between Min_Data=0x00 and Max_Data=0x1FF

Return values

- **None:**

Reference Manual to LL API cross reference:

- TDR TDR LL_LPUART_TransmitData9

`LL_LPUART_RequestBreakSending`

Function name

__STATIC_INLINE void LL_LPUART_RequestBreakSending (USART_TypeDef * LPUARTx)

Function description

Request Break sending.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR SBKRQ LL_LPUART_RequestBreakSending

`LL_LPUART_RequestEnterMuteMode`

Function name

__STATIC_INLINE void LL_LPUART_RequestEnterMuteMode (USART_TypeDef * LPUARTx)

Function description

Put LPUART in mute mode and set the RWU flag.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR MMRQ LL_LPUART_RequestEnterMuteMode

`LL_LPUART_RequestRxDataFlush`

Function name

__STATIC_INLINE void LL_LPUART_RequestRxDataFlush (USART_TypeDef * LPUARTx)

Function description

Request a Receive Data flush.

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR RXFRQ LL_LPUART_RequestRxDataFlush

`LL_LPUART_DeInit`

Function name

ErrorStatus LL_LPUART_DeInit (USART_TypeDef * LPUARTx)

Function description

De-initialize LPUART registers (Registers restored to their default values).

Parameters

- **LPUARTx:** LPUART Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: LPUART registers are de-initialized
  - ERROR: not applicable

`LL_LPUART_Init`

Function name

ErrorStatus LL_LPUART_Init (USART_TypeDef * LPUARTx, LL_LPUART_InitTypeDef * LPUART_InitStruct)

Function description

Initialize LPUART registers according to the specified parameters in LPUART_InitStruct.

Parameters

- **LPUARTx:** LPUART Instance
- **LPUART_InitStruct:** pointer to a LL_LPUART_InitTypeDef structure that contains the configuration information for the specified LPUART peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: LPUART registers are initialized according to LPUART_InitStruct content
  - ERROR: Problem occurred during LPUART Registers initialization

Notes

- As some bits in LPUART configuration registers can only be written when the LPUART is disabled (USART_CR1_UE bit =0), LPUART Peripheral should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.
- Baud rate value stored in LPUART_InitStruct BaudRate field, should be valid (different from 0).

`LL_LPUART_StructInit`

Function name

void LL_LPUART_StructInit (LL_LPUART_InitTypeDef * LPUART_InitStruct)

Function description

Set each LL_LPUART_InitTypeDef field to default value.

Parameters

- **LPUART_InitStruct:** pointer to a LL_LPUART_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

95.3 LPUART Firmware driver defines

The following section lists the various define and macros of the module.

95.3.1 LPUART

LPUART

Address Length Detection

LL_LPUART_ADDRESS_DETECT_4B

4-bit address detection method selected

LL_LPUART_ADDRESS_DETECT_7B

7-bit address detection (in 8-bit data mode) method selected

Binary Data Inversion

LL_LPUART_BINARY_LOGIC_POSITIVE

Logical data from the data register are send/received in positive/direct logic. (1=H, 0=L)

LL_LPUART_BINARY_LOGIC_NEGATIVE

Logical data from the data register are send/received in negative/inverse logic. (1=L, 0=H). The parity bit is also inverted.

Bit Order

LL_LPUART_BITORDER_LSBFIRST

data is transmitted/received with data bit 0 first, following the start bit

LL_LPUART_BITORDER_MSBFIRST

data is transmitted/received with the MSB first, following the start bit

Clear Flags Defines

LL_LPUART_ICR_PECF

Parity error flag

LL_LPUART_ICR_FECF

Framing error flag

LL_LPUART_ICR_NCF

Noise error detected flag

LL_LPUART_ICR_ORECF

Overrun error flag

LL_LPUART_ICR_IDLECF

Idle line detected flag

LL_LPUART_ICR_TXFECF

TX FIFO Empty Clear flag

LL_LPUART_ICR_TCCF

Transmission complete flag

LL_LPUART_ICR_CTSCF

CTS flag

LL_LPUART_ICR_CMCF

Character match flag

LL_LPUART_ICR_WUCF

Wakeup from Stop mode flag

Datawidth

LL_LPUART_DATAWIDTH_7B

7 bits word length : Start bit, 7 data bits, n stop bits

LL_LPUART_DATAWIDTH_8B

8 bits word length : Start bit, 8 data bits, n stop bits

LL_LPUART_DATAWIDTH_9B

9 bits word length : Start bit, 9 data bits, n stop bits

Driver Enable Polarity

LL_LPUART_DE_POLARITY_HIGH

DE signal is active high

LL_LPUART_DE_POLARITY_LOW

DE signal is active low

Direction

LL_LPUART_DIRECTION_NONE

Transmitter and Receiver are disabled

LL_LPUART_DIRECTION_RX

Transmitter is disabled and Receiver is enabled

LL_LPUART_DIRECTION_TX

Transmitter is enabled and Receiver is disabled

LL_LPUART_DIRECTION_TX_RX

Transmitter and Receiver are enabled

DMA Register Data

LL_LPUART_DMA_REG_DATA_TRANSMIT

Get address of data register used for transmission

LL_LPUART_DMA_REG_DATA_RECEIVE

Get address of data register used for reception

FIFO Threshold

LL_LPUART_FIFOTHRESHOLD_1_8

FIFO reaches 1/8 of its depth

LL_LPUART_FIFOTHRESHOLD_1_4

FIFO reaches 1/4 of its depth

LL_LPUART_FIFOTHRESHOLD_1_2

FIFO reaches 1/2 of its depth

LL_LPUART_FIFOTHRESHOLD_3_4

FIFO reaches 3/4 of its depth

LL_LPUART_FIFOTHRESHOLD_7_8

FIFO reaches 7/8 of its depth

LL_LPUART_FIFOTHRESHOLD_8_8

FIFO becomes empty for TX and full for RX

Get Flags Defines

LL_LPUART_ISR_PE

Parity error flag

LL_LPUART_ISR_FE

Framing error flag

LL_LPUART_ISR_NE

Noise detected flag

LL_LPUART_ISR_ORE

Overrun error flag

LL_LPUART_ISR_IDLE

Idle line detected flag

LL_LPUART_ISR_RXNE_RXFNE

Read data register or RX FIFO not empty flag

LL_LPUART_ISR_TC

Transmission complete flag

LL_LPUART_ISR_TXE_TXFNF

Transmit data register empty or TX FIFO Not Full flag

LL_LPUART_ISR_CTSIF

CTS interrupt flag

LL_LPUART_ISR_CTS

CTS flag

LL_LPUART_ISR_BUSY

Busy flag

LL_LPUART_ISR_CMF

Character match flag

LL_LPUART_ISR_SBKF

Send break flag

LL_LPUART_ISR_RWU

Receiver wakeup from Mute mode flag

LL_LPUART_ISR_WUF

Wakeup from Stop mode flag

LL_LPUART_ISR_TEACK

Transmit enable acknowledge flag

LL_LPUART_ISR_REACK

Receive enable acknowledge flag

LL_LPUART_ISR_TXFE

TX FIFO empty flag

LL_LPUART_ISR_RXFF

RX FIFO full flag

LL_LPUART_ISR_RXFT

RX FIFO threshold flag

LL_LPUART_ISR_TXFT

TX FIFO threshold flag

Hardware Control

LL_LPUART_HWCONTROL_NONE

CTS and RTS hardware flow control disabled

LL_LPUART_HWCONTROL_RTS

RTS output enabled, data is only requested when there is space in the receive buffer

LL_LPUART_HWCONTROL_CTS

CTS mode enabled, data is only transmitted when the nCTS input is asserted (tied to 0)

LL_LPUART_HWCONTROL_RTS_CTS

CTS and RTS hardware flow control enabled

IT Defines

LL_LPUART_CR1_IDLEIE

IDLE interrupt enable

LL_LPUART_CR1_RXNEIE_RXFNEIE

Read data register and RXFIFO not empty interrupt enable

LL_LPUART_CR1_TCIE

Transmission complete interrupt enable

LL_LPUART_CR1_TXEIE_TXFNFIE

Transmit data register empty and TX FIFO not full interrupt enable

LL_LPUART_CR1_PEIE

Parity error

LL_LPUART_CR1_CMIE

Character match interrupt enable

LL_LPUART_CR1_TXFEIE

TX FIFO empty interrupt enable

LL_LPUART_CR1_RXFFIE

RX FIFO full interrupt enable

LL_LPUART_CR3_EIE

Error interrupt enable

LL_LPUART_CR3_CTSIE

CTS interrupt enable

LL_LPUART_CR3_WUFIE

Wakeup from Stop mode interrupt enable

LL_LPUART_CR3_TXFTIE

TX FIFO threshold interrupt enable

LL_LPUART_CR3_RXFTIE

RX FIFO threshold interrupt enable

Parity Control

LL_LPUART_PARITY_NONE

Parity control disabled

LL_LPUART_PARITY_EVEN

Parity control enabled and Even Parity is selected

LL_LPUART_PARITY_ODD

Parity control enabled and Odd Parity is selected

Clock Source Prescaler

LL_LPUART_PRESCALER_DIV1

Input clock not devided

LL_LPUART_PRESCALER_DIV2

Input clock devided by 2

LL_LPUART_PRESCALER_DIV4

Input clock devided by 4

LL_LPUART_PRESCALER_DIV6

Input clock devided by 6

LL_LPUART_PRESCALER_DIV8

Input clock devided by 8

LL_LPUART_PRESCALER_DIV10

Input clock devided by 10

LL_LPUART_PRESCALER_DIV12

Input clock devided by 12

LL_LPUART_PRESCALER_DIV16

Input clock devided by 16

LL_LPUART_PRESCALER_DIV32

Input clock devided by 32

LL_LPUART_PRESCALER_DIV64

Input clock devided by 64

LL_LPUART_PRESCALER_DIV128

Input clock devided by 128

LL_LPUART_PRESCALER_DIV256

Input clock devided by 256

RX Pin Active Level Inversion

LL_LPUART_RXPIN_LEVEL_STANDARD

RX pin signal works using the standard logic levels

LL_LPUART_RXPIN_LEVEL_INVERTED

RX pin signal values are inverted.

Stop Bits

LL_LPUART_STOPBITS_1

1 stop bit

LL_LPUART_STOPBITS_2

2 stop bits

TX Pin Active Level Inversion

LL_LPUART_TXPIN_LEVEL_STANDARD

TX pin signal works using the standard logic levels

LL_LPUART_TXPIN_LEVEL_INVERTED

TX pin signal values are inverted.

TX RX Pins Swap

LL_LPUART_TXRX_STANDARD

TX/RX pins are used as defined in standard pinout

LL_LPUART_TXRX_SWAPPED

TX and RX pins functions are swapped.

Wakeup

LL_LPUART_WAKEUP_IDLELINE

LPUART wake up from Mute mode on Idle Line

LL_LPUART_WAKEUP_ADDRESSMARK

LPUART wake up from Mute mode on Address Mark

Wakeup Activation

LL_LPUART_WAKEUP_ON_ADDRESS

Wake up active on address match

LL_LPUART_WAKEUP_ON_STARTBIT

Wake up active on Start bit detection

LL_LPUART_WAKEUP_ON_RXNE

Wake up active on RXNE

FLAG_Management

LL_LPUART_IsActiveFlag_RXNE

LL_LPUART_IsActiveFlag_TXE

IT_Management

LL_LPUART_EnableIT_RXNE

LL_LPUART_EnableIT_TXE

LL_LPUART_DisableIT_RXNE

LL_LPUART_DisableIT_TXE

LL_LPUART_IsEnabledIT_RXNE

LL_LPUART_IsEnabledIT_TXE

Helper Macros

__LL_LPUART_DIV

Description:

- Compute LPUARTDIV value according to Peripheral Clock and expected Baud Rate (20-bit value of LPUARTDIV is returned)

Parameters:

- __PERIPHCLK__: Peripheral Clock frequency used for LPUART Instance
- __BAUDRATE__: Baud Rate value to achieve

Return value:

- LPUARTDIV: value to be used for BRR register filling

Common Write and read registers Macros

LL_LPUART_WriteReg

Description:

- Write a value in LPUART register.

Parameters:

- __INSTANCE__: LPUART Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_LPUART_ReadReg

Description:

- Read a value in LPUART register.

Parameters:

- __INSTANCE__: LPUART Instance
- __REG__: Register to be read

Return value:

- Register: value

96 LL OPAMP Generic Driver

96.1 OPAMP Firmware driver registers structures

96.1.1 LL_OPAMP_InitTypeDef

LL_OPAMP_InitTypeDef is defined in the stm32l4xx_ll_opamp.h

Data Fields

- ***uint32_t PowerMode***
- ***uint32_t FunctionalMode***
- ***uint32_t InputNonInverting***
- ***uint32_t InputInverting***

Field Documentation

- ***uint32_t LL_OPAMP_InitTypeDef::PowerMode***

  Set OPAMP power mode. This parameter can be a value of ***OPAMP_LL_EC_POWERMODE***This feature can be modified afterwards using unitary function **LL_OPAMP_SetPowerMode()**.

- ***uint32_t LL_OPAMP_InitTypeDef::FunctionalMode***

  Set OPAMP functional mode by setting internal connections: OPAMP operation in standalone, follower, ... This parameter can be a value of ***OPAMP_LL_EC_FUNCTIONAL_MODE***

  Note:

  – If OPAMP is configured in mode PGA, the gain can be configured using function **LL_OPAMP_SetPGAGain()**.

  This feature can be modified afterwards using unitary function **LL_OPAMP_SetFunctionalMode()**.

- ***uint32_t LL_OPAMP_InitTypeDef::InputNonInverting***

  Set OPAMP input non-inverting connection. This parameter can be a value of ***OPAMP_LL_EC_INPUT_NONINVERTING***This feature can be modified afterwards using unitary function **LL_OPAMP_SetInputNonInverting()**.

- ***uint32_t LL_OPAMP_InitTypeDef::InputInverting***

  Set OPAMP inverting input connection. This parameter can be a value of ***OPAMP_LL_EC_INPUT_INVERTING***

  Note:

  – OPAMP inverting input is used with OPAMP in mode standalone or PGA with external capacitors for filtering circuit. Otherwise (OPAMP in mode follower), OPAMP inverting input is not used (not connected to GPIO pin), this parameter is discarded.

  This feature can be modified afterwards using unitary function **LL_OPAMP_SetInputInverting()**.

96.2 OPAMP Firmware driver API description

The following section lists the various functions of the OPAMP library.

96.2.1 Detailed description of functions

`LL_OPAMP_SetCommonPowerRange`

Function name

__STATIC_INLINE void LL_OPAMP_SetCommonPowerRange (OPAMP_Common_TypeDef * OPAMPxy_COMMON, uint32_t PowerRange)

Function description

Set OPAMP power range.

Parameters

- **OPAMPxy_COMMON:** OPAMP common instance (can be set directly from CMSIS definition or by using helper macro __LL_OPAMP_COMMON_INSTANCE())
- **PowerRange:** This parameter can be one of the following values:
  - LL_OPAMP_POWERSUPPLY_RANGE_LOW
  - LL_OPAMP_POWERSUPPLY_RANGE_HIGH

Return values

- **None:**

Notes

- The OPAMP power range applies to several OPAMP instances (if several OPAMP instances available on the selected device).
- On this STM32 serie, setting of this feature is conditioned to OPAMP state: All OPAMP instances of the OPAMP common group must be disabled. This check can be done with function LL_OPAMP_IsEnabled() for each OPAMP instance or by using helper macro __LL_OPAMP_IS_ENABLED_ALL_COMMON_INSTANCE().

Reference Manual to LL API cross reference:

- CSR OPARANGE LL_OPAMP_SetCommonPowerRange

`LL_OPAMP_GetCommonPowerRange`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetCommonPowerRange (OPAMP_Common_TypeDef * OPAMPxy_COMMON)

Function description

Get OPAMP power range.

Parameters

- **OPAMPxy_COMMON:** OPAMP common instance (can be set directly from CMSIS definition or by using helper macro __LL_OPAMP_COMMON_INSTANCE())

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_POWERSUPPLY_RANGE_LOW
  - LL_OPAMP_POWERSUPPLY_RANGE_HIGH

Notes

- The OPAMP power range applies to several OPAMP instances (if several OPAMP instances available on the selected device).

Reference Manual to LL API cross reference:

- CSR OPARANGE LL_OPAMP_GetCommonPowerRange

`LL_OPAMP_SetPowerMode`

Function name

__STATIC_INLINE void LL_OPAMP_SetPowerMode (OPAMP_TypeDef * OPAMPx, uint32_t PowerMode)

Function description

Set OPAMP power mode.

Parameters

- **OPAMPx:** OPAMP instance
- **PowerMode:** This parameter can be one of the following values:
  - LL_OPAMP_POWERMODE_NORMAL
  - LL_OPAMP_POWERMODE_LOWPOWER

Return values

- **None:**

Notes

- The OPAMP must be disabled to change this configuration.

Reference Manual to LL API cross reference:

- CSR OPALPM LL_OPAMP_SetPowerMode

`LL_OPAMP_GetPowerMode`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetPowerMode (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP power mode.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_POWERMODE_NORMAL
  - LL_OPAMP_POWERMODE_LOWPOWER

Reference Manual to LL API cross reference:

- CSR OPALPM LL_OPAMP_GetPowerMode

`LL_OPAMP_SetMode`

Function name

__STATIC_INLINE void LL_OPAMP_SetMode (OPAMP_TypeDef * OPAMPx, uint32_t Mode)

Function description

Set OPAMP mode calibration or functional.

Parameters

- **OPAMPx:** OPAMP instance
- **Mode:** This parameter can be one of the following values:
  - LL_OPAMP_MODE_FUNCTIONAL
  - LL_OPAMP_MODE_CALIBRATION

Return values

- **None:**

Notes

- OPAMP mode corresponds to functional or calibration mode: functional mode: OPAMP operation in standalone, follower, ... Set functional mode using function LL_OPAMP_SetFunctionalMode().calibration mode: offset calibration of the selected transistors differential pair NMOS or PMOS.
- On this STM32 serie, during calibration, OPAMP functional mode must be set to standalone or follower mode (in order to open internal connections to resistors of PGA mode). Refer to function LL_OPAMP_SetFunctionalMode().

Reference Manual to LL API cross reference:

- CSR CALON LL_OPAMP_SetMode

LL_OPAMP_GetMode

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetMode (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP mode calibration or functional.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_MODE_FUNCTIONAL
  - LL_OPAMP_MODE_CALIBRATION

Notes

- OPAMP mode corresponds to functional or calibration mode: functional mode: OPAMP operation in standalone, follower, ... Set functional mode using function LL_OPAMP_SetFunctionalMode().calibration mode: offset calibration of the selected transistors differential pair NMOS or PMOS.

Reference Manual to LL API cross reference:

- CSR CALON LL_OPAMP_GetMode

LL_OPAMP_SetFunctionalMode

Function name

__STATIC_INLINE void LL_OPAMP_SetFunctionalMode (OPAMP_TypeDef * OPAMPx, uint32_t FunctionalMode)

Function description

Set OPAMP functional mode by setting internal connections.

Parameters

- **OPAMPx:** OPAMP instance
- **FunctionalMode:** This parameter can be one of the following values:
  - LL_OPAMP_MODE_STANDALONE
  - LL_OPAMP_MODE_FOLLOWER
  - LL_OPAMP_MODE_PGA

Return values

- **None:**

Notes

- This function reset bit of calibration mode to ensure to be in functional mode, in order to have OPAMP parameters (inputs selection, ...) set with the corresponding OPAMP mode to be effective.

Reference Manual to LL API cross reference:

- CSR OPAMODE LL_OPAMP_SetFunctionalMode

`LL_OPAMP_GetFunctionalMode`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetFunctionalMode (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP functional mode from setting of internal connections.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_MODE_STANDALONE
  - LL_OPAMP_MODE_FOLLOWER
  - LL_OPAMP_MODE_PGA

Reference Manual to LL API cross reference:

- CSR OPAMODE LL_OPAMP_GetFunctionalMode

`LL_OPAMP_SetPGAGain`

Function name

__STATIC_INLINE void LL_OPAMP_SetPGAGain (OPAMP_TypeDef * OPAMPx, uint32_t PGAGain)

Function description

Set OPAMP PGA gain.

Parameters

- **OPAMPx:** OPAMP instance
- **PGAGain:** This parameter can be one of the following values:
  - LL_OPAMP_PGA_GAIN_2
  - LL_OPAMP_PGA_GAIN_4
  - LL_OPAMP_PGA_GAIN_8
  - LL_OPAMP_PGA_GAIN_16

Return values

- **None:**

Notes

- Preliminarily, OPAMP must be set in mode PGA using function LL_OPAMP_SetFunctionalMode().

Reference Manual to LL API cross reference:

- CSR PGGAIN LL_OPAMP_SetPGAGain

`LL_OPAMP_GetPGAGain`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetPGAGain (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP PGA gain.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_PGA_GAIN_2
  - LL_OPAMP_PGA_GAIN_4
  - LL_OPAMP_PGA_GAIN_8
  - LL_OPAMP_PGA_GAIN_16

Notes

- Preliminarily, OPAMP must be set in mode PGA using function LL_OPAMP_SetFunctionalMode().

Reference Manual to LL API cross reference:

- CSR PGGAIN LL_OPAMP_GetPGAGain

LL_OPAMP_SetInputNonInverting

Function name

__STATIC_INLINE void LL_OPAMP_SetInputNonInverting (OPAMP_TypeDef * OPAMPx, uint32_t InputNonInverting)

Function description

Set OPAMP non-inverting input connection.

Parameters

- **OPAMPx:** OPAMP instance
- **InputNonInverting:** This parameter can be one of the following values:
  - LL_OPAMP_INPUT_NONINVERT_IO0
  - LL_OPAMP_INPUT_NONINV_DAC1_CH1

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR VPSEL LL_OPAMP_SetInputNonInverting

LL_OPAMP_GetInputNonInverting

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetInputNonInverting (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP non-inverting input connection.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_INPUT_NONINVERT_IO0
  - LL_OPAMP_INPUT_NONINV_DAC1_CH1

Reference Manual to LL API cross reference:

- CSR VPSEL LL_OPAMP_GetInputNonInverting

`LL_OPAMP_SetInputInverting`

Function name

__STATIC_INLINE void LL_OPAMP_SetInputInverting (OPAMP_TypeDef * OPAMPx, uint32_t InputInverting)

Function description

Set OPAMP inverting input connection.

Parameters

- **OPAMPx:** OPAMP instance
- **InputInverting:** This parameter can be one of the following values:
  - LL_OPAMP_INPUT_INVERT_IO0
  - LL_OPAMP_INPUT_INVERT_IO1
  - LL_OPAMP_INPUT_INVERT_CONNECT_NO

Return values

- **None:**

Notes

- OPAMP inverting input is used with OPAMP in mode standalone or PGA with external capacitors for filtering circuit. Otherwise (OPAMP in mode follower), OPAMP inverting input is not used (not connected to GPIO pin).

Reference Manual to LL API cross reference:

- CSR VMSEL LL_OPAMP_SetInputInverting

`LL_OPAMP_GetInputInverting`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetInputInverting (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP inverting input connection.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_INPUT_INVERT_IO0
  - LL_OPAMP_INPUT_INVERT_IO1
  - LL_OPAMP_INPUT_INVERT_CONNECT_NO

Reference Manual to LL API cross reference:

- CSR VMSEL LL_OPAMP_GetInputInverting

`LL_OPAMP_SetNonInvertingInput`

Function name

__STATIC_INLINE void LL_OPAMP_SetNonInvertingInput (OPAMP_TypeDef * OPAMPx, uint32_t NonInvertingInput)

Function description

`LL_OPAMP_SetInvertingInput`

Function name

__STATIC_INLINE void LL_OPAMP_SetInvertingInput (OPAMP_TypeDef * OPAMPx, uint32_t InvertingInput)

Function description

`LL_OPAMP_SetTrimmingMode`

Function name

__STATIC_INLINE void LL_OPAMP_SetTrimmingMode (OPAMP_TypeDef * OPAMPx, uint32_t TrimmingMode)

Function description

Set OPAMP trimming mode.

Parameters

- **OPAMPx:** OPAMP instance
- **TrimmingMode:** This parameter can be one of the following values:
  - LL_OPAMP_TRIMMING_FACTORY
  - LL_OPAMP_TRIMMING_USER

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR USERTRIM LL_OPAMP_SetTrimmingMode

`LL_OPAMP_GetTrimmingMode`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetTrimmingMode (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP trimming mode.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_TRIMMING_FACTORY
  - LL_OPAMP_TRIMMING_USER

Reference Manual to LL API cross reference:

- CSR USERTRIM LL_OPAMP_GetTrimmingMode

`LL_OPAMP_SetCalibrationSelection`

Function name

__STATIC_INLINE void LL_OPAMP_SetCalibrationSelection (OPAMP_TypeDef * OPAMPx, uint32_t TransistorsDiffPair)

Function description

Set OPAMP offset to calibrate the selected transistors differential pair NMOS or PMOS.

Parameters

- **OPAMPx:** OPAMP instance
- **TransistorsDiffPair:** This parameter can be one of the following values:
  - LL_OPAMP_TRIMMING_NMOS
  - LL_OPAMP_TRIMMING_PMOS

Return values

- **None:**

Notes

- Preliminarily, OPAMP must be set in mode calibration using function LL_OPAMP_SetMode().

Reference Manual to LL API cross reference:

- CSR CALSEL LL_OPAMP_SetCalibrationSelection

`LL_OPAMP_GetCalibrationSelection`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetCalibrationSelection (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP offset to calibrate the selected transistors differential pair NMOS or PMOS.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **Returned:** value can be one of the following values:
  - LL_OPAMP_TRIMMING_NMOS
  - LL_OPAMP_TRIMMING_PMOS

Notes

- Preliminarily, OPAMP must be set in mode calibration using function LL_OPAMP_SetMode().

Reference Manual to LL API cross reference:

- CSR CALSEL LL_OPAMP_GetCalibrationSelection

`LL_OPAMP_IsCalibrationOutputSet`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_IsCalibrationOutputSet (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP calibration result of toggling output.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **State:** of bit (1 or 0).

Notes

- This functions returns: 0 if OPAMP calibration output is reset 1 if OPAMP calibration output is set

Reference Manual to LL API cross reference:

- CSR CALOUT LL_OPAMP_IsCalibrationOutputSet

`LL_OPAMP_SetTrimmingValue`

Function name

__STATIC_INLINE void LL_OPAMP_SetTrimmingValue (OPAMP_TypeDef * OPAMPx, uint32_t PowerMode, uint32_t TransistorsDiffPair, uint32_t TrimmingValue)

Function description

Set OPAMP trimming factor for the selected transistors differential pair NMOS or PMOS, corresponding to the selected power mode.

Parameters

- **OPAMPx:** OPAMP instance
- **PowerMode:** This parameter can be one of the following values:
  - LL_OPAMP_POWERMODE_NORMAL
  - LL_OPAMP_POWERMODE_LOWPOWER
- **TransistorsDiffPair:** This parameter can be one of the following values:
  - LL_OPAMP_TRIMMING_NMOS
  - LL_OPAMP_TRIMMING_PMOS
- **TrimmingValue:** 0x00...0x1F

Return values

- **None:**

Reference Manual to LL API cross reference:

- OTR TRIMOFFSETN LL_OPAMP_SetTrimmingValue
- OTR TRIMOFFSETP LL_OPAMP_SetTrimmingValue
- LPOTR TRIMLPOFFSETN LL_OPAMP_SetTrimmingValue
- LPOTR TRIMLPOFFSETP LL_OPAMP_SetTrimmingValue

`LL_OPAMP_GetTrimmingValue`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_GetTrimmingValue (OPAMP_TypeDef * OPAMPx, uint32_t PowerMode, uint32_t TransistorsDiffPair)

Function description

Get OPAMP trimming factor for the selected transistors differential pair NMOS or PMOS, corresponding to the selected power mode.

Parameters

- **OPAMPx:** OPAMP instance
- **PowerMode:** This parameter can be one of the following values:
  - LL_OPAMP_POWERMODE_NORMAL
  - LL_OPAMP_POWERMODE_LOWPOWER
- **TransistorsDiffPair:** This parameter can be one of the following values:
  - LL_OPAMP_TRIMMING_NMOS
  - LL_OPAMP_TRIMMING_PMOS

Return values

- **0x0...0x1F:**

Reference Manual to LL API cross reference:

- OTR TRIMOFFSETN LL_OPAMP_GetTrimmingValue
- OTR TRIMOFFSETP LL_OPAMP_GetTrimmingValue
- LPOTR TRIMLPOFFSETN LL_OPAMP_GetTrimmingValue
- LPOTR TRIMLPOFFSETP LL_OPAMP_GetTrimmingValue

`LL_OPAMP_Enable`

Function name

__STATIC_INLINE void LL_OPAMP_Enable (OPAMP_TypeDef * OPAMPx)

Function description

Enable OPAMP instance.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **None:**

Notes

- After enable from off state, OPAMP requires a delay to fullfill wake up time specification. Refer to device datasheet, parameter "tWAKEUP".

Reference Manual to LL API cross reference:

- CSR OPAMPXEN LL_OPAMP_Enable

`LL_OPAMP_Disable`

Function name

__STATIC_INLINE void LL_OPAMP_Disable (OPAMP_TypeDef * OPAMPx)

Function description

Disable OPAMP instance.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR OPAMPXEN LL_OPAMP_Disable

`LL_OPAMP_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_OPAMP_IsEnabled (OPAMP_TypeDef * OPAMPx)

Function description

Get OPAMP instance enable state (0: OPAMP is disabled, 1: OPAMP is enabled)

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR OPAMPXEN LL_OPAMP_IsEnabled

`LL_OPAMP_DeInit`

Function name

ErrorStatus LL_OPAMP_DeInit (OPAMP_TypeDef * OPAMPx)

Function description

De-initialize registers of the selected OPAMP instance to their default reset values.

Parameters

- **OPAMPx:** OPAMP instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: OPAMP registers are de-initialized
  - ERROR: OPAMP registers are not de-initialized

`LL_OPAMP_Init`

Function name

ErrorStatus LL_OPAMP_Init (OPAMP_TypeDef * OPAMPx, LL_OPAMP_InitTypeDef * OPAMP_InitStruct)

Function description

Initialize some features of OPAMP instance.

Parameters

- **OPAMPx:** OPAMP instance
- **OPAMP_InitStruct:** Pointer to a LL_OPAMP_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: OPAMP registers are initialized
  - ERROR: OPAMP registers are not initialized

Notes

- This function reset bit of calibration mode to ensure to be in functional mode, in order to have OPAMP parameters (inputs selection, ...) set with the corresponding OPAMP mode to be effective.
- This function configures features of the selected OPAMP instance. Some features are also available at scope OPAMP common instance (common to several OPAMP instances). Refer to functions having argument "OPAMPxy_COMMON" as parameter.

`LL_OPAMP_StructInit`

Function name

void LL_OPAMP_StructInit (LL_OPAMP_InitTypeDef * OPAMP_InitStruct)

Function description

Set each LL_OPAMP_InitTypeDef field to default value.

Parameters

- **OPAMP_InitStruct:** pointer to a LL_OPAMP_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

96.3 OPAMP Firmware driver defines

The following section lists the various define and macros of the module.

96.3.1 OPAMP

OPAMP

OPAMP functional mode

LL_OPAMP_MODE_STANDALONE

OPAMP functional mode, OPAMP operation in standalone

LL_OPAMP_MODE_FOLLOWER

OPAMP functional mode, OPAMP operation in follower

LL_OPAMP_MODE_PGA

OPAMP functional mode, OPAMP operation in PGA

Definitions of OPAMP hardware constraints delays

LL_OPAMP_DELAY_STARTUP_US

Delay for OPAMP startup time

OPAMP input inverting

LL_OPAMP_INPUT_INVERT_IO0

OPAMP inverting input connected to GPIO pin (valid also in PGA mode for filtering). Note: OPAMP inverting input is used with OPAMP in mode standalone or PGA with external capacitors for filtering circuit. Otherwise (OPAMP in mode follower), OPAMP inverting input is not used (not connected to GPIO pin).

LL_OPAMP_INPUT_INVERT_IO1

OPAMP inverting input (low leakage input) connected to GPIO pin (available only on package BGA132). Note: OPAMP inverting input is used with OPAMP in mode standalone or PGA with external capacitors for filtering circuit. Otherwise (OPAMP in mode follower), OPAMP inverting input is not used (not connected to GPIO pin).

LL_OPAMP_INPUT_INVERT_CONNECT_NO

OPAMP inverting input not externally connected (intended for OPAMP in mode follower or PGA without external capacitors for filtering)

OPAMP inputs legacy literals name

LL_OPAMP_NONINVERTINGINPUT_IO0

LL_OPAMP_NONINVERTINGINPUT_DAC_CH

LL_OPAMP_INVERTINGINPUT_IO0

LL_OPAMP_INVERTINGINPUT_IO1

LL_OPAMP_INVERTINGINPUT_CONNECT_NO

LL_OPAMP_INPUT_NONINVERT_DAC1_CH1

OPAMP input non-inverting

LL_OPAMP_INPUT_NONINVERT_IO0

OPAMP non inverting input connected to GPIO pin (pin PA0 for OPAMP1, pin PA6 for OPAMP2)

LL_OPAMP_INPUT_NONINV_DAC1_CH1

OPAMP non inverting input connected to DAC1 channel1 output

OPAMP mode calibration or functional.

LL_OPAMP_MODE_FUNCTIONAL

OPAMP functional mode

LL_OPAMP_MODE_CALIBRATION

OPAMP calibration mode

OPAMP PGA gain (relevant when OPAMP is in functional mode PGA)

LL_OPAMP_PGA_GAIN_2

OPAMP PGA gain 2

LL_OPAMP_PGA_GAIN_4

OPAMP PGA gain 4

LL_OPAMP_PGA_GAIN_8

OPAMP PGA gain 8

LL_OPAMP_PGA_GAIN_16

OPAMP PGA gain 16

OPAMP power mode

LL_OPAMP_POWERMODE_NORMAL

OPAMP power mode normal

LL_OPAMP_POWERMODE_LOWPOWER

OPAMP power mode low-power

OPAMP power supply range

LL_OPAMP_POWERSUPPLY_RANGE_LOW

Power supply range low. On STM32L4 serie: Vdda lower than 2.4V.

LL_OPAMP_POWERSUPPLY_RANGE_HIGH

Power supply range high. On STM32L4 serie: Vdda higher than 2.4V.

OPAMP trimming mode

LL_OPAMP_TRIMMING_FACTORY

OPAMP trimming factors set to factory values

LL_OPAMP_TRIMMING_USER

OPAMP trimming factors set to user values

OPAMP trimming of transistors differential pair NMOS or PMOS

LL_OPAMP_TRIMMING_NMOS

OPAMP trimming of transistors differential pair NMOS

LL_OPAMP_TRIMMING_PMOS

OPAMP trimming of transistors differential pair PMOS

OPAMP helper macro

__LL_OPAMP_COMMON_INSTANCE

Description:

- Helper macro to select the OPAMP common instance to which is belonging the selected OPAMP instance.

Parameters:

- __OPAMPx__: OPAMP instance

Return value:

- OPAMP: common instance

Notes:

- OPAMP common register instance can be used to set parameters common to several OPAMP instances. Refer to functions having argument "OPAMPxy_COMMON" as parameter.

__LL_OPAMP_IS_ENABLED_ALL_COMMON_INSTANCE

Description:

- Helper macro to check if all OPAMP instances sharing the same OPAMP common instance are disabled.

Return value:

- 0: All OPAMP instances sharing the same OPAMP common instance are disabled. 1: At least one OPAMP instance sharing the same OPAMP common instance is enabled

Notes:

- This check is required by functions with setting conditioned to OPAMP state: All OPAMP instances of the OPAMP common group must be disabled. Refer to functions having argument "OPAMPxy_COMMON" as parameter.

Common write and read registers macro

LL_OPAMP_WriteReg

Description:

- Write a value in OPAMP register.

Parameters:

- __INSTANCE__: OPAMP Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_OPAMP_ReadReg

Description:

- Read a value in OPAMP register.

Parameters:

- __INSTANCE__: OPAMP Instance
- __REG__: Register to be read

Return value:

- Register: value

97 LL PKA Generic Driver

97.1 PKA Firmware driver registers structures

97.1.1 LL_PKA_InitTypeDef

LL_PKA_InitTypeDef is defined in the stm32l4xx_ll_pka.h

Data Fields

- ***uint32_t Mode***

Field Documentation

- ***uint32_t LL_PKA_InitTypeDef::Mode***
  Specifies the PKA operation mode. This parameter can be a value of ***PKA_LL_EC_MODE***.This feature can be modified afterwards using unitary function **LL_PKA_SetMode()**.

97.2 PKA Firmware driver API description

The following section lists the various functions of the PKA library.

97.2.1 Detailed description of functions

`LL_PKA_Config`

Function name

__STATIC_INLINE void LL_PKA_Config (PKA_TypeDef * PKAx, uint32_t Mode)

Function description

Configure PKA peripheral.

Parameters

- **PKAx:** PKA Instance.
- **Mode:** This parameter can be one of the following values:
  - LL_PKA_MODE_MONTGOMERY_PARAM_MOD_EXP
  - LL_PKA_MODE_MONTGOMERY_PARAM
  - LL_PKA_MODE_MODULAR_EXP
  - LL_PKA_MODE_MONTGOMERY_PARAM_ECC
  - LL_PKA_MODE_ECC_KP_PRIMITIVE
  - LL_PKA_MODE_ECDSA_SIGNATURE
  - LL_PKA_MODE_ECDSA_VERIFICATION
  - LL_PKA_MODE_POINT_CHECK
  - LL_PKA_MODE_RSA_CRT_EXP
  - LL_PKA_MODE_MODULAR_INV
  - LL_PKA_MODE_ARITHMETIC_ADD
  - LL_PKA_MODE_ARITHMETIC_SUB
  - LL_PKA_MODE_ARITHMETIC_MUL
  - LL_PKA_MODE_COMPARISON
  - LL_PKA_MODE_MODULAR_REDUC
  - LL_PKA_MODE_MODULAR_ADD
  - LL_PKA_MODE_MODULAR_SUB
  - LL_PKA_MODE_MONTGOMERY_MUL

Reference Manual to LL API cross reference:

- CR MODE LL_PKA_Config

`LL_PKA_Enable`

Function name

__STATIC_INLINE void LL_PKA_Enable (PKA_TypeDef * PKAx)

Function description

Enable PKA peripheral.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR EN LL_PKA_Enable

`LL_PKA_Disable`

Function name

__STATIC_INLINE void LL_PKA_Disable (PKA_TypeDef * PKAx)

Function description

Disable PKA peripheral.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR EN LL_PKA_Disable

`LL_PKA_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_PKA_IsEnabled (PKA_TypeDef * PKAx)

Function description

Check if the PKA peripheral is enabled or disabled.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR EN LL_PKA_IsEnabled

`LL_PKA_SetMode`

Function name

__STATIC_INLINE void LL_PKA_SetMode (PKA_TypeDef * PKAx, uint32_t Mode)

Function description

Set PKA operating mode.

Parameters

- **PKAx:** PKA Instance.
- **Mode:** This parameter can be one of the following values:
  - LL_PKA_MODE_MONTGOMERY_PARAM_MOD_EXP
  - LL_PKA_MODE_MONTGOMERY_PARAM
  - LL_PKA_MODE_MODULAR_EXP
  - LL_PKA_MODE_MONTGOMERY_PARAM_ECC
  - LL_PKA_MODE_ECC_KP_PRIMITIVE
  - LL_PKA_MODE_ECDSA_SIGNATURE
  - LL_PKA_MODE_ECDSA_VERIFICATION
  - LL_PKA_MODE_POINT_CHECK
  - LL_PKA_MODE_RSA_CRT_EXP
  - LL_PKA_MODE_MODULAR_INV
  - LL_PKA_MODE_ARITHMETIC_ADD
  - LL_PKA_MODE_ARITHMETIC_SUB
  - LL_PKA_MODE_ARITHMETIC_MUL
  - LL_PKA_MODE_COMPARISON
  - LL_PKA_MODE_MODULAR_REDUC
  - LL_PKA_MODE_MODULAR_ADD
  - LL_PKA_MODE_MODULAR_SUB
  - LL_PKA_MODE_MONTGOMERY_MUL

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR MODE LL_PKA_SetMode

`LL_PKA_GetMode`

Function name

__STATIC_INLINE uint32_t LL_PKA_GetMode (PKA_TypeDef * PKAx)

Function description

Get PKA operating mode.

Parameters

- **PKAx:** PKA Instance.

Return values

- **Returned:** value can be one of the following values:
  - LL_PKA_MODE_MONTGOMERY_PARAM_MOD_EXP
  - LL_PKA_MODE_MONTGOMERY_PARAM
  - LL_PKA_MODE_MODULAR_EXP
  - LL_PKA_MODE_MONTGOMERY_PARAM_ECC
  - LL_PKA_MODE_ECC_KP_PRIMITIVE
  - LL_PKA_MODE_ECDSA_SIGNATURE
  - LL_PKA_MODE_ECDSA_VERIFICATION
  - LL_PKA_MODE_POINT_CHECK
  - LL_PKA_MODE_RSA_CRT_EXP
  - LL_PKA_MODE_MODULAR_INV
  - LL_PKA_MODE_ARITHMETIC_ADD
  - LL_PKA_MODE_ARITHMETIC_SUB
  - LL_PKA_MODE_ARITHMETIC_MUL
  - LL_PKA_MODE_COMPARISON
  - LL_PKA_MODE_MODULAR_REDUC
  - LL_PKA_MODE_MODULAR_ADD
  - LL_PKA_MODE_MODULAR_SUB
  - LL_PKA_MODE_MONTGOMERY_MUL

Reference Manual to LL API cross reference:

- CR MODE LL_PKA_GetMode

`LL_PKA_Start`

Function name

__STATIC_INLINE void LL_PKA_Start (PKA_TypeDef * PKAx)

Function description

Start the operation selected using LL_PKA_SetMode.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR START LL_PKA_Start

`LL_PKA_EnableIT_ADDRERR`

Function name

__STATIC_INLINE void LL_PKA_EnableIT_ADDRERR (PKA_TypeDef * PKAx)

Function description

Enable address error interrupt.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR ADDRERRIE LL_PKA_EnableIT_ADDRERR

`LL_PKA_EnableIT_RAMERR`

Function name

__STATIC_INLINE void LL_PKA_EnableIT_RAMERR (PKA_TypeDef * PKAx)

Function description

Enable RAM error interrupt.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RAMERRIE LL_PKA_EnableIT_RAMERR

`LL_PKA_EnableIT_PROCEND`

Function name

__STATIC_INLINE void LL_PKA_EnableIT_PROCEND (PKA_TypeDef * PKAx)

Function description

Enable end of operation interrupt.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PROCENDIE LL_PKA_EnableIT_PROCEND

`LL_PKA_DisableIT_ADDERR`

Function name

__STATIC_INLINE void LL_PKA_DisableIT_ADDERR (PKA_TypeDef * PKAx)

Function description

Disable address error interrupt.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR ADDRERRIE LL_PKA_DisableIT_ADDERR

`LL_PKA_DisableIT_RAMERR`

Function name

__STATIC_INLINE void LL_PKA_DisableIT_RAMERR (PKA_TypeDef * PKAx)

Function description

Disable RAM error interrupt.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RAMERRIE LL_PKA_DisableIT_RAMERR

`LL_PKA_DisableIT_PROCEND`

Function name

__STATIC_INLINE void LL_PKA_DisableIT_PROCEND (PKA_TypeDef * PKAx)

Function description

Disable End of operation interrupt.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PROCENDIE LL_PKA_DisableIT_PROCEND

`LL_PKA_IsEnabledIT_ADDRERR`

Function name

__STATIC_INLINE uint32_t LL_PKA_IsEnabledIT_ADDRERR (PKA_TypeDef * PKAx)

Function description

Check if address error interrupt is enabled.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR ADDRERRIE LL_PKA_IsEnabledIT_ADDRERR

`LL_PKA_IsEnabledIT_RAMERR`

Function name

__STATIC_INLINE uint32_t LL_PKA_IsEnabledIT_RAMERR (PKA_TypeDef * PKAx)

Function description

Check if RAM error interrupt is enabled.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR RAMERRIE LL_PKA_IsEnabledIT_RAMERR

LL_PKA_IsEnabledIT_PROCEND

Function name

__STATIC_INLINE uint32_t LL_PKA_IsEnabledIT_PROCEND (PKA_TypeDef * PKAx)

Function description

Check if end of operation interrupt is enabled.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR PROCENDIE LL_PKA_IsEnabledIT_PROCEND

LL_PKA_IsActiveFlag_ADDRERR

Function name

__STATIC_INLINE uint32_t LL_PKA_IsActiveFlag_ADDRERR (PKA_TypeDef * PKAx)

Function description

Get PKA address error flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR ADDRERRF LL_PKA_IsActiveFlag_ADDRERR

LL_PKA_IsActiveFlag_RAMERR

Function name

__STATIC_INLINE uint32_t LL_PKA_IsActiveFlag_RAMERR (PKA_TypeDef * PKAx)

Function description

Get PKA RAM error flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR RAMERRF LL_PKA_IsActiveFlag_RAMERR

`LL_PKA_IsActiveFlag_PROCEND`

Function name

__STATIC_INLINE uint32_t LL_PKA_IsActiveFlag_PROCEND (PKA_TypeDef * PKAx)

Function description

Get PKA end of operation flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR PROCENDF LL_PKA_IsActiveFlag_PROCEND

`LL_PKA_IsActiveFlag_BUSY`

Function name

__STATIC_INLINE uint32_t LL_PKA_IsActiveFlag_BUSY (PKA_TypeDef * PKAx)

Function description

Get PKA busy flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR BUSY LL_PKA_IsActiveFlag_BUSY

`LL_PKA_ClearFlag_ADDERR`

Function name

__STATIC_INLINE void LL_PKA_ClearFlag_ADDERR (PKA_TypeDef * PKAx)

Function description

Clear PKA address error flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CLRFR ADDRERRFC LL_PKA_ClearFlag_ADDERR

`LL_PKA_ClearFlag_RAMERR`

Function name

__STATIC_INLINE void LL_PKA_ClearFlag_RAMERR (PKA_TypeDef * PKAx)

Function description

Clear PKA RAM error flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CLRFR RAMERRFC LL_PKA_ClearFlag_RAMERR

`LL_PKA_ClearFlag_PROCEND`

Function name

__STATIC_INLINE void LL_PKA_ClearFlag_PROCEND (PKA_TypeDef * PKAx)

Function description

Clear PKA end of operation flag.

Parameters

- **PKAx:** PKA Instance.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CLRFR PROCENDFC LL_PKA_ClearFlag_PROCEND

`LL_PKA_DeInit`

Function name

ErrorStatus LL_PKA_DeInit (PKA_TypeDef * PKAx)

Function description

De-initialize PKA registers (Registers restored to their default values).

Parameters

- **PKAx:** PKA Instance.

Return values

- **ErrorStatus:**
  - SUCCESS: PKA registers are de-initialized
  - ERROR: PKA registers are not de-initialized

`LL_PKA_Init`

Function name

ErrorStatus LL_PKA_Init (PKA_TypeDef * PKAx, LL_PKA_InitTypeDef * PKA_InitStruct)

Function description

Initialize PKA registers according to the specified parameters in PKA_InitStruct.

Parameters

- **PKAx:** PKA Instance.
- **PKA_InitStruct:** pointer to a LL_PKA_InitTypeDef structure that contains the configuration information for the specified PKA peripheral.

Return values

- **ErrorStatus:**
  - SUCCESS: PKA registers are initialized according to PKA_InitStruct content
  - ERROR: Not applicable

`LL_PKA_StructInit`

Function name

void LL_PKA_StructInit (LL_PKA_InitTypeDef * PKA_InitStruct)

Function description

Set each LL_PKA_InitTypeDef field to default value.

Parameters

- **PKA_InitStruct:** pointer to a LL_PKA_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

97.3 PKA Firmware driver defines

The following section lists the various define and macros of the module.

97.3.1 PKA

PKA

Get Flags Defines

LL_PKA_SR_ADDRERRF

LL_PKA_SR_RAMERRF

LL_PKA_SR_PROCENDF

LL_PKA_SR_BUSY

IT Defines

LL_PKA_CR_ADDRERRIE

LL_PKA_CR_RAMERRIE

LL_PKA_CR_PROCENDIE

LL_PKA_CLRFR_PROCENDFC

LL_PKA_CLRFR_RAMERRFC

LL_PKA_CLRFR_ADDRERRFC

Operation Mode

LL_PKA_MODE_MONTGOMERY_PARAM_MOD_EXP

Compute Montgomery parameter and modular exponentiation

LL_PKA_MODE_MONTGOMERY_PARAM

Compute Montgomery parameter only

LL_PKA_MODE_MODULAR_EXP

Compute modular exponentiation only (Montgomery parameter should be loaded)

LL_PKA_MODE_MONTGOMERY_PARAM_ECC

Compute Montgomery parameter and compute ECC kP operation

LL_PKA_MODE_ECC_KP_PRIMITIVE

Compute the ECC kP primitive only (Montgomery parameter should be loaded)

LL_PKA_MODE_ECDSA_SIGNATURE

ECDSA signature

LL_PKA_MODE_ECDSA_VERIFICATION

ECDSA verification

LL_PKA_MODE_POINT_CHECK

Point check

LL_PKA_MODE_RSA_CRT_EXP

RSA CRT exponentiation

LL_PKA_MODE_MODULAR_INV

Modular inversion

LL_PKA_MODE_ARITHMETIC_ADD

Arithmetic addition

LL_PKA_MODE_ARITHMETIC_SUB

Arithmetic subtraction

LL_PKA_MODE_ARITHMETIC_MUL

Arithmetic multiplication

LL_PKA_MODE_COMPARISON

Comparison

LL_PKA_MODE_MODULAR_REDUC

Modular reduction

LL_PKA_MODE_MODULAR_ADD

Modular addition

LL_PKA_MODE_MODULAR_SUB

Modular subtraction

LL_PKA_MODE_MONTGOMERY_MUL

Montgomery multiplication

Common Write and read registers Macros

LL_PKA_WriteReg

Description:

- Write a value in PKA register.

Parameters:

- __INSTANCE__: PKA Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_PKA_ReadReg

Description:

- Read a value in PKA register.

Parameters:

- __INSTANCE__: PKA Instance
- __REG__: Register to be read

Return value:

- Register: value

98 LL PWR Generic Driver

98.1 PWR Firmware driver API description

The following section lists the various functions of the PWR library.

98.1.1 Detailed description of functions

`LL_PWR_EnableLowPowerRunMode`

Function name

__STATIC_INLINE void LL_PWR_EnableLowPowerRunMode (void)

Function description

Switch the regulator from main mode to low-power mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 LPR LL_PWR_EnableLowPowerRunMode

`LL_PWR_DisableLowPowerRunMode`

Function name

__STATIC_INLINE void LL_PWR_DisableLowPowerRunMode (void)

Function description

Switch the regulator from low-power mode to main mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 LPR LL_PWR_DisableLowPowerRunMode

`LL_PWR_EnterLowPowerRunMode`

Function name

__STATIC_INLINE void LL_PWR_EnterLowPowerRunMode (void)

Function description

Switch from run main mode to run low-power mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 LPR LL_PWR_EnterLowPowerRunMode

`LL_PWR_ExitLowPowerRunMode`

Function name

__STATIC_INLINE void LL_PWR_ExitLowPowerRunMode (void)

Function description

Switch from run main mode to low-power mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 LPR LL_PWR_ExitLowPowerRunMode

LL_PWR_IsEnabledLowPowerRunMode

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledLowPowerRunMode (void)

Function description

Check if the regulator is in low-power mode.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 LPR LL_PWR_IsEnabledLowPowerRunMode

LL_PWR_SetRegulVoltageScaling

Function name

__STATIC_INLINE void LL_PWR_SetRegulVoltageScaling (uint32_t VoltageScaling)

Function description

Set the main internal regulator output voltage.

Parameters

- **VoltageScaling:** This parameter can be one of the following values:
  - LL_PWR_REGU_VOLTAGE_SCALE1
  - LL_PWR_REGU_VOLTAGE_SCALE2

Return values

- **None:**

Notes

- This configuration may be completed with LL_PWR_EnableRange1BoostMode() on STM32L4Rx/ STM32L4Sx devices.

Reference Manual to LL API cross reference:

- CR1 VOS LL_PWR_SetRegulVoltageScaling

LL_PWR_GetRegulVoltageScaling

Function name

__STATIC_INLINE uint32_t LL_PWR_GetRegulVoltageScaling (void)

Function description

Get the main internal regulator output voltage.

Return values

- **Returned:** value can be one of the following values:
  - LL_PWR_REGU_VOLTAGE_SCALE1
  - LL_PWR_REGU_VOLTAGE_SCALE2

Reference Manual to LL API cross reference:

- CR1 VOS LL_PWR_GetRegulVoltageScaling

`LL_PWR_EnableRange1BoostMode`

Function name

__STATIC_INLINE void LL_PWR_EnableRange1BoostMode (void)

Function description

Enable main regulator voltage range 1 boost mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR5 R1MODE LL_PWR_EnableRange1BoostMode

`LL_PWR_DisableRange1BoostMode`

Function name

__STATIC_INLINE void LL_PWR_DisableRange1BoostMode (void)

Function description

Disable main regulator voltage range 1 boost mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR5 R1MODE LL_PWR_DisableRange1BoostMode

`LL_PWR_IsEnabledRange1BoostMode`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledRange1BoostMode (void)

Function description

Check if the main regulator voltage range 1 boost mode is enabled.

Return values

- **Inverted:** state of bit (0 or 1).

Reference Manual to LL API cross reference:

- CR5 R1MODE LL_PWR_IsEnabledRange1BoostMode

`LL_PWR_EnableBkUpAccess`

Function name

__STATIC_INLINE void LL_PWR_EnableBkUpAccess (void)

Function description

Enable access to the backup domain.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 DBP LL_PWR_EnableBkUpAccess

`LL_PWR_DisableBkUpAccess`

Function name

__STATIC_INLINE void LL_PWR_DisableBkUpAccess (void)

Function description

Disable access to the backup domain.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 DBP LL_PWR_DisableBkUpAccess

`LL_PWR_IsEnabledBkUpAccess`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledBkUpAccess (void)

Function description

Check if the backup domain is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 DBP LL_PWR_IsEnabledBkUpAccess

`LL_PWR_SetPowerMode`

Function name

__STATIC_INLINE void LL_PWR_SetPowerMode (uint32_t LowPowerMode)

Function description

Set Low-Power mode.

Parameters

- **LowPowerMode:** This parameter can be one of the following values:
  - LL_PWR_MODE_STOP0
  - LL_PWR_MODE_STOP1
  - LL_PWR_MODE_STOP2
  - LL_PWR_MODE_STANDBY
  - LL_PWR_MODE_SHUTDOWN

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 LPMS LL_PWR_SetPowerMode

LL_PWR_GetPowerMode

Function name

__STATIC_INLINE uint32_t LL_PWR_GetPowerMode (void)

Function description

Get Low-Power mode.

Return values

- **Returned:** value can be one of the following values:
  - LL_PWR_MODE_STOP0
  - LL_PWR_MODE_STOP1
  - LL_PWR_MODE_STOP2
  - LL_PWR_MODE_STANDBY
  - LL_PWR_MODE_SHUTDOWN

Reference Manual to LL API cross reference:

- CR1 LPMS LL_PWR_GetPowerMode

LL_PWR_EnableSRAM3Retention

Function name

__STATIC_INLINE void LL_PWR_EnableSRAM3Retention (void)

Function description

Enable SRAM3 content retention in Stop mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RRSTP LL_PWR_EnableSRAM3Retention

LL_PWR_DisableSRAM3Retention

Function name

__STATIC_INLINE void LL_PWR_DisableSRAM3Retention (void)

Function description

Disable SRAM3 content retention in Stop mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RRSTP LL_PWR_DisableSRAM3Retention

LL_PWR_IsEnabledSRAM3Retention

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledSRAM3Retention (void)

Function description

Check if SRAM3 content retention in Stop mode is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RRSTP LL_PWR_IsEnabledSRAM3Retention

`LL_PWR_EnableDSIPinsPDActivation`

Function name

__STATIC_INLINE void LL_PWR_EnableDSIPinsPDActivation (void)

Function description

Enable pull-down activation on DSI pins.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DSIPDEN LL_PWR_EnableDSIPinsPDActivation

`LL_PWR_DisableDSIPinsPDActivation`

Function name

__STATIC_INLINE void LL_PWR_DisableDSIPinsPDActivation (void)

Function description

Disable pull-down activation on DSI pins.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DSIPDEN LL_PWR_DisableDSIPinsPDActivation

`LL_PWR_IsEnabledDSIPinsPDActivation`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledDSIPinsPDActivation (void)

Function description

Check if pull-down activation on DSI pins is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DSIPDEN LL_PWR_IsEnabledDSIPinsPDActivation

`LL_PWR_EnableVddUSB`

Function name

__STATIC_INLINE void LL_PWR_EnableVddUSB (void)

Function description

Enable VDDUSB supply.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 USV LL_PWR_EnableVddUSB

`LL_PWR_DisableVddUSB`

Function name

__STATIC_INLINE void LL_PWR_DisableVddUSB (void)

Function description

Disable VDDUSB supply.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 USV LL_PWR_DisableVddUSB

`LL_PWR_IsEnabledVddUSB`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledVddUSB (void)

Function description

Check if VDDUSB supply is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 USV LL_PWR_IsEnabledVddUSB

`LL_PWR_EnableVddIO2`

Function name

__STATIC_INLINE void LL_PWR_EnableVddIO2 (void)

Function description

Enable VDDIO2 supply.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 IOSV LL_PWR_EnableVddIO2

`LL_PWR_DisableVddIO2`

Function name

__STATIC_INLINE void LL_PWR_DisableVddIO2 (void)

Function description

Disable VDDIO2 supply.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 IOSV LL_PWR_DisableVddIO2

`LL_PWR_IsEnabledVddIO2`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledVddIO2 (void)

Function description

Check if VDDIO2 supply is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 IOSV LL_PWR_IsEnabledVddIO2

`LL_PWR_EnablePVM`

Function name

__STATIC_INLINE void LL_PWR_EnablePVM (uint32_t PeriphVoltage)

Function description

Enable the Power Voltage Monitoring on a peripheral.

Parameters

- **PeriphVoltage:** This parameter can be one of the following values:
  - LL_PWR_PVM_VDDUSB_1_2V (*)
  - LL_PWR_PVM_VDDIO2_0_9V (*)
  - LL_PWR_PVM_VDDA_1_62V
  - LL_PWR_PVM_VDDA_2_2V

  (*) value not defined in all devices

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 PVME1 LL_PWR_EnablePVM
- CR2 PVME2 LL_PWR_EnablePVM
- CR2 PVME3 LL_PWR_EnablePVM
- CR2 PVME4 LL_PWR_EnablePVM

`LL_PWR_DisablePVM`

Function name

__STATIC_INLINE void LL_PWR_DisablePVM (uint32_t PeriphVoltage)

Function description

Disable the Power Voltage Monitoring on a peripheral.

Parameters

- **PeriphVoltage:** This parameter can be one of the following values:
  - LL_PWR_PVM_VDDUSB_1_2V (*)
  - LL_PWR_PVM_VDDIO2_0_9V (*)
  - LL_PWR_PVM_VDDA_1_62V
  - LL_PWR_PVM_VDDA_2_2V

  (*) value not defined in all devices

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 PVME1 LL_PWR_DisablePVM
- CR2 PVME2 LL_PWR_DisablePVM
- CR2 PVME3 LL_PWR_DisablePVM
- CR2 PVME4 LL_PWR_DisablePVM

LL_PWR_IsEnabledPVM

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledPVM (uint32_t PeriphVoltage)

Function description

Check if Power Voltage Monitoring is enabled on a peripheral.

Parameters

- **PeriphVoltage:** This parameter can be one of the following values:
  - LL_PWR_PVM_VDDUSB_1_2V (*)
  - LL_PWR_PVM_VDDIO2_0_9V (*)
  - LL_PWR_PVM_VDDA_1_62V
  - LL_PWR_PVM_VDDA_2_2V

  (*) value not defined in all devices

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 PVME1 LL_PWR_IsEnabledPVM
- CR2 PVME2 LL_PWR_IsEnabledPVM
- CR2 PVME3 LL_PWR_IsEnabledPVM
- CR2 PVME4 LL_PWR_IsEnabledPVM

LL_PWR_SetPVDLevel

Function name

__STATIC_INLINE void LL_PWR_SetPVDLevel (uint32_t PVDLevel)

Function description

Configure the voltage threshold detected by the Power Voltage Detector.

Parameters

- **PVDLevel:** This parameter can be one of the following values:
  - LL_PWR_PVDLEVEL_0
  - LL_PWR_PVDLEVEL_1
  - LL_PWR_PVDLEVEL_2
  - LL_PWR_PVDLEVEL_3
  - LL_PWR_PVDLEVEL_4
  - LL_PWR_PVDLEVEL_5
  - LL_PWR_PVDLEVEL_6
  - LL_PWR_PVDLEVEL_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 PLS LL_PWR_SetPVDLevel

`LL_PWR_GetPVDLevel`

Function name

__STATIC_INLINE uint32_t LL_PWR_GetPVDLevel (void)

Function description

Get the voltage threshold detection.

Return values

- **Returned:** value can be one of the following values:
  - LL_PWR_PVDLEVEL_0
  - LL_PWR_PVDLEVEL_1
  - LL_PWR_PVDLEVEL_2
  - LL_PWR_PVDLEVEL_3
  - LL_PWR_PVDLEVEL_4
  - LL_PWR_PVDLEVEL_5
  - LL_PWR_PVDLEVEL_6
  - LL_PWR_PVDLEVEL_7

Reference Manual to LL API cross reference:

- CR2 PLS LL_PWR_GetPVDLevel

`LL_PWR_EnablePVD`

Function name

__STATIC_INLINE void LL_PWR_EnablePVD (void)

Function description

Enable Power Voltage Detector.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 PVDE LL_PWR_EnablePVD

LL_PWR_DisablePVD

Function name

__STATIC_INLINE void LL_PWR_DisablePVD (void)

Function description

Disable Power Voltage Detector.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 PVDE LL_PWR_DisablePVD

LL_PWR_IsEnabledPVD

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledPVD (void)

Function description

Check if Power Voltage Detector is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 PVDE LL_PWR_IsEnabledPVD

LL_PWR_EnableInternWU

Function name

__STATIC_INLINE void LL_PWR_EnableInternWU (void)

Function description

Enable Internal Wake-up line.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 EIWF LL_PWR_EnableInternWU

LL_PWR_DisableInternWU

Function name

__STATIC_INLINE void LL_PWR_DisableInternWU (void)

Function description

Disable Internal Wake-up line.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 EIWF LL_PWR_DisableInternWU

`LL_PWR_IsEnabledInternWU`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledInternWU (void)

Function description

Check if Internal Wake-up line is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 EIWF LL_PWR_IsEnabledInternWU

`LL_PWR_EnablePUPDCfg`

Function name

__STATIC_INLINE void LL_PWR_EnablePUPDCfg (void)

Function description

Enable pull-up and pull-down configuration.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 APC LL_PWR_EnablePUPDCfg

`LL_PWR_DisablePUPDCfg`

Function name

__STATIC_INLINE void LL_PWR_DisablePUPDCfg (void)

Function description

Disable pull-up and pull-down configuration.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 APC LL_PWR_DisablePUPDCfg

`LL_PWR_IsEnabledPUPDCfg`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledPUPDCfg (void)

Function description

Check if pull-up and pull-down configuration is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 APC LL_PWR_IsEnabledPUPDCfg

LL_PWR_EnableDSIPullDown

Function name

__STATIC_INLINE void LL_PWR_EnableDSIPullDown (void)

Function description

Enable pull-down activation on DSI pins.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DSIPDEN LL_PWR_EnableDSIPullDown

LL_PWR_DisableDSIPullDown

Function name

__STATIC_INLINE void LL_PWR_DisableDSIPullDown (void)

Function description

Disable pull-down activation on DSI pins.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DSIPDEN LL_PWR_DisableDSIPullDown

LL_PWR_IsEnabledDSIPullDown

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledDSIPullDown (void)

Function description

Check if pull-down activation on DSI pins is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DSIPDEN LL_PWR_IsEnabledDSIPullDown

LL_PWR_EnableSRAM2Retention

Function name

__STATIC_INLINE void LL_PWR_EnableSRAM2Retention (void)

Function description

Enable SRAM2 full content retention in Standby mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RRS LL_PWR_EnableSRAM2Retention

LL_PWR_DisableSRAM2Retention

Function name

__STATIC_INLINE void LL_PWR_DisableSRAM2Retention (void)

Function description

Disable SRAM2 content retention in Standby mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 RRS LL_PWR_DisableSRAM2Retention

LL_PWR_IsEnabledSRAM2Retention

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledSRAM2Retention (void)

Function description

Check if SRAM2 full content retention in Standby mode is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 RRS LL_PWR_IsEnabledSRAM2Retention

LL_PWR_SetSRAM2ContentRetention

Function name

__STATIC_INLINE void LL_PWR_SetSRAM2ContentRetention (uint32_t SRAM2Size)

Function description

Set SRAM2 content retention in Standby mode.

Parameters

- **SRAM2Size:** This parameter can be one of the following values:
  - LL_PWR_NO_SRAM2_RETENTION
  - LL_PWR_FULL_SRAM2_RETENTION
  - LL_PWR_4KBYTES_SRAM2_RETENTION

Return values

- **None:**

Notes

- LL_PWR_4KBYTES_SRAM2_RETENTION parameter is not available on all devices
- Setting LL_PWR_NO_SRAM2_RETENTION is same as calling LL_PWR_DisableSRAM2Retention()
- Setting LL_PWR_FULL_SRAM2_RETENTION is same as calling LL_PWR_EnableSRAM2Retention()

Reference Manual to LL API cross reference:

- CR3 RRS LL_PWR_SetSRAM2ContentRetention

LL_PWR_GetSRAM2ContentRetention

Function name

__STATIC_INLINE uint32_t LL_PWR_GetSRAM2ContentRetention (void)

Function description

Get SRAM2 content retention in Standby mode.

Return values

- **Returned:** value can be one of the following values:
  - LL_PWR_NO_SRAM2_RETENTION
  - LL_PWR_FULL_SRAM2_RETENTION
  - LL_PWR_4KBYTES_SRAM2_RETENTION

Notes

- LL_PWR_4KBYTES_SRAM2_RETENTION parameter is not available on all devices

Reference Manual to LL API cross reference:

- CR3 RRS LL_PWR_GetSRAM2ContentRetention

LL_PWR_EnableWakeUpPin

Function name

__STATIC_INLINE void LL_PWR_EnableWakeUpPin (uint32_t WakeUpPin)

Function description

Enable the WakeUp PINx functionality.

Parameters

- **WakeUpPin:** This parameter can be one of the following values:
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3
  - LL_PWR_WAKEUP_PIN4
  - LL_PWR_WAKEUP_PIN5

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 EWUP1 LL_PWR_EnableWakeUpPin
- CR3 EWUP2 LL_PWR_EnableWakeUpPin
- CR3 EWUP3 LL_PWR_EnableWakeUpPin
- CR3 EWUP4 LL_PWR_EnableWakeUpPin
- CR3 EWUP5 LL_PWR_EnableWakeUpPin
-

LL_PWR_DisableWakeUpPin

Function name

__STATIC_INLINE void LL_PWR_DisableWakeUpPin (uint32_t WakeUpPin)

Function description

Disable the WakeUp PINx functionality.

Parameters

- **WakeUpPin:** This parameter can be one of the following values:
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3
  - LL_PWR_WAKEUP_PIN4
  - LL_PWR_WAKEUP_PIN5

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 EWUP1 LL_PWR_DisableWakeUpPin
- CR3 EWUP2 LL_PWR_DisableWakeUpPin
- CR3 EWUP3 LL_PWR_DisableWakeUpPin
- CR3 EWUP4 LL_PWR_DisableWakeUpPin
- CR3 EWUP5 LL_PWR_DisableWakeUpPin
-

LL_PWR_IsEnabledWakeUpPin

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledWakeUpPin (uint32_t WakeUpPin)

Function description

Check if the WakeUp PINx functionality is enabled.

Parameters

- **WakeUpPin:** This parameter can be one of the following values:
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3
  - LL_PWR_WAKEUP_PIN4
  - LL_PWR_WAKEUP_PIN5

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 EWUP1 LL_PWR_IsEnabledWakeUpPin
- CR3 EWUP2 LL_PWR_IsEnabledWakeUpPin
- CR3 EWUP3 LL_PWR_IsEnabledWakeUpPin
- CR3 EWUP4 LL_PWR_IsEnabledWakeUpPin
- CR3 EWUP5 LL_PWR_IsEnabledWakeUpPin
-

LL_PWR_SetBattChargResistor

Function name

__STATIC_INLINE void LL_PWR_SetBattChargResistor (uint32_t Resistor)

Function description

Set the resistor impedance.

Parameters

- **Resistor:** This parameter can be one of the following values:
  - LL_PWR_BATT_CHARG_RESISTOR_5K
  - LL_PWR_BATT_CHARGRESISTOR_1_5K

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR4 VBRS LL_PWR_SetBattChargResistor

`LL_PWR_GetBattChargResistor`

Function name

__STATIC_INLINE uint32_t LL_PWR_GetBattChargResistor (void)

Function description

Get the resistor impedance.

Return values

- **Returned:** value can be one of the following values:
  - LL_PWR_BATT_CHARG_RESISTOR_5K
  - LL_PWR_BATT_CHARGRESISTOR_1_5K

Reference Manual to LL API cross reference:

- CR4 VBRS LL_PWR_GetBattChargResistor

`LL_PWR_EnableBatteryCharging`

Function name

__STATIC_INLINE void LL_PWR_EnableBatteryCharging (void)

Function description

Enable battery charging.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR4 VBE LL_PWR_EnableBatteryCharging

`LL_PWR_DisableBatteryCharging`

Function name

__STATIC_INLINE void LL_PWR_DisableBatteryCharging (void)

Function description

Disable battery charging.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR4 VBE LL_PWR_DisableBatteryCharging

LL_PWR_IsEnabledBatteryCharging

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledBatteryCharging (void)

Function description

Check if battery charging is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR4 VBE LL_PWR_IsEnabledBatteryCharging

LL_PWR_SetWakeUpPinPolarityLow

Function name

__STATIC_INLINE void LL_PWR_SetWakeUpPinPolarityLow (uint32_t WakeUpPin)

Function description

Set the Wake-Up pin polarity low for the event detection.

Parameters

- **WakeUpPin:** This parameter can be one of the following values:
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3
  - LL_PWR_WAKEUP_PIN4
  - LL_PWR_WAKEUP_PIN5

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR4 WP1 LL_PWR_SetWakeUpPinPolarityLow
- CR4 WP2 LL_PWR_SetWakeUpPinPolarityLow
- CR4 WP3 LL_PWR_SetWakeUpPinPolarityLow
- CR4 WP4 LL_PWR_SetWakeUpPinPolarityLow
- CR4 WP5 LL_PWR_SetWakeUpPinPolarityLow

LL_PWR_SetWakeUpPinPolarityHigh

Function name

__STATIC_INLINE void LL_PWR_SetWakeUpPinPolarityHigh (uint32_t WakeUpPin)

Function description

Set the Wake-Up pin polarity high for the event detection.

Parameters

- **WakeUpPin:** This parameter can be one of the following values:
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3
  - LL_PWR_WAKEUP_PIN4
  - LL_PWR_WAKEUP_PIN5

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR4 WP1 LL_PWR_SetWakeUpPinPolarityHigh
- CR4 WP2 LL_PWR_SetWakeUpPinPolarityHigh
- CR4 WP3 LL_PWR_SetWakeUpPinPolarityHigh
- CR4 WP4 LL_PWR_SetWakeUpPinPolarityHigh
- CR4 WP5 LL_PWR_SetWakeUpPinPolarityHigh

`LL_PWR_IsWakeUpPinPolarityLow`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsWakeUpPinPolarityLow (uint32_t WakeUpPin)

Function description

Get the Wake-Up pin polarity for the event detection.

Parameters

- **WakeUpPin:** This parameter can be one of the following values:
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3
  - LL_PWR_WAKEUP_PIN4
  - LL_PWR_WAKEUP_PIN5

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR4 WP1 LL_PWR_IsWakeUpPinPolarityLow
- CR4 WP2 LL_PWR_IsWakeUpPinPolarityLow
- CR4 WP3 LL_PWR_IsWakeUpPinPolarityLow
- CR4 WP4 LL_PWR_IsWakeUpPinPolarityLow
- CR4 WP5 LL_PWR_IsWakeUpPinPolarityLow

`LL_PWR_EnableGPIOPullUp`

Function name

__STATIC_INLINE void LL_PWR_EnableGPIOPullUp (uint32_t GPIO, uint32_t GPIONumber)

Function description

Enable GPIO pull-up state in Standby and Shutdown modes.

Parameters

- **GPIO:** This parameter can be one of the following values:
  - LL_PWR_GPIO_A
  - LL_PWR_GPIO_B
  - LL_PWR_GPIO_C
  - LL_PWR_GPIO_D
  - LL_PWR_GPIO_E
  - LL_PWR_GPIO_F (*)
  - LL_PWR_GPIO_G (*)
  - LL_PWR_GPIO_H
  - LL_PWR_GPIO_I (*)

  (*) value not defined in all devices
- **GPIONumber:** This parameter can be one of the following values:
  - LL_PWR_GPIO_BIT_0
  - LL_PWR_GPIO_BIT_1
  - LL_PWR_GPIO_BIT_2
  - LL_PWR_GPIO_BIT_3
  - LL_PWR_GPIO_BIT_4
  - LL_PWR_GPIO_BIT_5
  - LL_PWR_GPIO_BIT_6
  - LL_PWR_GPIO_BIT_7
  - LL_PWR_GPIO_BIT_8
  - LL_PWR_GPIO_BIT_9
  - LL_PWR_GPIO_BIT_10
  - LL_PWR_GPIO_BIT_11
  - LL_PWR_GPIO_BIT_12
  - LL_PWR_GPIO_BIT_13
  - LL_PWR_GPIO_BIT_14
  - LL_PWR_GPIO_BIT_15

Return values

- **None:**

Reference Manual to LL API cross reference:

- PUCRA PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRB PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRC PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRD PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRE PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRF PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRG PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRH PU0-15 LL_PWR_EnableGPIOPullUp
- PUCRI PU0-11 LL_PWR_EnableGPIOPullUp

LL_PWR_DisableGPIOPullUp

Function name

__STATIC_INLINE void LL_PWR_DisableGPIOPullUp (uint32_t GPIO, uint32_t GPIONumber)

Function description

Disable GPIO pull-up state in Standby and Shutdown modes.

Parameters

- **GPIO:** This parameter can be one of the following values:
  - LL_PWR_GPIO_A
  - LL_PWR_GPIO_B
  - LL_PWR_GPIO_C
  - LL_PWR_GPIO_D
  - LL_PWR_GPIO_E
  - LL_PWR_GPIO_F (*)
  - LL_PWR_GPIO_G (*)
  - LL_PWR_GPIO_H
  - LL_PWR_GPIO_I (*)

  (*) value not defined in all devices
- **GPIONumber:** This parameter can be one of the following values:
  - LL_PWR_GPIO_BIT_0
  - LL_PWR_GPIO_BIT_1
  - LL_PWR_GPIO_BIT_2
  - LL_PWR_GPIO_BIT_3
  - LL_PWR_GPIO_BIT_4
  - LL_PWR_GPIO_BIT_5
  - LL_PWR_GPIO_BIT_6
  - LL_PWR_GPIO_BIT_7
  - LL_PWR_GPIO_BIT_8
  - LL_PWR_GPIO_BIT_9
  - LL_PWR_GPIO_BIT_10
  - LL_PWR_GPIO_BIT_11
  - LL_PWR_GPIO_BIT_12
  - LL_PWR_GPIO_BIT_13
  - LL_PWR_GPIO_BIT_14
  - LL_PWR_GPIO_BIT_15

Return values

- **None:**

Reference Manual to LL API cross reference:

- PUCRA PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRB PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRC PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRD PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRE PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRF PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRG PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRH PU0-15 LL_PWR_DisableGPIOPullUp
- PUCRI PU0-11 LL_PWR_DisableGPIOPullUp

LL_PWR_IsEnabledGPIOPullUp

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledGPIOPullUp (uint32_t GPIO, uint32_t GPIONumber)

Function description

Check if GPIO pull-up state is enabled.

Parameters

- **GPIO:** This parameter can be one of the following values:
  - LL_PWR_GPIO_A
  - LL_PWR_GPIO_B
  - LL_PWR_GPIO_C
  - LL_PWR_GPIO_D
  - LL_PWR_GPIO_E
  - LL_PWR_GPIO_F (*)
  - LL_PWR_GPIO_G (*)
  - LL_PWR_GPIO_H
  - LL_PWR_GPIO_I (*)

  (*) value not defined in all devices
- **GPIONumber:** This parameter can be one of the following values:
  - LL_PWR_GPIO_BIT_0
  - LL_PWR_GPIO_BIT_1
  - LL_PWR_GPIO_BIT_2
  - LL_PWR_GPIO_BIT_3
  - LL_PWR_GPIO_BIT_4
  - LL_PWR_GPIO_BIT_5
  - LL_PWR_GPIO_BIT_6
  - LL_PWR_GPIO_BIT_7
  - LL_PWR_GPIO_BIT_8
  - LL_PWR_GPIO_BIT_9
  - LL_PWR_GPIO_BIT_10
  - LL_PWR_GPIO_BIT_11
  - LL_PWR_GPIO_BIT_12
  - LL_PWR_GPIO_BIT_13
  - LL_PWR_GPIO_BIT_14
  - LL_PWR_GPIO_BIT_15

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- PUCRA PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRB PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRC PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRD PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRE PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRF PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRG PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRH PU0-15 LL_PWR_IsEnabledGPIOPullUp
- PUCRI PU0-11 LL_PWR_IsEnabledGPIOPullUp

LL_PWR_EnableGPIOPullDown

Function name

__STATIC_INLINE void LL_PWR_EnableGPIOPullDown (uint32_t GPIO, uint32_t GPIONumber)

Function description

Enable GPIO pull-down state in Standby and Shutdown modes.

Parameters

- **GPIO:** This parameter can be one of the following values:
  - LL_PWR_GPIO_A
  - LL_PWR_GPIO_B
  - LL_PWR_GPIO_C
  - LL_PWR_GPIO_D
  - LL_PWR_GPIO_E
  - LL_PWR_GPIO_F (*)
  - LL_PWR_GPIO_G (*)
  - LL_PWR_GPIO_H
  - LL_PWR_GPIO_I (*)

  (*) value not defined in all devices
- **GPIONumber:** This parameter can be one of the following values:
  - LL_PWR_GPIO_BIT_0
  - LL_PWR_GPIO_BIT_1
  - LL_PWR_GPIO_BIT_2
  - LL_PWR_GPIO_BIT_3
  - LL_PWR_GPIO_BIT_4
  - LL_PWR_GPIO_BIT_5
  - LL_PWR_GPIO_BIT_6
  - LL_PWR_GPIO_BIT_7
  - LL_PWR_GPIO_BIT_8
  - LL_PWR_GPIO_BIT_9
  - LL_PWR_GPIO_BIT_10
  - LL_PWR_GPIO_BIT_11
  - LL_PWR_GPIO_BIT_12
  - LL_PWR_GPIO_BIT_13
  - LL_PWR_GPIO_BIT_14
  - LL_PWR_GPIO_BIT_15

Return values

- **None:**

Reference Manual to LL API cross reference:

- PDCRA PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRB PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRC PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRD PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRE PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRF PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRG PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRH PD0-15 LL_PWR_EnableGPIOPullDown
- PDCRI PD0-11 LL_PWR_EnableGPIOPullDown

LL_PWR_DisableGPIOPullDown

Function name

__STATIC_INLINE void LL_PWR_DisableGPIOPullDown (uint32_t GPIO, uint32_t GPIONumber)

Function description

Disable GPIO pull-down state in Standby and Shutdown modes.

Parameters

- **GPIO:** This parameter can be one of the following values:
  - LL_PWR_GPIO_A
  - LL_PWR_GPIO_B
  - LL_PWR_GPIO_C
  - LL_PWR_GPIO_D
  - LL_PWR_GPIO_E
  - LL_PWR_GPIO_F (*)
  - LL_PWR_GPIO_G (*)
  - LL_PWR_GPIO_H
  - LL_PWR_GPIO_I (*)

  (*) value not defined in all devices
- **GPIONumber:** This parameter can be one of the following values:
  - LL_PWR_GPIO_BIT_0
  - LL_PWR_GPIO_BIT_1
  - LL_PWR_GPIO_BIT_2
  - LL_PWR_GPIO_BIT_3
  - LL_PWR_GPIO_BIT_4
  - LL_PWR_GPIO_BIT_5
  - LL_PWR_GPIO_BIT_6
  - LL_PWR_GPIO_BIT_7
  - LL_PWR_GPIO_BIT_8
  - LL_PWR_GPIO_BIT_9
  - LL_PWR_GPIO_BIT_10
  - LL_PWR_GPIO_BIT_11
  - LL_PWR_GPIO_BIT_12
  - LL_PWR_GPIO_BIT_13
  - LL_PWR_GPIO_BIT_14
  - LL_PWR_GPIO_BIT_15

Return values

- **None:**

Reference Manual to LL API cross reference:

- PDCRA PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRB PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRC PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRD PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRE PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRF PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRG PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRH PD0-15 LL_PWR_DisableGPIOPullDown
- PDCRI PD0-11 LL_PWR_DisableGPIOPullDown

LL_PWR_IsEnabledGPIOPullDown

Function name

__STATIC_INLINE uint32_t LL_PWR_IsEnabledGPIOPullDown (uint32_t GPIO, uint32_t GPIONumber)

Function description

Check if GPIO pull-down state is enabled.

Parameters

- **GPIO:** This parameter can be one of the following values:
  - LL_PWR_GPIO_A
  - LL_PWR_GPIO_B
  - LL_PWR_GPIO_C
  - LL_PWR_GPIO_D
  - LL_PWR_GPIO_E
  - LL_PWR_GPIO_F (*)
  - LL_PWR_GPIO_G (*)
  - LL_PWR_GPIO_H
  - LL_PWR_GPIO_I (*)

  (*) value not defined in all devices
- **GPIONumber:** This parameter can be one of the following values:
  - LL_PWR_GPIO_BIT_0
  - LL_PWR_GPIO_BIT_1
  - LL_PWR_GPIO_BIT_2
  - LL_PWR_GPIO_BIT_3
  - LL_PWR_GPIO_BIT_4
  - LL_PWR_GPIO_BIT_5
  - LL_PWR_GPIO_BIT_6
  - LL_PWR_GPIO_BIT_7
  - LL_PWR_GPIO_BIT_8
  - LL_PWR_GPIO_BIT_9
  - LL_PWR_GPIO_BIT_10
  - LL_PWR_GPIO_BIT_11
  - LL_PWR_GPIO_BIT_12
  - LL_PWR_GPIO_BIT_13
  - LL_PWR_GPIO_BIT_14
  - LL_PWR_GPIO_BIT_15

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- PDCRA PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRB PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRC PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRD PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRE PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRF PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRG PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRH PD0-15 LL_PWR_IsEnabledGPIOPullDown
- PDCRI PD0-11 LL_PWR_IsEnabledGPIOPullDown

LL_PWR_IsActiveFlag_InternWU

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_InternWU (void)

Function description

Get Internal Wake-up line Flag.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 WUFI LL_PWR_IsActiveFlag_InternWU

`LL_PWR_IsActiveFlag_SB`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_SB (void)

Function description

Get Stand-By Flag.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 SBF LL_PWR_IsActiveFlag_SB

`LL_PWR_IsActiveFlag_WU5`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU5 (void)

Function description

Get Wake-up Flag 5.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 WUF5 LL_PWR_IsActiveFlag_WU5

`LL_PWR_IsActiveFlag_WU4`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU4 (void)

Function description

Get Wake-up Flag 4.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 WUF4 LL_PWR_IsActiveFlag_WU4

`LL_PWR_IsActiveFlag_WU3`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU3 (void)

Function description

Get Wake-up Flag 3.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 WUF3 LL_PWR_IsActiveFlag_WU3

`LL_PWR_IsActiveFlag_WU2`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU2 (void)

Function description

Get Wake-up Flag 2.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 WUF2 LL_PWR_IsActiveFlag_WU2

`LL_PWR_IsActiveFlag_WU1`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU1 (void)

Function description

Get Wake-up Flag 1.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR1 WUF1 LL_PWR_IsActiveFlag_WU1

`LL_PWR_ClearFlag_SB`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_SB (void)

Function description

Clear Stand-By Flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CSBF LL_PWR_ClearFlag_SB

`LL_PWR_ClearFlag_WU`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_WU (void)

Function description

Clear Wake-up Flags.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CWUF LL_PWR_ClearFlag_WU

`LL_PWR_ClearFlag_WU5`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_WU5 (void)

Function description

Clear Wake-up Flag 5.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CWUF5 LL_PWR_ClearFlag_WU5

`LL_PWR_ClearFlag_WU4`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_WU4 (void)

Function description

Clear Wake-up Flag 4.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CWUF4 LL_PWR_ClearFlag_WU4

`LL_PWR_ClearFlag_WU3`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_WU3 (void)

Function description

Clear Wake-up Flag 3.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CWUF3 LL_PWR_ClearFlag_WU3

`LL_PWR_ClearFlag_WU2`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_WU2 (void)

Function description

Clear Wake-up Flag 2.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CWUF2 LL_PWR_ClearFlag_WU2

`LL_PWR_ClearFlag_WU1`

Function name

__STATIC_INLINE void LL_PWR_ClearFlag_WU1 (void)

Function description

Clear Wake-up Flag 1.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SCR CWUF1 LL_PWR_ClearFlag_WU1

`LL_PWR_IsActiveFlag_PVMO4`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVMO4 (void)

Function description

Indicate whether VDDA voltage is below or above PVM4 threshold.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 PVMO4 LL_PWR_IsActiveFlag_PVMO4

`LL_PWR_IsActiveFlag_PVMO3`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVMO3 (void)

Function description

Indicate whether VDDA voltage is below or above PVM3 threshold.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 PVMO3 LL_PWR_IsActiveFlag_PVMO3

`LL_PWR_IsActiveFlag_PVMO2`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVMO2 (void)

Function description

Indicate whether VDDIO2 voltage is below or above PVM2 threshold.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 PVMO2 LL_PWR_IsActiveFlag_PVMO2

`LL_PWR_IsActiveFlag_PVMO1`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVMO1 (void)

Function description

Indicate whether VDDUSB voltage is below or above PVM1 threshold.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 PVMO1 LL_PWR_IsActiveFlag_PVMO1

`LL_PWR_IsActiveFlag_PVDO`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVDO (void)

Function description

Indicate whether VDD voltage is below or above the selected PVD threshold.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 PVDO LL_PWR_IsActiveFlag_PVDO

`LL_PWR_IsActiveFlag_VOS`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_VOS (void)

Function description

Indicate whether the regulator is ready in the selected voltage range or if its output voltage is still changing to the required voltage level.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 VOSF LL_PWR_IsActiveFlag_VOS

`LL_PWR_IsActiveFlag_REGLPF`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_REGLPF (void)

Function description

Indicate whether the regulator is ready in main mode or is in low-power mode.

Return values

- **State:** of bit (1 or 0).

Notes

- Take care, return value "0" means the regulator is ready. Return value "1" means the output voltage range is still changing.

Reference Manual to LL API cross reference:

- SR2 REGLPF LL_PWR_IsActiveFlag_REGLPF

`LL_PWR_IsActiveFlag_REGLPS`

Function name

__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_REGLPS (void)

Function description

Indicate whether or not the low-power regulator is ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR2 REGLPS LL_PWR_IsActiveFlag_REGLPS

`LL_PWR_DeInit`

Function name

ErrorStatus LL_PWR_DeInit (void)

Function description

De-initialize the PWR registers to their default reset values.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: PWR registers are de-initialized
  - ERROR: not applicable

98.2 PWR Firmware driver defines

The following section lists the various define and macros of the module.

98.2.1 PWR

PWR

BATT CHARG RESISTOR

LL_PWR_BATT_CHARG_RESISTOR_5K

LL_PWR_BATT_CHARGRESISTOR_1_5K

Clear Flags Defines

LL_PWR_SCR_CSBF

LL_PWR_SCR_CWUF

LL_PWR_SCR_CWUF5

LL_PWR_SCR_CWUF4

LL_PWR_SCR_CWUF3

LL_PWR_SCR_CWUF2

LL_PWR_SCR_CWUF1

Get Flags Defines

LL_PWR_SR1_WUFI

LL_PWR_SR1_SBF

LL_PWR_SR1_WUF5

LL_PWR_SR1_WUF4

LL_PWR_SR1_WUF3

LL_PWR_SR1_WUF2

LL_PWR_SR1_WUF1

LL_PWR_SR2_PVMO4

LL_PWR_SR2_PVMO3

LL_PWR_SR2_PVMO2

LL_PWR_SR2_PVMO1

LL_PWR_SR2_PVDO

LL_PWR_SR2_VOSF

LL_PWR_SR2_REGLPF

LL_PWR_SR2_REGLPS

GPIO

LL_PWR_GPIO_A

LL_PWR_GPIO_B

LL_PWR_GPIO_C

LL_PWR_GPIO_D

LL_PWR_GPIO_E

LL_PWR_GPIO_F

LL_PWR_GPIO_G

LL_PWR_GPIO_H

LL_PWR_GPIO_I

GPIO BIT

LL_PWR_GPIO_BIT_0

LL_PWR_GPIO_BIT_1

LL_PWR_GPIO_BIT_2

LL_PWR_GPIO_BIT_3

LL_PWR_GPIO_BIT_4

LL_PWR_GPIO_BIT_5

LL_PWR_GPIO_BIT_6

LL_PWR_GPIO_BIT_7

LL_PWR_GPIO_BIT_8

LL_PWR_GPIO_BIT_9

LL_PWR_GPIO_BIT_10

LL_PWR_GPIO_BIT_11

LL_PWR_GPIO_BIT_12

LL_PWR_GPIO_BIT_13

LL_PWR_GPIO_BIT_14

LL_PWR_GPIO_BIT_15

MODE PWR

LL_PWR_MODE_STOP0

LL_PWR_MODE_STOP1

LL_PWR_MODE_STOP2

LL_PWR_MODE_STANDBY

LL_PWR_MODE_SHUTDOWN

PVDLEVEL

LL_PWR_PVDLEVEL_0

LL_PWR_PVDLEVEL_1

LL_PWR_PVDLEVEL_2

LL_PWR_PVDLEVEL_3

LL_PWR_PVDLEVEL_4

LL_PWR_PVDLEVEL_5

LL_PWR_PVDLEVEL_6

LL_PWR_PVDLEVEL_7

Peripheral voltage monitoring

LL_PWR_PVM_VDDUSB_1_2V

LL_PWR_PVM_VDDIO2_0_9V

LL_PWR_PVM_VDDA_1_62V

LL_PWR_PVM_VDDA_2_2V

REGU VOLTAGE

LL_PWR_REGU_VOLTAGE_SCALE1

LL_PWR_REGU_VOLTAGE_SCALE2

SRAM2 CONTENT RETENTION

LL_PWR_NO_SRAM2_RETENTION

LL_PWR_FULL_SRAM2_RETENTION

WAKEUP

LL_PWR_WAKEUP_PIN1

LL_PWR_WAKEUP_PIN2

LL_PWR_WAKEUP_PIN3

LL_PWR_WAKEUP_PIN4

LL_PWR_WAKEUP_PIN5

Legacy functions name

LL_PWR_IsActiveFlag_VOSF

Common Write and read registers Macros

LL_PWR_WriteReg

Description:

- Write a value in PWR register.

Parameters:

- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_PWR_ReadReg

Description:

- Read a value in PWR register.

Parameters:

- __REG__: Register to be read

Return value:

- Register: value

99 LL RCC Generic Driver

99.1 RCC Firmware driver registers structures

99.1.1 LL_RCC_ClocksTypeDef

LL_RCC_ClocksTypeDef is defined in the stm32l4xx_ll_rcc.h

Data Fields

- ***uint32_t SYSCLK_Frequency***
- ***uint32_t HCLK_Frequency***
- ***uint32_t PCLK1_Frequency***
- ***uint32_t PCLK2_Frequency***

Field Documentation

- ***uint32_t LL_RCC_ClocksTypeDef::SYSCLK_Frequency***
  SYSCLK clock frequency
- ***uint32_t LL_RCC_ClocksTypeDef::HCLK_Frequency***
  HCLK clock frequency
- ***uint32_t LL_RCC_ClocksTypeDef::PCLK1_Frequency***
  PCLK1 clock frequency
- ***uint32_t LL_RCC_ClocksTypeDef::PCLK2_Frequency***
  PCLK2 clock frequency

99.2 RCC Firmware driver API description

The following section lists the various functions of the RCC library.

99.2.1 Detailed description of functions

`LL_RCC_HSE_EnableCSS`

Function name

__STATIC_INLINE void LL_RCC_HSE_EnableCSS (void)

Function description

Enable the Clock Security System.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CSSON LL_RCC_HSE_EnableCSS

`LL_RCC_HSE_EnableBypass`

Function name

__STATIC_INLINE void LL_RCC_HSE_EnableBypass (void)

Function description

Enable HSE external oscillator (HSE Bypass)

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSEBYP LL_RCC_HSE_EnableBypass

`LL_RCC_HSE_DisableBypass`

Function name

__STATIC_INLINE void LL_RCC_HSE_DisableBypass (void)

Function description

Disable HSE external oscillator (HSE Bypass)

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSEBYP LL_RCC_HSE_DisableBypass

`LL_RCC_HSE_Enable`

Function name

__STATIC_INLINE void LL_RCC_HSE_Enable (void)

Function description

Enable HSE crystal oscillator (HSE ON)

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSEON LL_RCC_HSE_Enable

`LL_RCC_HSE_Disable`

Function name

__STATIC_INLINE void LL_RCC_HSE_Disable (void)

Function description

Disable HSE crystal oscillator (HSE ON)

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSEON LL_RCC_HSE_Disable

`LL_RCC_HSE_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_HSE_IsReady (void)

Function description

Check if HSE oscillator Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR HSERDY LL_RCC_HSE_IsReady

`LL_RCC_HSI_EnableInStopMode`

Function name

__STATIC_INLINE void LL_RCC_HSI_EnableInStopMode (void)

Function description

Enable HSI even in stop mode.

Return values

- **None:**

Notes

- HSI oscillator is forced ON even in Stop mode

Reference Manual to LL API cross reference:

- CR HSIKERON LL_RCC_HSI_EnableInStopMode

`LL_RCC_HSI_DisableInStopMode`

Function name

__STATIC_INLINE void LL_RCC_HSI_DisableInStopMode (void)

Function description

Disable HSI in stop mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSIKERON LL_RCC_HSI_DisableInStopMode

`LL_RCC_HSI_IsEnabledInStopMode`

Function name

__STATIC_INLINE uint32_t LL_RCC_HSI_IsEnabledInStopMode (void)

Function description

Check if HSI is enabled in stop mode.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR HSIKERON LL_RCC_HSI_IsEnabledInStopMode

`LL_RCC_HSI_Enable`

Function name

__STATIC_INLINE void LL_RCC_HSI_Enable (void)

Function description

Enable HSI oscillator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSION LL_RCC_HSI_Enable

`LL_RCC_HSI_Disable`

Function name

__STATIC_INLINE void LL_RCC_HSI_Disable (void)

Function description

Disable HSI oscillator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSION LL_RCC_HSI_Disable

`LL_RCC_HSI_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_HSI_IsReady (void)

Function description

Check if HSI clock is ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR HSIRDY LL_RCC_HSI_IsReady

`LL_RCC_HSI_EnableAutoFromStop`

Function name

__STATIC_INLINE void LL_RCC_HSI_EnableAutoFromStop (void)

Function description

Enable HSI Automatic from stop mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSIASFS LL_RCC_HSI_EnableAutoFromStop

`LL_RCC_HSI_DisableAutoFromStop`

Function name

__STATIC_INLINE void LL_RCC_HSI_DisableAutoFromStop (void)

Function description

Disable HSI Automatic from stop mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR HSIASFS LL_RCC_HSI_DisableAutoFromStop

`LL_RCC_HSI_GetCalibration`

Function name

__STATIC_INLINE uint32_t LL_RCC_HSI_GetCalibration (void)

Function description

Get HSI Calibration value.

Return values

- **Between:** Min_Data = 0x00 and Max_Data = 0xFF

Notes

- When HSITRIM is written, HSICAL is updated with the sum of HSITRIM and the factory trim value

Reference Manual to LL API cross reference:

- ICSCR HSICAL LL_RCC_HSI_GetCalibration

`LL_RCC_HSI_SetCalibTrimming`

Function name

__STATIC_INLINE void LL_RCC_HSI_SetCalibTrimming (uint32_t Value)

Function description

Set HSI Calibration trimming.

Parameters

- **Value:** Between Min_Data = 0 and Max_Data = 31

Return values

- **None:**

Notes

- user-programmable trimming value that is added to the HSICAL
- Default value is 16, which, when added to the HSICAL value, should trim the HSI to 16 MHz +/- 1 %

Reference Manual to LL API cross reference:

- ICSCR HSITRIM LL_RCC_HSI_SetCalibTrimming

`LL_RCC_HSI_GetCalibTrimming`

Function name

__STATIC_INLINE uint32_t LL_RCC_HSI_GetCalibTrimming (void)

Function description

Get HSI Calibration trimming.

Return values

- **Between:** Min_Data = 0 and Max_Data = 31

Reference Manual to LL API cross reference:

- ICSCR HSITRIM LL_RCC_HSI_GetCalibTrimming

LL_RCC_HSI48_Enable

Function name

__STATIC_INLINE void LL_RCC_HSI48_Enable (void)

Function description

Enable HSI48.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CRRCR HSI48ON LL_RCC_HSI48_Enable

LL_RCC_HSI48_Disable

Function name

__STATIC_INLINE void LL_RCC_HSI48_Disable (void)

Function description

Disable HSI48.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CRRCR HSI48ON LL_RCC_HSI48_Disable

LL_RCC_HSI48_IsReady

Function name

__STATIC_INLINE uint32_t LL_RCC_HSI48_IsReady (void)

Function description

Check if HSI48 oscillator Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CRRCR HSI48RDY LL_RCC_HSI48_IsReady

LL_RCC_HSI48_GetCalibration

Function name

__STATIC_INLINE uint32_t LL_RCC_HSI48_GetCalibration (void)

Function description

Get HSI48 Calibration value.

Return values

- **Between:** Min_Data = 0x00 and Max_Data = 0x1FF

Reference Manual to LL API cross reference:

- CRRCR HSI48CAL LL_RCC_HSI48_GetCalibration

LL_RCC_LSE_Enable

Function name

__STATIC_INLINE void LL_RCC_LSE_Enable (void)

Function description

Enable Low Speed External (LSE) crystal.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSEON LL_RCC_LSE_Enable

LL_RCC_LSE_Disable

Function name

__STATIC_INLINE void LL_RCC_LSE_Disable (void)

Function description

Disable Low Speed External (LSE) crystal.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSEON LL_RCC_LSE_Disable

LL_RCC_LSE_EnableBypass

Function name

__STATIC_INLINE void LL_RCC_LSE_EnableBypass (void)

Function description

Enable external clock source (LSE bypass).

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSEBYP LL_RCC_LSE_EnableBypass

LL_RCC_LSE_DisableBypass

Function name

__STATIC_INLINE void LL_RCC_LSE_DisableBypass (void)

Function description

Disable external clock source (LSE bypass).

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSEBYP LL_RCC_LSE_DisableBypass

`LL_RCC_LSE_SetDriveCapability`

Function name

__STATIC_INLINE void LL_RCC_LSE_SetDriveCapability (uint32_t LSEDrive)

Function description

Set LSE oscillator drive capability.

Parameters

- **LSEDrive:** This parameter can be one of the following values:
  - LL_RCC_LSEDRIVE_LOW
  - LL_RCC_LSEDRIVE_MEDIUMLOW
  - LL_RCC_LSEDRIVE_MEDIUMHIGH
  - LL_RCC_LSEDRIVE_HIGH

Return values

- **None:**

Notes

- The oscillator is in Xtal mode when it is not in bypass mode.

Reference Manual to LL API cross reference:

- BDCR LSEDRV LL_RCC_LSE_SetDriveCapability

`LL_RCC_LSE_GetDriveCapability`

Function name

__STATIC_INLINE uint32_t LL_RCC_LSE_GetDriveCapability (void)

Function description

Get LSE oscillator drive capability.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_LSEDRIVE_LOW
  - LL_RCC_LSEDRIVE_MEDIUMLOW
  - LL_RCC_LSEDRIVE_MEDIUMHIGH
  - LL_RCC_LSEDRIVE_HIGH

Reference Manual to LL API cross reference:

- BDCR LSEDRV LL_RCC_LSE_GetDriveCapability

`LL_RCC_LSE_EnableCSS`

Function name

__STATIC_INLINE void LL_RCC_LSE_EnableCSS (void)

Function description

Enable Clock security system on LSE.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSECSSON LL_RCC_LSE_EnableCSS

`LL_RCC_LSE_DisableCSS`

Function name

__STATIC_INLINE void LL_RCC_LSE_DisableCSS (void)

Function description

Disable Clock security system on LSE.

Return values

- **None:**

Notes

- Clock security system can be disabled only after a LSE failure detection. In that case it MUST be disabled by software.

Reference Manual to LL API cross reference:

- BDCR LSECSSON LL_RCC_LSE_DisableCSS

`LL_RCC_LSE_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_LSE_IsReady (void)

Function description

Check if LSE oscillator Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- BDCR LSERDY LL_RCC_LSE_IsReady

`LL_RCC_LSE_IsCSSDetected`

Function name

__STATIC_INLINE uint32_t LL_RCC_LSE_IsCSSDetected (void)

Function description

Check if CSS on LSE failure Detection.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- BDCR LSECSSD LL_RCC_LSE_IsCSSDetected

`LL_RCC_LSI_Enable`

Function name

__STATIC_INLINE void LL_RCC_LSI_Enable (void)

Function description

Enable LSI Oscillator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR LSION LL_RCC_LSI_Enable

`LL_RCC_LSI_Disable`

Function name

__STATIC_INLINE void LL_RCC_LSI_Disable (void)

Function description

Disable LSI Oscillator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR LSION LL_RCC_LSI_Disable

`LL_RCC_LSI_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_LSI_IsReady (void)

Function description

Check if LSI is Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR LSIRDY LL_RCC_LSI_IsReady

`LL_RCC_MSI_Enable`

Function name

__STATIC_INLINE void LL_RCC_MSI_Enable (void)

Function description

Enable MSI oscillator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR MSION LL_RCC_MSI_Enable

`LL_RCC_MSI_Disable`

Function name

__STATIC_INLINE void LL_RCC_MSI_Disable (void)

Function description

Disable MSI oscillator.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR MSION LL_RCC_MSI_Disable

`LL_RCC_MSI_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_MSI_IsReady (void)

Function description

Check if MSI oscillator Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR MSIRDY LL_RCC_MSI_IsReady

`LL_RCC_MSI_EnablePLLMode`

Function name

__STATIC_INLINE void LL_RCC_MSI_EnablePLLMode (void)

Function description

Enable MSI PLL-mode (Hardware auto calibration with LSE)

Return values

- **None:**

Notes

- MSIPLLEN must be enabled after LSE is enabled (LSEON enabled) and ready (LSERDY set by hardware)
- hardware protection to avoid enabling MSIPLLEN if LSE is not ready

Reference Manual to LL API cross reference:

- CR MSIPLLEN LL_RCC_MSI_EnablePLLMode

`LL_RCC_MSI_DisablePLLMode`

Function name

__STATIC_INLINE void LL_RCC_MSI_DisablePLLMode (void)

Function description

Disable MSI-PLL mode.

Return values

- **None:**

Notes

- cleared by hardware when LSE is disabled (LSEON = 0) or when the Clock Security System on LSE detects a LSE failure

Reference Manual to LL API cross reference:

- CR MSIPLLEN LL_RCC_MSI_DisablePLLMode

`LL_RCC_MSI_EnableRangeSelection`

Function name

__STATIC_INLINE void LL_RCC_MSI_EnableRangeSelection (void)

Function description

Enable MSI clock range selection with MSIRANGE register.

Return values

- **None:**

Notes

- Write 0 has no effect. After a standby or a reset MSIRGSEL is at 0 and the MSI range value is provided by MSISRANGE

Reference Manual to LL API cross reference:

- CR MSIRGSEL LL_RCC_MSI_EnableRangeSelection

`LL_RCC_MSI_IsEnabledRangeSelect`

Function name

__STATIC_INLINE uint32_t LL_RCC_MSI_IsEnabledRangeSelect (void)

Function description

Check if MSI clock range is selected with MSIRANGE register.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR MSIRGSEL LL_RCC_MSI_IsEnabledRangeSelect

`LL_RCC_MSI_SetRange`

Function name

__STATIC_INLINE void LL_RCC_MSI_SetRange (uint32_t Range)

Function description

Configure the Internal Multi Speed oscillator (MSI) clock range in run mode.

Parameters

- **Range:** This parameter can be one of the following values:
  - LL_RCC_MSIRANGE_0
  - LL_RCC_MSIRANGE_1
  - LL_RCC_MSIRANGE_2
  - LL_RCC_MSIRANGE_3
  - LL_RCC_MSIRANGE_4
  - LL_RCC_MSIRANGE_5
  - LL_RCC_MSIRANGE_6
  - LL_RCC_MSIRANGE_7
  - LL_RCC_MSIRANGE_8
  - LL_RCC_MSIRANGE_9
  - LL_RCC_MSIRANGE_10
  - LL_RCC_MSIRANGE_11

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR MSIRANGE LL_RCC_MSI_SetRange

LL_RCC_MSI_GetRange

Function name

__STATIC_INLINE uint32_t LL_RCC_MSI_GetRange (void)

Function description

Get the Internal Multi Speed oscillator (MSI) clock range in run mode.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_MSIRANGE_0
  - LL_RCC_MSIRANGE_1
  - LL_RCC_MSIRANGE_2
  - LL_RCC_MSIRANGE_3
  - LL_RCC_MSIRANGE_4
  - LL_RCC_MSIRANGE_5
  - LL_RCC_MSIRANGE_6
  - LL_RCC_MSIRANGE_7
  - LL_RCC_MSIRANGE_8
  - LL_RCC_MSIRANGE_9
  - LL_RCC_MSIRANGE_10
  - LL_RCC_MSIRANGE_11

Reference Manual to LL API cross reference:

- CR MSIRANGE LL_RCC_MSI_GetRange

LL_RCC_MSI_SetRangeAfterStandby

Function name

__STATIC_INLINE void LL_RCC_MSI_SetRangeAfterStandby (uint32_t Range)

Function description

Configure MSI range used after standby.

Parameters

- **Range:** This parameter can be one of the following values:
  - LL_RCC_MSISRANGE_4
  - LL_RCC_MSISRANGE_5
  - LL_RCC_MSISRANGE_6
  - LL_RCC_MSISRANGE_7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR MSISRANGE LL_RCC_MSI_SetRangeAfterStandby

LL_RCC_MSI_GetRangeAfterStandby

Function name

__STATIC_INLINE uint32_t LL_RCC_MSI_GetRangeAfterStandby (void)

Function description

Get MSI range used after standby.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_MSISRANGE_4
  - LL_RCC_MSISRANGE_5
  - LL_RCC_MSISRANGE_6
  - LL_RCC_MSISRANGE_7

Reference Manual to LL API cross reference:

- CSR MSISRANGE LL_RCC_MSI_GetRangeAfterStandby

`LL_RCC_MSI_GetCalibration`

Function name

__STATIC_INLINE uint32_t LL_RCC_MSI_GetCalibration (void)

Function description

Get MSI Calibration value.

Return values

- **Between:** Min_Data = 0 and Max_Data = 255

Notes

- When MSITRIM is written, MSICAL is updated with the sum of MSITRIM and the factory trim value

Reference Manual to LL API cross reference:

- ICSCR MSICAL LL_RCC_MSI_GetCalibration

`LL_RCC_MSI_SetCalibTrimming`

Function name

__STATIC_INLINE void LL_RCC_MSI_SetCalibTrimming (uint32_t Value)

Function description

Set MSI Calibration trimming.

Parameters

- **Value:** Between Min_Data = 0 and Max_Data = 255

Return values

- **None:**

Notes

- user-programmable trimming value that is added to the MSICAL

Reference Manual to LL API cross reference:

- ICSCR MSITRIM LL_RCC_MSI_SetCalibTrimming

`LL_RCC_MSI_GetCalibTrimming`

Function name

__STATIC_INLINE uint32_t LL_RCC_MSI_GetCalibTrimming (void)

Function description

Get MSI Calibration trimming.

Return values

- **Between:** 0 and 255

Reference Manual to LL API cross reference:

- ICSCR MSITRIM LL_RCC_MSI_GetCalibTrimming

`LL_RCC_LSCO_Enable`

Function name

__STATIC_INLINE void LL_RCC_LSCO_Enable (void)

Function description

Enable Low speed clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSCOEN LL_RCC_LSCO_Enable

`LL_RCC_LSCO_Disable`

Function name

__STATIC_INLINE void LL_RCC_LSCO_Disable (void)

Function description

Disable Low speed clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSCOEN LL_RCC_LSCO_Disable

`LL_RCC_LSCO_SetSource`

Function name

__STATIC_INLINE void LL_RCC_LSCO_SetSource (uint32_t Source)

Function description

Configure Low speed clock selection.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_LSCO_CLKSOURCE_LSI
  - LL_RCC_LSCO_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR LSCOSEL LL_RCC_LSCO_SetSource

`LL_RCC_LSCO_GetSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_LSCO_GetSource (void)

Function description

Get Low speed clock selection.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_LSCO_CLKSOURCE_LSI
  - LL_RCC_LSCO_CLKSOURCE_LSE

Reference Manual to LL API cross reference:

- BDCR LSCOSEL LL_RCC_LSCO_GetSource

LL_RCC_SetSysClkSource

Function name

__STATIC_INLINE void LL_RCC_SetSysClkSource (uint32_t Source)

Function description

Configure the system clock source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_SYS_CLKSOURCE_MSI
  - LL_RCC_SYS_CLKSOURCE_HSI
  - LL_RCC_SYS_CLKSOURCE_HSE
  - LL_RCC_SYS_CLKSOURCE_PLL

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR SW LL_RCC_SetSysClkSource

LL_RCC_GetSysClkSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetSysClkSource (void)

Function description

Get the system clock source.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_SYS_CLKSOURCE_STATUS_MSI
  - LL_RCC_SYS_CLKSOURCE_STATUS_HSI
  - LL_RCC_SYS_CLKSOURCE_STATUS_HSE
  - LL_RCC_SYS_CLKSOURCE_STATUS_PLL

Reference Manual to LL API cross reference:

- CFGR SWS LL_RCC_GetSysClkSource

LL_RCC_SetAHBPrescaler

Function name

__STATIC_INLINE void LL_RCC_SetAHBPrescaler (uint32_t Prescaler)

Function description

Set AHB prescaler.

Parameters

- **Prescaler:** This parameter can be one of the following values:
  - LL_RCC_SYSCLK_DIV_1
  - LL_RCC_SYSCLK_DIV_2
  - LL_RCC_SYSCLK_DIV_4
  - LL_RCC_SYSCLK_DIV_8
  - LL_RCC_SYSCLK_DIV_16
  - LL_RCC_SYSCLK_DIV_64
  - LL_RCC_SYSCLK_DIV_128
  - LL_RCC_SYSCLK_DIV_256
  - LL_RCC_SYSCLK_DIV_512

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR HPRE LL_RCC_SetAHBPrescaler

LL_RCC_SetAPB1Prescaler

Function name

__STATIC_INLINE void LL_RCC_SetAPB1Prescaler (uint32_t Prescaler)

Function description

Set APB1 prescaler.

Parameters

- **Prescaler:** This parameter can be one of the following values:
  - LL_RCC_APB1_DIV_1
  - LL_RCC_APB1_DIV_2
  - LL_RCC_APB1_DIV_4
  - LL_RCC_APB1_DIV_8
  - LL_RCC_APB1_DIV_16

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR PPRE1 LL_RCC_SetAPB1Prescaler

LL_RCC_SetAPB2Prescaler

Function name

__STATIC_INLINE void LL_RCC_SetAPB2Prescaler (uint32_t Prescaler)

Function description

Set APB2 prescaler.

Parameters

- **Prescaler:** This parameter can be one of the following values:
  - LL_RCC_APB2_DIV_1
  - LL_RCC_APB2_DIV_2
  - LL_RCC_APB2_DIV_4
  - LL_RCC_APB2_DIV_8
  - LL_RCC_APB2_DIV_16

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR PPRE2 LL_RCC_SetAPB2Prescaler

`LL_RCC_GetAHBPrescaler`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetAHBPrescaler (void)

Function description

Get AHB prescaler.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_SYSCLK_DIV_1
  - LL_RCC_SYSCLK_DIV_2
  - LL_RCC_SYSCLK_DIV_4
  - LL_RCC_SYSCLK_DIV_8
  - LL_RCC_SYSCLK_DIV_16
  - LL_RCC_SYSCLK_DIV_64
  - LL_RCC_SYSCLK_DIV_128
  - LL_RCC_SYSCLK_DIV_256
  - LL_RCC_SYSCLK_DIV_512

Reference Manual to LL API cross reference:

- CFGR HPRE LL_RCC_GetAHBPrescaler

`LL_RCC_GetAPB1Prescaler`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetAPB1Prescaler (void)

Function description

Get APB1 prescaler.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_APB1_DIV_1
  - LL_RCC_APB1_DIV_2
  - LL_RCC_APB1_DIV_4
  - LL_RCC_APB1_DIV_8
  - LL_RCC_APB1_DIV_16

Reference Manual to LL API cross reference:

- CFGR PPRE1 LL_RCC_GetAPB1Prescaler

`LL_RCC_GetAPB2Prescaler`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetAPB2Prescaler (void)

Function description

Get APB2 prescaler.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_APB2_DIV_1
  - LL_RCC_APB2_DIV_2
  - LL_RCC_APB2_DIV_4
  - LL_RCC_APB2_DIV_8
  - LL_RCC_APB2_DIV_16

Reference Manual to LL API cross reference:

- CFGR PPRE2 LL_RCC_GetAPB2Prescaler

`LL_RCC_SetClkAfterWakeFromStop`

Function name

__STATIC_INLINE void LL_RCC_SetClkAfterWakeFromStop (uint32_t Clock)

Function description

Set Clock After Wake-Up From Stop mode.

Parameters

- **Clock:** This parameter can be one of the following values:
  - LL_RCC_STOP_WAKEUPCLOCK_MSI
  - LL_RCC_STOP_WAKEUPCLOCK_HSI

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR STOPWUCK LL_RCC_SetClkAfterWakeFromStop

`LL_RCC_GetClkAfterWakeFromStop`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetClkAfterWakeFromStop (void)

Function description

Get Clock After Wake-Up From Stop mode.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_STOP_WAKEUPCLOCK_MSI
  - LL_RCC_STOP_WAKEUPCLOCK_HSI

Reference Manual to LL API cross reference:

- CFGR STOPWUCK LL_RCC_GetClkAfterWakeFromStop

`LL_RCC_ConfigMCO`

Function name

__STATIC_INLINE void LL_RCC_ConfigMCO (uint32_t MCOxSource, uint32_t MCOxPrescaler)

Function description

Configure MCOx.

Parameters

- **MCOxSource:** This parameter can be one of the following values:
  - LL_RCC_MCO1SOURCE_NOCLOCK
  - LL_RCC_MCO1SOURCE_SYSCLK
  - LL_RCC_MCO1SOURCE_MSI
  - LL_RCC_MCO1SOURCE_HSI
  - LL_RCC_MCO1SOURCE_HSE
  - LL_RCC_MCO1SOURCE_HSI48 (*)
  - LL_RCC_MCO1SOURCE_PLLCLK
  - LL_RCC_MCO1SOURCE_LSI
  - LL_RCC_MCO1SOURCE_LSE

  (*) value not defined in all devices.
- **MCOxPrescaler:** This parameter can be one of the following values:
  - LL_RCC_MCO1_DIV_1
  - LL_RCC_MCO1_DIV_2
  - LL_RCC_MCO1_DIV_4
  - LL_RCC_MCO1_DIV_8
  - LL_RCC_MCO1_DIV_16

Return values

- **None:**

Reference Manual to LL API cross reference:

- CFGR MCOSEL LL_RCC_ConfigMCO
- CFGR MCOPRE LL_RCC_ConfigMCO

`LL_RCC_SetUSARTClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetUSARTClockSource (uint32_t USARTxSource)

Function description

Configure USARTx clock source.

Parameters

- **USARTxSource:** This parameter can be one of the following values:
  - LL_RCC_USART1_CLKSOURCE_PCLK2
  - LL_RCC_USART1_CLKSOURCE_SYSCLK
  - LL_RCC_USART1_CLKSOURCE_HSI
  - LL_RCC_USART1_CLKSOURCE_LSE
  - LL_RCC_USART2_CLKSOURCE_PCLK1
  - LL_RCC_USART2_CLKSOURCE_SYSCLK
  - LL_RCC_USART2_CLKSOURCE_HSI
  - LL_RCC_USART2_CLKSOURCE_LSE
  - LL_RCC_USART3_CLKSOURCE_PCLK1 (*)
  - LL_RCC_USART3_CLKSOURCE_SYSCLK (*)
  - LL_RCC_USART3_CLKSOURCE_HSI (*)
  - LL_RCC_USART3_CLKSOURCE_LSE (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR USARTxSEL LL_RCC_SetUSARTClockSource

`LL_RCC_SetUARTClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetUARTClockSource (uint32_t UARTxSource)

Function description

Configure UARTx clock source.

Parameters

- **UARTxSource:** This parameter can be one of the following values:
  - LL_RCC_UART4_CLKSOURCE_PCLK1
  - LL_RCC_UART4_CLKSOURCE_SYSCLK
  - LL_RCC_UART4_CLKSOURCE_HSI
  - LL_RCC_UART4_CLKSOURCE_LSE
  - LL_RCC_UART5_CLKSOURCE_PCLK1
  - LL_RCC_UART5_CLKSOURCE_SYSCLK
  - LL_RCC_UART5_CLKSOURCE_HSI
  - LL_RCC_UART5_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR UARTxSEL LL_RCC_SetUARTClockSource

`LL_RCC_SetLPUARTClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetLPUARTClockSource (uint32_t LPUARTxSource)

Function description

Configure LPUART1x clock source.

Parameters

- **LPUARTxSource:** This parameter can be one of the following values:
  - LL_RCC_LPUART1_CLKSOURCE_PCLK1
  - LL_RCC_LPUART1_CLKSOURCE_SYSCLK
  - LL_RCC_LPUART1_CLKSOURCE_HSI
  - LL_RCC_LPUART1_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR LPUART1SEL LL_RCC_SetLPUARTClockSource

LL_RCC_SetI2CClockSource

Function name

__STATIC_INLINE void LL_RCC_SetI2CClockSource (uint32_t I2CxSource)

Function description

Configure I2Cx clock source.

Parameters

- **I2CxSource:** This parameter can be one of the following values:
  - LL_RCC_I2C1_CLKSOURCE_PCLK1
  - LL_RCC_I2C1_CLKSOURCE_SYSCLK
  - LL_RCC_I2C1_CLKSOURCE_HSI
  - LL_RCC_I2C2_CLKSOURCE_PCLK1 (*)
  - LL_RCC_I2C2_CLKSOURCE_SYSCLK (*)
  - LL_RCC_I2C2_CLKSOURCE_HSI (*)
  - LL_RCC_I2C3_CLKSOURCE_PCLK1
  - LL_RCC_I2C3_CLKSOURCE_SYSCLK
  - LL_RCC_I2C3_CLKSOURCE_HSI
  - LL_RCC_I2C4_CLKSOURCE_PCLK1 (*)
  - LL_RCC_I2C4_CLKSOURCE_SYSCLK (*)
  - LL_RCC_I2C4_CLKSOURCE_HSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR I2CxSEL LL_RCC_SetI2CClockSource

LL_RCC_SetLPTIMClockSource

Function name

__STATIC_INLINE void LL_RCC_SetLPTIMClockSource (uint32_t LPTIMxSource)

Function description

Configure LPTIMx clock source.

Parameters

- **LPTIMxSource:** This parameter can be one of the following values:
  - LL_RCC_LPTIM1_CLKSOURCE_PCLK1
  - LL_RCC_LPTIM1_CLKSOURCE_LSI
  - LL_RCC_LPTIM1_CLKSOURCE_HSI
  - LL_RCC_LPTIM1_CLKSOURCE_LSE
  - LL_RCC_LPTIM2_CLKSOURCE_PCLK1
  - LL_RCC_LPTIM2_CLKSOURCE_LSI
  - LL_RCC_LPTIM2_CLKSOURCE_HSI
  - LL_RCC_LPTIM2_CLKSOURCE_LSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR LPTIMxSEL LL_RCC_SetLPTIMClockSource

`LL_RCC_SetSAIClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetSAIClockSource (uint32_t SAIxSource)

Function description

Configure SAIx clock source.

Parameters

- **SAIxSource:** This parameter can be one of the following values:
  - LL_RCC_SAI1_CLKSOURCE_PLLSAI1
  - LL_RCC_SAI1_CLKSOURCE_PLLSAI2 (*)
  - LL_RCC_SAI1_CLKSOURCE_PLL
  - LL_RCC_SAI1_CLKSOURCE_PIN
  - LL_RCC_SAI2_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_SAI2_CLKSOURCE_PLLSAI2 (*)
  - LL_RCC_SAI2_CLKSOURCE_PLL (*)
  - LL_RCC_SAI2_CLKSOURCE_PIN (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 SAIxSEL LL_RCC_SetSAIClockSource

`LL_RCC_SetSDMMCKernelClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetSDMMCKernelClockSource (uint32_t SDMMCxSource)

Function description

Configure SDMMC1 kernel clock source.

Parameters

- **SDMMCxSource:** This parameter can be one of the following values:
  - LL_RCC_SDMMC1_KERNELCLKSOURCE_48CLK (*)
  - LL_RCC_SDMMC1_KERNELCLKSOURCE_PLLP (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 SDMMCSEL LL_RCC_SetSDMMCKernelClockSource

`LL_RCC_SetSDMMCClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetSDMMCClockSource (uint32_t SDMMCxSource)

Function description

Configure SDMMC1 clock source.

Parameters

- **SDMMCxSource:** This parameter can be one of the following values:
  - LL_RCC_SDMMC1_CLKSOURCE_NONE (*)
  - LL_RCC_SDMMC1_CLKSOURCE_HSI48 (*)
  - LL_RCC_SDMMC1_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_SDMMC1_CLKSOURCE_PLL
  - LL_RCC_SDMMC1_CLKSOURCE_MSI (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR CLK48SEL LL_RCC_SetSDMMCClockSource

`LL_RCC_SetRNGClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetRNGClockSource (uint32_t RNGxSource)

Function description

Configure RNG clock source.

Parameters

- **RNGxSource:** This parameter can be one of the following values:
  - LL_RCC_RNG_CLKSOURCE_NONE (*)
  - LL_RCC_RNG_CLKSOURCE_HSI48 (*)
  - LL_RCC_RNG_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_RNG_CLKSOURCE_PLL
  - LL_RCC_RNG_CLKSOURCE_MSI

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR CLK48SEL LL_RCC_SetRNGClockSource

`LL_RCC_SetUSBClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetUSBClockSource (uint32_t USBxSource)

Function description

Configure USB clock source.

Parameters

- **USBxSource:** This parameter can be one of the following values:
  - LL_RCC_USB_CLKSOURCE_NONE (*)
  - LL_RCC_USB_CLKSOURCE_HSI48 (*)
  - LL_RCC_USB_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_USB_CLKSOURCE_PLL
  - LL_RCC_USB_CLKSOURCE_MSI

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR CLK48SEL LL_RCC_SetUSBClockSource

`LL_RCC_SetADCClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetADCClockSource (uint32_t ADCxSource)

Function description

Configure ADC clock source.

Parameters

- **ADCxSource:** This parameter can be one of the following values:
  - LL_RCC_ADC_CLKSOURCE_NONE
  - LL_RCC_ADC_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_ADC_CLKSOURCE_PLLSAI2 (*)
  - LL_RCC_ADC_CLKSOURCE_SYSCLK

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR ADCSEL LL_RCC_SetADCClockSource

`LL_RCC_SetDFSDMAudioClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetDFSDMAudioClockSource (uint32_t Source)

Function description

Configure DFSDM Audio clock source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI1
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_HSI
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_MSI

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 ADFSDM1SEL LL_RCC_SetDFSDMAudioClockSource

`LL_RCC_SetDFSDMClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetDFSDMClockSource (uint32_t DFSDMxSource)

Function description

Configure DFSDM Kernel clock source.

Parameters

- **DFSDMxSource:** This parameter can be one of the following values:
  - LL_RCC_DFSDM1_CLKSOURCE_PCLK2
  - LL_RCC_DFSDM1_CLKSOURCE_SYSCLK

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 DFSDM1SEL LL_RCC_SetDFSDMClockSource

`LL_RCC_SetDSIClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetDSIClockSource (uint32_t Source)

Function description

Configure DSI clock source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_DSI_CLKSOURCE_PHY
  - LL_RCC_DSI_CLKSOURCE_PLL

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 DSISEL LL_RCC_SetDSIClockSource

`LL_RCC_SetLTDCClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetLTDCClockSource (uint32_t Source)

Function description

Configure LTDC Clock Source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV2
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV4
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV8
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV16

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 PLLSAI2DIVR LL_RCC_SetLTDCClockSource

LL_RCC_SetOCTOSPIClockSource

Function name

__STATIC_INLINE void LL_RCC_SetOCTOSPIClockSource (uint32_t Source)

Function description

Configure OCTOSPI clock source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_OCTOSPI_CLKSOURCE_SYSCLK
  - LL_RCC_OCTOSPI_CLKSOURCE_MSI
  - LL_RCC_OCTOSPI_CLKSOURCE_PLL

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCIPR2 OSPISEL LL_RCC_SetOCTOSPIClockSource

LL_RCC_GetUSARTClockSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetUSARTClockSource (uint32_t USARTx)

Function description

Get USARTx clock source.

Parameters

- **USARTx:** This parameter can be one of the following values:
  - LL_RCC_USART1_CLKSOURCE
  - LL_RCC_USART2_CLKSOURCE
  - LL_RCC_USART3_CLKSOURCE (*)

  (*) value not defined in all devices.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_USART1_CLKSOURCE_PCLK2
  - LL_RCC_USART1_CLKSOURCE_SYSCLK
  - LL_RCC_USART1_CLKSOURCE_HSI
  - LL_RCC_USART1_CLKSOURCE_LSE
  - LL_RCC_USART2_CLKSOURCE_PCLK1
  - LL_RCC_USART2_CLKSOURCE_SYSCLK
  - LL_RCC_USART2_CLKSOURCE_HSI
  - LL_RCC_USART2_CLKSOURCE_LSE
  - LL_RCC_USART3_CLKSOURCE_PCLK1 (*)
  - LL_RCC_USART3_CLKSOURCE_SYSCLK (*)
  - LL_RCC_USART3_CLKSOURCE_HSI (*)
  - LL_RCC_USART3_CLKSOURCE_LSE (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR USARTxSEL LL_RCC_GetUSARTClockSource

`LL_RCC_GetUARTClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetUARTClockSource (uint32_t UARTx)

Function description

Get UARTx clock source.

Parameters

- **UARTx:** This parameter can be one of the following values:
  - LL_RCC_UART4_CLKSOURCE
  - LL_RCC_UART5_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_UART4_CLKSOURCE_PCLK1
  - LL_RCC_UART4_CLKSOURCE_SYSCLK
  - LL_RCC_UART4_CLKSOURCE_HSI
  - LL_RCC_UART4_CLKSOURCE_LSE
  - LL_RCC_UART5_CLKSOURCE_PCLK1
  - LL_RCC_UART5_CLKSOURCE_SYSCLK
  - LL_RCC_UART5_CLKSOURCE_HSI
  - LL_RCC_UART5_CLKSOURCE_LSE

Reference Manual to LL API cross reference:

- CCIPR UARTxSEL LL_RCC_GetUARTClockSource

`LL_RCC_GetLPUARTClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetLPUARTClockSource (uint32_t LPUARTx)

Function description

Get LPUARTx clock source.

Parameters

- **LPUARTx:** This parameter can be one of the following values:
  - LL_RCC_LPUART1_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_LPUART1_CLKSOURCE_PCLK1
  - LL_RCC_LPUART1_CLKSOURCE_SYSCLK
  - LL_RCC_LPUART1_CLKSOURCE_HSI
  - LL_RCC_LPUART1_CLKSOURCE_LSE

Reference Manual to LL API cross reference:

- CCIPR LPUART1SEL LL_RCC_GetLPUARTClockSource

LL_RCC_GetI2CClockSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetI2CClockSource (uint32_t I2Cx)

Function description

Get I2Cx clock source.

Parameters

- **I2Cx:** This parameter can be one of the following values:
  - LL_RCC_I2C1_CLKSOURCE
  - LL_RCC_I2C2_CLKSOURCE (*)
  - LL_RCC_I2C3_CLKSOURCE
  - LL_RCC_I2C4_CLKSOURCE (*)

  (*) value not defined in all devices.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_I2C1_CLKSOURCE_PCLK1
  - LL_RCC_I2C1_CLKSOURCE_SYSCLK
  - LL_RCC_I2C1_CLKSOURCE_HSI
  - LL_RCC_I2C2_CLKSOURCE_PCLK1 (*)
  - LL_RCC_I2C2_CLKSOURCE_SYSCLK (*)
  - LL_RCC_I2C2_CLKSOURCE_HSI (*)
  - LL_RCC_I2C3_CLKSOURCE_PCLK1
  - LL_RCC_I2C3_CLKSOURCE_SYSCLK
  - LL_RCC_I2C3_CLKSOURCE_HSI
  - LL_RCC_I2C4_CLKSOURCE_PCLK1 (*)
  - LL_RCC_I2C4_CLKSOURCE_SYSCLK (*)
  - LL_RCC_I2C4_CLKSOURCE_HSI (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR I2CxSEL LL_RCC_GetI2CClockSource

`LL_RCC_GetLPTIMClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetLPTIMClockSource (uint32_t LPTIMx)

Function description

Get LPTIMx clock source.

Parameters

- **LPTIMx:** This parameter can be one of the following values:
  - LL_RCC_LPTIM1_CLKSOURCE
  - LL_RCC_LPTIM2_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_LPTIM1_CLKSOURCE_PCLK1
  - LL_RCC_LPTIM1_CLKSOURCE_LSI
  - LL_RCC_LPTIM1_CLKSOURCE_HSI
  - LL_RCC_LPTIM1_CLKSOURCE_LSE
  - LL_RCC_LPTIM2_CLKSOURCE_PCLK1
  - LL_RCC_LPTIM2_CLKSOURCE_LSI
  - LL_RCC_LPTIM2_CLKSOURCE_HSI
  - LL_RCC_LPTIM2_CLKSOURCE_LSE

Reference Manual to LL API cross reference:

- CCIPR LPTIMxSEL LL_RCC_GetLPTIMClockSource

`LL_RCC_GetSAIClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetSAIClockSource (uint32_t SAIx)

Function description

Get SAIx clock source.

Parameters

- **SAIx:** This parameter can be one of the following values:
  - LL_RCC_SAI1_CLKSOURCE
  - LL_RCC_SAI2_CLKSOURCE (*)

  (*) value not defined in all devices.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_SAI1_CLKSOURCE_PLLSAI1
  - LL_RCC_SAI1_CLKSOURCE_PLLSAI2 (*)
  - LL_RCC_SAI1_CLKSOURCE_PLL
  - LL_RCC_SAI1_CLKSOURCE_PIN
  - LL_RCC_SAI2_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_SAI2_CLKSOURCE_PLLSAI2 (*)
  - LL_RCC_SAI2_CLKSOURCE_PLL (*)
  - LL_RCC_SAI2_CLKSOURCE_PIN (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR2 SAIxSEL LL_RCC_GetSAIClockSource

`LL_RCC_GetSDMMCKernelClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetSDMMCKernelClockSource (uint32_t SDMMCx)

Function description

Get SDMMCx kernel clock source.

Parameters

- **SDMMCx:** This parameter can be one of the following values:
  - LL_RCC_SDMMC1_KERNELCLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_SDMMC1_KERNELCLKSOURCE_48CLK (*)
  - LL_RCC_SDMMC1_KERNELCLKSOURCE_PLL (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR2 SDMMCSEL LL_RCC_GetSDMMCKernelClockSource

`LL_RCC_GetSDMMCClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetSDMMCClockSource (uint32_t SDMMCx)

Function description

Get SDMMCx clock source.

Parameters

- **SDMMCx:** This parameter can be one of the following values:
  - LL_RCC_SDMMC1_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_SDMMC1_CLKSOURCE_NONE (*)
  - LL_RCC_SDMMC1_CLKSOURCE_HSI48 (*)
  - LL_RCC_SDMMC1_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_SDMMC1_CLKSOURCE_PLL
  - LL_RCC_SDMMC1_CLKSOURCE_MSI (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR CLK48SEL LL_RCC_GetSDMMCClockSource

`LL_RCC_GetRNGClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetRNGClockSource (uint32_t RNGx)

Function description

Get RNGx clock source.

Parameters

- **RNGx:** This parameter can be one of the following values:
  - LL_RCC_RNG_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_RNG_CLKSOURCE_NONE (*)
  - LL_RCC_RNG_CLKSOURCE_HSI48 (*)
  - LL_RCC_RNG_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_RNG_CLKSOURCE_PLL
  - LL_RCC_RNG_CLKSOURCE_MSI

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR CLK48SEL LL_RCC_GetRNGClockSource

LL_RCC_GetUSBClockSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetUSBClockSource (uint32_t USBx)

Function description

Get USBx clock source.

Parameters

- **USBx:** This parameter can be one of the following values:
  - LL_RCC_USB_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_USB_CLKSOURCE_NONE (*)
  - LL_RCC_USB_CLKSOURCE_HSI48 (*)
  - LL_RCC_USB_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_USB_CLKSOURCE_PLL
  - LL_RCC_USB_CLKSOURCE_MSI

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR CLK48SEL LL_RCC_GetUSBClockSource

LL_RCC_GetADCClockSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetADCClockSource (uint32_t ADCx)

Function description

Get ADCx clock source.

Parameters

- **ADCx:** This parameter can be one of the following values:
  - LL_RCC_ADC_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_ADC_CLKSOURCE_NONE
  - LL_RCC_ADC_CLKSOURCE_PLLSAI1 (*)
  - LL_RCC_ADC_CLKSOURCE_PLLSAI2 (*)
  - LL_RCC_ADC_CLKSOURCE_SYSCLK

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- CCIPR ADCSEL LL_RCC_GetADCClockSource

LL_RCC_GetDFSDMAudioClockSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetDFSDMAudioClockSource (uint32_t DFSDMx)

Function description

Get DFSDM Audio Clock Source.

Parameters

- **DFSDMx:** This parameter can be one of the following values:
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI1
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_HSI
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE_MSI

Reference Manual to LL API cross reference:

- CCIPR2 ADFSDM1SEL LL_RCC_GetDFSDMAudioClockSource

LL_RCC_GetDFSDMClockSource

Function name

__STATIC_INLINE uint32_t LL_RCC_GetDFSDMClockSource (uint32_t DFSDMx)

Function description

Get DFSDMx Kernel clock source.

Parameters

- **DFSDMx:** This parameter can be one of the following values:
  - LL_RCC_DFSDM1_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_DFSDM1_CLKSOURCE_PCLK2
  - LL_RCC_DFSDM1_CLKSOURCE_SYSCLK

Reference Manual to LL API cross reference:

- CCIPR2 DFSDM1SEL LL_RCC_GetDFSDMClockSource

`LL_RCC_GetDSIClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetDSIClockSource (uint32_t DSIx)

Function description

Get DSI Clock Source.

Parameters

- **DSIx:** This parameter can be one of the following values:
  - LL_RCC_DSI_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_DSI_CLKSOURCE_PHY
  - LL_RCC_DSI_CLKSOURCE_PLL

Reference Manual to LL API cross reference:

- CCIPR2 DSISEL LL_RCC_GetDSIClockSource

`LL_RCC_GetLTDCClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetLTDCClockSource (uint32_t LTDCx)

Function description

Get LTDC Clock Source.

Parameters

- **LTDCx:** This parameter can be one of the following values:
  - LL_RCC_LTDC_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV2
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV4
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV8
  - LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV16

Reference Manual to LL API cross reference:

- CCIPR2 PLLSAI2DIVR LL_RCC_GetLTDCClockSource

`LL_RCC_GetOCTOSPIClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetOCTOSPIClockSource (uint32_t OCTOSPIx)

Function description

Get OCTOSPI clock source.

Parameters

- **OCTOSPIx:** This parameter can be one of the following values:
  - LL_RCC_OCTOSPI_CLKSOURCE

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_OCTOSPI_CLKSOURCE_SYSCLK
  - LL_RCC_OCTOSPI_CLKSOURCE_MSI
  - LL_RCC_OCTOSPI_CLKSOURCE_PLL

Reference Manual to LL API cross reference:

- CCIPR2 OSPISEL LL_RCC_GetOCTOSPIClockSource

`LL_RCC_SetRTCClockSource`

Function name

__STATIC_INLINE void LL_RCC_SetRTCClockSource (uint32_t Source)

Function description

Set RTC Clock Source.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_RTC_CLKSOURCE_NONE
  - LL_RCC_RTC_CLKSOURCE_LSE
  - LL_RCC_RTC_CLKSOURCE_LSI
  - LL_RCC_RTC_CLKSOURCE_HSE_DIV32

Return values

- **None:**

Notes

- Once the RTC clock source has been selected, it cannot be changed anymore unless the Backup domain is reset, or unless a failure is detected on LSE (LSECSSD is set). The BDRST bit can be used to reset them.

Reference Manual to LL API cross reference:

- BDCR RTCSEL LL_RCC_SetRTCClockSource

`LL_RCC_GetRTCClockSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_GetRTCClockSource (void)

Function description

Get RTC Clock Source.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_RTC_CLKSOURCE_NONE
  - LL_RCC_RTC_CLKSOURCE_LSE
  - LL_RCC_RTC_CLKSOURCE_LSI
  - LL_RCC_RTC_CLKSOURCE_HSE_DIV32

Reference Manual to LL API cross reference:

- BDCR RTCSEL LL_RCC_GetRTCClockSource

`LL_RCC_EnableRTC`

Function name

__STATIC_INLINE void LL_RCC_EnableRTC (void)

Function description

Enable RTC.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR RTCEN LL_RCC_EnableRTC

`LL_RCC_DisableRTC`

Function name

__STATIC_INLINE void LL_RCC_DisableRTC (void)

Function description

Disable RTC.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR RTCEN LL_RCC_DisableRTC

`LL_RCC_IsEnabledRTC`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledRTC (void)

Function description

Check if RTC has been enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- BDCR RTCEN LL_RCC_IsEnabledRTC

`LL_RCC_ForceBackupDomainReset`

Function name

__STATIC_INLINE void LL_RCC_ForceBackupDomainReset (void)

Function description

Force the Backup domain reset.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR BDRST LL_RCC_ForceBackupDomainReset

`LL_RCC_ReleaseBackupDomainReset`

Function name

__STATIC_INLINE void LL_RCC_ReleaseBackupDomainReset (void)

Function description

Release the Backup domain reset.

Return values

- **None:**

Reference Manual to LL API cross reference:

- BDCR BDRST LL_RCC_ReleaseBackupDomainReset

`LL_RCC_PLL_Enable`

Function name

__STATIC_INLINE void LL_RCC_PLL_Enable (void)

Function description

Enable PLL.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLON LL_RCC_PLL_Enable

`LL_RCC_PLL_Disable`

Function name

__STATIC_INLINE void LL_RCC_PLL_Disable (void)

Function description

Disable PLL.

Return values

- **None:**

Notes

- Cannot be disabled if the PLL clock is used as the system clock

Reference Manual to LL API cross reference:

- CR PLLON LL_RCC_PLL_Disable

`LL_RCC_PLL_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_IsReady (void)

Function description

Check if PLL Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR PLLRDY LL_RCC_PLL_IsReady

`LL_RCC_PLL_ConfigDomain_SYS`

Function name

__STATIC_INLINE void LL_RCC_PLL_ConfigDomain_SYS (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLR)

Function description

Configure PLL used for SYSCLK Domain.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)

  (*) value not defined in all devices.
- **PLLN:** Between 8 and 86
- **PLLR:** This parameter can be one of the following values:
  - LL_RCC_PLLR_DIV_2
  - LL_RCC_PLLR_DIV_4
  - LL_RCC_PLLR_DIV_6
  - LL_RCC_PLLR_DIV_8

Return values

- **None:**

Notes

- PLL Source and PLLM Divider can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLN/PLLR can be written only when PLL is disabled.

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLL_ConfigDomain_SYS
- PLLCFGR PLLM LL_RCC_PLL_ConfigDomain_SYS
- PLLCFGR PLLN LL_RCC_PLL_ConfigDomain_SYS
- PLLCFGR PLLR LL_RCC_PLL_ConfigDomain_SYS

`LL_RCC_PLL_ConfigDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLL_ConfigDomain_SAI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLP)

Function description

Configure PLL used for SAI domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)

  (*) value not defined in all devices.
- **PLLN:** Between 8 and 86
- **PLLP:** This parameter can be one of the following values:
  - LL_RCC_PLLP_DIV_2
  - LL_RCC_PLLP_DIV_3
  - LL_RCC_PLLP_DIV_4
  - LL_RCC_PLLP_DIV_5
  - LL_RCC_PLLP_DIV_6
  - LL_RCC_PLLP_DIV_7
  - LL_RCC_PLLP_DIV_8
  - LL_RCC_PLLP_DIV_9
  - LL_RCC_PLLP_DIV_10
  - LL_RCC_PLLP_DIV_11
  - LL_RCC_PLLP_DIV_12
  - LL_RCC_PLLP_DIV_13
  - LL_RCC_PLLP_DIV_14
  - LL_RCC_PLLP_DIV_15
  - LL_RCC_PLLP_DIV_16
  - LL_RCC_PLLP_DIV_17
  - LL_RCC_PLLP_DIV_18
  - LL_RCC_PLLP_DIV_19
  - LL_RCC_PLLP_DIV_20
  - LL_RCC_PLLP_DIV_21
  - LL_RCC_PLLP_DIV_22
  - LL_RCC_PLLP_DIV_23
  - LL_RCC_PLLP_DIV_24

- LL_RCC_PLLP_DIV_25
- LL_RCC_PLLP_DIV_26
- LL_RCC_PLLP_DIV_27
- LL_RCC_PLLP_DIV_28
- LL_RCC_PLLP_DIV_29
- LL_RCC_PLLP_DIV_30
- LL_RCC_PLLP_DIV_31

Return values

- **None:**

Notes

- PLL Source and PLLM Divider can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLN/PLLP can be written only when PLL is disabled.
- This can be selected for SAI1 or SAI2 (*)

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLL_ConfigDomain_SAI
- PLLCFGR PLLM LL_RCC_PLL_ConfigDomain_SAI
- PLLCFGR PLLN LL_RCC_PLL_ConfigDomain_SAI
- PLLCFGR PLLPDIV LL_RCC_PLL_ConfigDomain_SAI

`LL_RCC_PLL_ConfigDomain_48M`

Function name

__STATIC_INLINE void LL_RCC_PLL_ConfigDomain_48M (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLQ)

Function description

Configure PLL used for 48Mhz domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)

  (*) value not defined in all devices.
- **PLLN:** Between 8 and 86
- **PLLQ:** This parameter can be one of the following values:
  - LL_RCC_PLLQ_DIV_2
  - LL_RCC_PLLQ_DIV_4
  - LL_RCC_PLLQ_DIV_6
  - LL_RCC_PLLQ_DIV_8

Return values

- **None:**

Notes

- PLL Source and PLLM Divider can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLN/PLLQ can be written only when PLL is disabled.
- This can be selected for USB, RNG, SDMMC

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLL_ConfigDomain_48M
- PLLCFGR PLLM LL_RCC_PLL_ConfigDomain_48M
- PLLCFGR PLLN LL_RCC_PLL_ConfigDomain_48M
- PLLCFGR PLLQ LL_RCC_PLL_ConfigDomain_48M

`LL_RCC_PLL_SetMainSource`

Function name

__STATIC_INLINE void LL_RCC_PLL_SetMainSource (uint32_t PLLSource)

Function description

Configure PLL clock source.

Parameters

- **PLLSource:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLL_SetMainSource

`LL_RCC_PLL_GetMainSource`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_GetMainSource (void)

Function description

Get the oscillator used as PLL clock source.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLL_GetMainSource

`LL_RCC_PLL_GetN`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_GetN (void)

Function description

Get Main PLL multiplication factor for VCO.

Return values

- **Between:** 8 and 86

Reference Manual to LL API cross reference:

- PLLCFGR PLLN LL_RCC_PLL_GetN

`LL_RCC_PLL_GetP`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_GetP (void)

Function description

Get Main PLL division factor for PLLP.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLP_DIV_2
  - LL_RCC_PLLP_DIV_3
  - LL_RCC_PLLP_DIV_4
  - LL_RCC_PLLP_DIV_5
  - LL_RCC_PLLP_DIV_6
  - LL_RCC_PLLP_DIV_7
  - LL_RCC_PLLP_DIV_8
  - LL_RCC_PLLP_DIV_9
  - LL_RCC_PLLP_DIV_10
  - LL_RCC_PLLP_DIV_11
  - LL_RCC_PLLP_DIV_12
  - LL_RCC_PLLP_DIV_13
  - LL_RCC_PLLP_DIV_14
  - LL_RCC_PLLP_DIV_15
  - LL_RCC_PLLP_DIV_16
  - LL_RCC_PLLP_DIV_17
  - LL_RCC_PLLP_DIV_18
  - LL_RCC_PLLP_DIV_19
  - LL_RCC_PLLP_DIV_20
  - LL_RCC_PLLP_DIV_21
  - LL_RCC_PLLP_DIV_22
  - LL_RCC_PLLP_DIV_23
  - LL_RCC_PLLP_DIV_24
  - LL_RCC_PLLP_DIV_25
  - LL_RCC_PLLP_DIV_26
  - LL_RCC_PLLP_DIV_27
  - LL_RCC_PLLP_DIV_28
  - LL_RCC_PLLP_DIV_29
  - LL_RCC_PLLP_DIV_30
  - LL_RCC_PLLP_DIV_31

Notes

- Used for PLLSAI3CLK (SAI1 and SAI2 clock)

Reference Manual to LL API cross reference:

- PLLCFGR PLLPDIV LL_RCC_PLL_GetP

LL_RCC_PLL_GetQ

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_GetQ (void)

Function description

Get Main PLL division factor for PLLQ.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLQ_DIV_2
  - LL_RCC_PLLQ_DIV_4
  - LL_RCC_PLLQ_DIV_6
  - LL_RCC_PLLQ_DIV_8

Notes

- Used for PLL48M1CLK selected for USB, RNG, SDMMC (48 MHz clock)

Reference Manual to LL API cross reference:

- PLLCFGR PLLQ LL_RCC_PLL_GetQ

LL_RCC_PLL_GetR

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_GetR (void)

Function description

Get Main PLL division factor for PLLR.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLR_DIV_2
  - LL_RCC_PLLR_DIV_4
  - LL_RCC_PLLR_DIV_6
  - LL_RCC_PLLR_DIV_8

Notes

- Used for PLLCLK (system clock)

Reference Manual to LL API cross reference:

- PLLCFGR PLLR LL_RCC_PLL_GetR

LL_RCC_PLL_GetDivider

Function name

__STATIC_INLINE uint32_t LL_RCC_PLL_GetDivider (void)

Function description

Get Division factor for the main PLL and other PLL.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- PLLCFGR PLLM LL_RCC_PLL_GetDivider

LL_RCC_PLL_EnableDomain_SAI

Function name

__STATIC_INLINE void LL_RCC_PLL_EnableDomain_SAI (void)

Function description

Enable PLL output mapped on SAI domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLCFGR PLLPEN LL_RCC_PLL_EnableDomain_SAI

LL_RCC_PLL_DisableDomain_SAI

Function name

__STATIC_INLINE void LL_RCC_PLL_DisableDomain_SAI (void)

Function description

Disable PLL output mapped on SAI domain clock.

Return values

- **None:**

Notes

- Cannot be disabled if the PLL clock is used as the system clock
- In order to save power, when the PLLCLK of the PLL is not used, should be 0

Reference Manual to LL API cross reference:

- PLLCFGR PLLPEN LL_RCC_PLL_DisableDomain_SAI

`LL_RCC_PLL_EnableDomain_48M`

Function name

__STATIC_INLINE void LL_RCC_PLL_EnableDomain_48M (void)

Function description

Enable PLL output mapped on 48MHz domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLCFGR PLLQEN LL_RCC_PLL_EnableDomain_48M

`LL_RCC_PLL_DisableDomain_48M`

Function name

__STATIC_INLINE void LL_RCC_PLL_DisableDomain_48M (void)

Function description

Disable PLL output mapped on 48MHz domain clock.

Return values

- **None:**

Notes

- Cannot be disabled if the PLL clock is used as the system clock
- In order to save power, when the PLLCLK of the PLL is not used, should be 0

Reference Manual to LL API cross reference:

- PLLCFGR PLLQEN LL_RCC_PLL_DisableDomain_48M

`LL_RCC_PLL_EnableDomain_SYS`

Function name

__STATIC_INLINE void LL_RCC_PLL_EnableDomain_SYS (void)

Function description

Enable PLL output mapped on SYSCLK domain.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLCFGR PLLREN LL_RCC_PLL_EnableDomain_SYS

`LL_RCC_PLL_DisableDomain_SYS`

Function name

__STATIC_INLINE void LL_RCC_PLL_DisableDomain_SYS (void)

Function description

Disable PLL output mapped on SYSCLK domain.

Return values

- **None:**

Notes

- Cannot be disabled if the PLL clock is used as the system clock
- In order to save power, when the PLLCLK of the PLL is not used, Main PLL should be 0

Reference Manual to LL API cross reference:

- PLLCFGR PLLREN LL_RCC_PLL_DisableDomain_SYS

`LL_RCC_PLLSAI1_Enable`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_Enable (void)

Function description

Enable PLLSAI1.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLSAI1ON LL_RCC_PLLSAI1_Enable

`LL_RCC_PLLSAI1_Disable`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_Disable (void)

Function description

Disable PLLSAI1.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLSAI1ON LL_RCC_PLLSAI1_Disable

`LL_RCC_PLLSAI1_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI1_IsReady (void)

Function description

Check if PLLSAI1 Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR PLLSAI1RDY LL_RCC_PLLSAI1_IsReady

`LL_RCC_PLLSAI1_ConfigDomain_48M`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_ConfigDomain_48M (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLQ)

Function description

Configure PLLSAI1 used for 48Mhz domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16
- **PLLN:** Between 8 and 86
- **PLLQ:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI1Q_DIV_2
  - LL_RCC_PLLSAI1Q_DIV_4
  - LL_RCC_PLLSAI1Q_DIV_6
  - LL_RCC_PLLSAI1Q_DIV_8

Return values

- **None:**

Notes

- PLL Source can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLSAI1M/PLLSAI1N/PLLSAI1Q can be written only when PLLSAI1 is disabled.
- This can be selected for USB, RNG, SDMMC

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI1_ConfigDomain_48M
- PLLSAI1CFGR PLLSAI1M LL_RCC_PLLSAI1_ConfigDomain_48M
- PLLSAI1CFGR PLLSAI1N LL_RCC_PLLSAI1_ConfigDomain_48M
- PLLSAI1CFGR PLLSAI1Q LL_RCC_PLLSAI1_ConfigDomain_48M

`LL_RCC_PLLSAI1_ConfigDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_ConfigDomain_SAI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLP)

Function description

Configure PLLSAI1 used for SAI domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16
- **PLLN:** Between 8 and 86
- **PLLP:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI1P_DIV_2
  - LL_RCC_PLLSAI1P_DIV_3
  - LL_RCC_PLLSAI1P_DIV_4
  - LL_RCC_PLLSAI1P_DIV_5
  - LL_RCC_PLLSAI1P_DIV_6
  - LL_RCC_PLLSAI1P_DIV_7
  - LL_RCC_PLLSAI1P_DIV_8
  - LL_RCC_PLLSAI1P_DIV_9
  - LL_RCC_PLLSAI1P_DIV_10
  - LL_RCC_PLLSAI1P_DIV_11
  - LL_RCC_PLLSAI1P_DIV_12
  - LL_RCC_PLLSAI1P_DIV_13
  - LL_RCC_PLLSAI1P_DIV_14
  - LL_RCC_PLLSAI1P_DIV_15
  - LL_RCC_PLLSAI1P_DIV_16
  - LL_RCC_PLLSAI1P_DIV_17
  - LL_RCC_PLLSAI1P_DIV_18
  - LL_RCC_PLLSAI1P_DIV_19
  - LL_RCC_PLLSAI1P_DIV_20
  - LL_RCC_PLLSAI1P_DIV_21
  - LL_RCC_PLLSAI1P_DIV_22
  - LL_RCC_PLLSAI1P_DIV_23
  - LL_RCC_PLLSAI1P_DIV_24
  - LL_RCC_PLLSAI1P_DIV_25

- LL_RCC_PLLSAI1P_DIV_26
- LL_RCC_PLLSAI1P_DIV_27
- LL_RCC_PLLSAI1P_DIV_28
- LL_RCC_PLLSAI1P_DIV_29
- LL_RCC_PLLSAI1P_DIV_30
- LL_RCC_PLLSAI1P_DIV_31

Return values

- **None:**

Notes

- PLL Source can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLSAI1M/PLLSAI1N/PLLSAI1PDIV can be written only when PLLSAI1 is disabled.
- This can be selected for SAI1 or SAI2

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI1_ConfigDomain_SAI
- PLLSAI1CFGR PLLSAI1M LL_RCC_PLLSAI1_ConfigDomain_SAI
- PLLSAI1CFGR PLLSAI1N LL_RCC_PLLSAI1_ConfigDomain_SAI
- PLLSAI1CFGR PLLSAI1PDIV LL_RCC_PLLSAI1_ConfigDomain_SAI

`LL_RCC_PLLSAI1_ConfigDomain_ADC`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_ConfigDomain_ADC (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLR)

Function description

Configure PLLSAI1 used for ADC domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16
- **PLLN:** Between 8 and 86
- **PLLR:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI1R_DIV_2
  - LL_RCC_PLLSAI1R_DIV_4
  - LL_RCC_PLLSAI1R_DIV_6
  - LL_RCC_PLLSAI1R_DIV_8

Return values

- **None:**

Notes

- PLL Source can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLSAI1M/PLLSAI1N/PLLSAI1R can be written only when PLLSAI1 is disabled.
- This can be selected for ADC

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI1_ConfigDomain_ADC
- PLLSAI1CFGR PLLSAI1M LL_RCC_PLLSAI1_ConfigDomain_ADC
- PLLSAI1CFGR PLLSAI1N LL_RCC_PLLSAI1_ConfigDomain_ADC
- PLLSAI1CFGR PLLSAI1R LL_RCC_PLLSAI1_ConfigDomain_ADC

`LL_RCC_PLLSAI1_GetN`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI1_GetN (void)

Function description

Get SAI1PLL multiplication factor for VCO.

Return values

- **Between:** 8 and 86

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1N LL_RCC_PLLSAI1_GetN

`LL_RCC_PLLSAI1_GetP`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI1_GetP (void)

Function description

Get SAI1PLL division factor for PLLSAI1P.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI1P_DIV_2
  - LL_RCC_PLLSAI1P_DIV_3
  - LL_RCC_PLLSAI1P_DIV_4
  - LL_RCC_PLLSAI1P_DIV_5
  - LL_RCC_PLLSAI1P_DIV_6
  - LL_RCC_PLLSAI1P_DIV_7
  - LL_RCC_PLLSAI1P_DIV_8
  - LL_RCC_PLLSAI1P_DIV_9
  - LL_RCC_PLLSAI1P_DIV_10
  - LL_RCC_PLLSAI1P_DIV_11
  - LL_RCC_PLLSAI1P_DIV_12
  - LL_RCC_PLLSAI1P_DIV_13
  - LL_RCC_PLLSAI1P_DIV_14
  - LL_RCC_PLLSAI1P_DIV_15
  - LL_RCC_PLLSAI1P_DIV_16
  - LL_RCC_PLLSAI1P_DIV_17
  - LL_RCC_PLLSAI1P_DIV_18
  - LL_RCC_PLLSAI1P_DIV_19
  - LL_RCC_PLLSAI1P_DIV_20
  - LL_RCC_PLLSAI1P_DIV_21
  - LL_RCC_PLLSAI1P_DIV_22
  - LL_RCC_PLLSAI1P_DIV_23
  - LL_RCC_PLLSAI1P_DIV_24
  - LL_RCC_PLLSAI1P_DIV_25
  - LL_RCC_PLLSAI1P_DIV_26
  - LL_RCC_PLLSAI1P_DIV_27
  - LL_RCC_PLLSAI1P_DIV_28
  - LL_RCC_PLLSAI1P_DIV_29
  - LL_RCC_PLLSAI1P_DIV_30
  - LL_RCC_PLLSAI1P_DIV_31

Notes

- Used for PLLSAI1CLK (SAI1 or SAI2 (*) clock).

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1PDIV LL_RCC_PLLSAI1_GetP

`LL_RCC_PLLSAI1_GetQ`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI1_GetQ (void)

Function description

Get SAI1PLL division factor for PLLSAI1Q.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI1Q_DIV_2
  - LL_RCC_PLLSAI1Q_DIV_4
  - LL_RCC_PLLSAI1Q_DIV_6
  - LL_RCC_PLLSAI1Q_DIV_8

Notes

- Used PLL48M2CLK selected for USB, RNG, SDMMC (48 MHz clock)

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1Q LL_RCC_PLLSAI1_GetQ

`LL_RCC_PLLSAI1_GetR`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI1_GetR (void)

Function description

Get PLLSAI1 division factor for PLLSAIR.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI1R_DIV_2
  - LL_RCC_PLLSAI1R_DIV_4
  - LL_RCC_PLLSAI1R_DIV_6
  - LL_RCC_PLLSAI1R_DIV_8

Notes

- Used for PLLADC1CLK (ADC clock)

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1R LL_RCC_PLLSAI1_GetR

`LL_RCC_PLLSAI1_GetDivider`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI1_GetDivider (void)

Function description

Get Division factor for the PLLSAI1.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1M LL_RCC_PLLSAI1_GetDivider

`LL_RCC_PLLSAI1_EnableDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_EnableDomain_SAI (void)

Function description

Enable PLLSAI1 output mapped on SAI domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1PEN LL_RCC_PLLSAI1_EnableDomain_SAI

`LL_RCC_PLLSAI1_DisableDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_DisableDomain_SAI (void)

Function description

Disable PLLSAI1 output mapped on SAI domain clock.

Return values

- **None:**

Notes

- In order to save power, when of the PLLSAI1 is not used, should be 0

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1PEN LL_RCC_PLLSAI1_DisableDomain_SAI

`LL_RCC_PLLSAI1_EnableDomain_48M`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_EnableDomain_48M (void)

Function description

Enable PLLSAI1 output mapped on 48MHz domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1QEN LL_RCC_PLLSAI1_EnableDomain_48M

`LL_RCC_PLLSAI1_DisableDomain_48M`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_DisableDomain_48M (void)

Function description

Disable PLLSAI1 output mapped on 48MHz domain clock.

Return values

- **None:**

Notes

- In order to save power, when of the PLLSAI1 is not used, should be 0

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1QEN LL_RCC_PLLSAI1_DisableDomain_48M

`LL_RCC_PLLSAI1_EnableDomain_ADC`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_EnableDomain_ADC (void)

Function description

Enable PLLSAI1 output mapped on ADC domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1REN LL_RCC_PLLSAI1_EnableDomain_ADC

`LL_RCC_PLLSAI1_DisableDomain_ADC`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI1_DisableDomain_ADC (void)

Function description

Disable PLLSAI1 output mapped on ADC domain clock.

Return values

- **None:**

Notes

- In order to save power, when of the PLLSAI1 is not used, Main PLLSAI1 should be 0

Reference Manual to LL API cross reference:

- PLLSAI1CFGR PLLSAI1REN LL_RCC_PLLSAI1_DisableDomain_ADC

`LL_RCC_PLLSAI2_Enable`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_Enable (void)

Function description

Enable PLLSAI2.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLSAI2ON LL_RCC_PLLSAI2_Enable

`LL_RCC_PLLSAI2_Disable`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_Disable (void)

Function description

Disable PLLSAI2.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR PLLSAI2ON LL_RCC_PLLSAI2_Disable

`LL_RCC_PLLSAI2_IsReady`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_IsReady (void)

Function description

Check if PLLSAI2 Ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR PLLSAI2RDY LL_RCC_PLLSAI2_IsReady

`LL_RCC_PLLSAI2_ConfigDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_ConfigDomain_SAI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLP)

Function description

Configure PLLSAI2 used for SAI domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16
- **PLLN:** Between 8 and 86
- **PLLP:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2P_DIV_2
  - LL_RCC_PLLSAI2P_DIV_3
  - LL_RCC_PLLSAI2P_DIV_4
  - LL_RCC_PLLSAI2P_DIV_5
  - LL_RCC_PLLSAI2P_DIV_6
  - LL_RCC_PLLSAI2P_DIV_7
  - LL_RCC_PLLSAI2P_DIV_8
  - LL_RCC_PLLSAI2P_DIV_9
  - LL_RCC_PLLSAI2P_DIV_10
  - LL_RCC_PLLSAI2P_DIV_11
  - LL_RCC_PLLSAI2P_DIV_12
  - LL_RCC_PLLSAI2P_DIV_13
  - LL_RCC_PLLSAI2P_DIV_14
  - LL_RCC_PLLSAI2P_DIV_15
  - LL_RCC_PLLSAI2P_DIV_16
  - LL_RCC_PLLSAI2P_DIV_17
  - LL_RCC_PLLSAI2P_DIV_18
  - LL_RCC_PLLSAI2P_DIV_19
  - LL_RCC_PLLSAI2P_DIV_20
  - LL_RCC_PLLSAI2P_DIV_21
  - LL_RCC_PLLSAI2P_DIV_22
  - LL_RCC_PLLSAI2P_DIV_23
  - LL_RCC_PLLSAI2P_DIV_24
  - LL_RCC_PLLSAI2P_DIV_25

- LL_RCC_PLLSAI2P_DIV_26
- LL_RCC_PLLSAI2P_DIV_27
- LL_RCC_PLLSAI2P_DIV_28
- LL_RCC_PLLSAI2P_DIV_29
- LL_RCC_PLLSAI2P_DIV_30
- LL_RCC_PLLSAI2P_DIV_31

Return values

- **None:**

Notes

- PLL Source can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLSAI2M/PLLSAI2N/PLLSAI2PDIV can be written only when PLLSAI2 is disabled.
- This can be selected for SAI1 or SAI2

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI2_ConfigDomain_SAI
- PLLSAI2CFGR PLLSAI2M LL_RCC_PLLSAI2_ConfigDomain_SAI
- PLLSAI2CFGR PLLSAI2N LL_RCC_PLLSAI2_ConfigDomain_SAI
- PLLSAI2CFGR PLLSAI2PDIV LL_RCC_PLLSAI2_ConfigDomain_SAI

`LL_RCC_PLLSAI2_ConfigDomain_DSI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_ConfigDomain_DSI (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLQ)

Function description

Configure PLLSAI2 used for DSI domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16
- **PLLN:** Between 8 and 86
- **PLLQ:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2Q_DIV_2
  - LL_RCC_PLLSAI2Q_DIV_4
  - LL_RCC_PLLSAI2Q_DIV_6
  - LL_RCC_PLLSAI2Q_DIV_8

Return values

- **None:**

Notes

- PLL Source can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLSAI2M/PLLSAI2N/PLLSAI2Q can be written only when PLLSAI2 is disabled.
- This can be selected for DSI

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI2_ConfigDomain_DSI
- PLLSAI2CFGR PLLSAI2M LL_RCC_PLLSAI2_ConfigDomain_DSI
- PLLSAI2CFGR PLLSAI2N LL_RCC_PLLSAI2_ConfigDomain_DSI
- PLLSAI2CFGR PLLSAI2Q LL_RCC_PLLSAI2_ConfigDomain_DSI

LL_RCC_PLLSAI2_ConfigDomain_LTDC

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_ConfigDomain_LTDC (uint32_t Source, uint32_t PLLM, uint32_t PLLN, uint32_t PLLR, uint32_t PLLDIVR)

Function description

Configure PLLSAI2 used for LTDC domain clock.

Parameters

- **Source:** This parameter can be one of the following values:
  - LL_RCC_PLLSOURCE_NONE
  - LL_RCC_PLLSOURCE_MSI
  - LL_RCC_PLLSOURCE_HSI
  - LL_RCC_PLLSOURCE_HSE
- **PLLM:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16
- **PLLN:** Between 8 and 86
- **PLLR:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2R_DIV_2
  - LL_RCC_PLLSAI2R_DIV_4
  - LL_RCC_PLLSAI2R_DIV_6
  - LL_RCC_PLLSAI2R_DIV_8
- **PLLDIVR:** This parameter can be one of the following values:
  - LL_RCC_PLLSAI2DIVR_DIV_2
  - LL_RCC_PLLSAI2DIVR_DIV_4
  - LL_RCC_PLLSAI2DIVR_DIV_8
  - LL_RCC_PLLSAI2DIVR_DIV_16

Return values

- **None:**

Notes

- PLL Source can be written only when PLL, PLLSAI1 and PLLSAI2 (*) are disabled.
- PLLSAI2M/PLLSAI2N/PLLSAI2R can be written only when PLLSAI2 is disabled.
- This can be selected for LTDC

Reference Manual to LL API cross reference:

- PLLCFGR PLLSRC LL_RCC_PLLSAI2_ConfigDomain_LTDC
- PLLSAI2CFGR PLLSAI2M LL_RCC_PLLSAI2_ConfigDomain_LTDC
- PLLSAI2CFGR PLLSAI2N LL_RCC_PLLSAI2_ConfigDomain_LTDC
- PLLSAI2CFGR PLLSAI2R LL_RCC_PLLSAI2_ConfigDomain_LTDC
- CCIPR2 PLLSAI2DIVR LL_RCC_PLLSAI2_ConfigDomain_LTDC

`LL_RCC_PLLSAI2_GetN`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_GetN (void)

Function description

Get SAI2PLL multiplication factor for VCO.

Return values

- **Between:** 8 and 86

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2N LL_RCC_PLLSAI2_GetN

`LL_RCC_PLLSAI2_GetP`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_GetP (void)

Function description

Get SAI2PLL division factor for PLLSAI2P.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI2P_DIV_2
  - LL_RCC_PLLSAI2P_DIV_3
  - LL_RCC_PLLSAI2P_DIV_4
  - LL_RCC_PLLSAI2P_DIV_5
  - LL_RCC_PLLSAI2P_DIV_6
  - LL_RCC_PLLSAI2P_DIV_7
  - LL_RCC_PLLSAI2P_DIV_8
  - LL_RCC_PLLSAI2P_DIV_9
  - LL_RCC_PLLSAI2P_DIV_10
  - LL_RCC_PLLSAI2P_DIV_11
  - LL_RCC_PLLSAI2P_DIV_12
  - LL_RCC_PLLSAI2P_DIV_13
  - LL_RCC_PLLSAI2P_DIV_14
  - LL_RCC_PLLSAI2P_DIV_15
  - LL_RCC_PLLSAI2P_DIV_16
  - LL_RCC_PLLSAI2P_DIV_17
  - LL_RCC_PLLSAI2P_DIV_18
  - LL_RCC_PLLSAI2P_DIV_19
  - LL_RCC_PLLSAI2P_DIV_20
  - LL_RCC_PLLSAI2P_DIV_21
  - LL_RCC_PLLSAI2P_DIV_22
  - LL_RCC_PLLSAI2P_DIV_23
  - LL_RCC_PLLSAI2P_DIV_24
  - LL_RCC_PLLSAI2P_DIV_25
  - LL_RCC_PLLSAI2P_DIV_26
  - LL_RCC_PLLSAI2P_DIV_27
  - LL_RCC_PLLSAI2P_DIV_28
  - LL_RCC_PLLSAI2P_DIV_29
  - LL_RCC_PLLSAI2P_DIV_30
  - LL_RCC_PLLSAI2P_DIV_31

Notes

- Used for PLLSAI2CLK (SAI1 or SAI2 clock).

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2PDIV LL_RCC_PLLSAI2_GetP

LL_RCC_PLLSAI2_GetQ

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_GetQ (void)

Function description

Get division factor for PLLSAI2Q.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI2Q_DIV_2
  - LL_RCC_PLLSAI2Q_DIV_4
  - LL_RCC_PLLSAI2Q_DIV_6
  - LL_RCC_PLLSAI2Q_DIV_8

Notes

- Used for PLLDSICLK (DSI clock)

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2Q LL_RCC_PLLSAI2_GetQ

LL_RCC_PLLSAI2_GetR

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_GetR (void)

Function description

Get SAI2PLL division factor for PLLSAI2R.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI2R_DIV_2
  - LL_RCC_PLLSAI2R_DIV_4
  - LL_RCC_PLLSAI2R_DIV_6
  - LL_RCC_PLLSAI2R_DIV_8

Notes

- Used for PLLADC2CLK (ADC clock) or PLLLCDCLK (LTDC clock) depending on devices

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2R LL_RCC_PLLSAI2_GetR

LL_RCC_PLLSAI2_GetDivider

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_GetDivider (void)

Function description

Get Division factor for the PLLSAI2.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2M LL_RCC_PLLSAI2_GetDivider

`LL_RCC_PLLSAI2_GetDIVR`

Function name

__STATIC_INLINE uint32_t LL_RCC_PLLSAI2_GetDIVR (void)

Function description

Get PLLSAI2 division factor for PLLSAI2DIVR.

Return values

- **Returned:** value can be one of the following values:
  - LL_RCC_PLLSAI2DIVR_DIV_2
  - LL_RCC_PLLSAI2DIVR_DIV_4
  - LL_RCC_PLLSAI2DIVR_DIV_8
  - LL_RCC_PLLSAI2DIVR_DIV_16

Notes

- Used for LTDC domain clock

Reference Manual to LL API cross reference:

- CCIPR2 PLLSAI2DIVR LL_RCC_PLLSAI2_GetDIVR

`LL_RCC_PLLSAI2_EnableDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_EnableDomain_SAI (void)

Function description

Enable PLLSAI2 output mapped on SAI domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2PEN LL_RCC_PLLSAI2_EnableDomain_SAI

`LL_RCC_PLLSAI2_DisableDomain_SAI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_DisableDomain_SAI (void)

Function description

Disable PLLSAI2 output mapped on SAI domain clock.

Return values

- **None:**

Notes

- In order to save power, when of the PLLSAI2 is not used, should be 0

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2PEN LL_RCC_PLLSAI2_DisableDomain_SAI

`LL_RCC_PLLSAI2_EnableDomain_DSI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_EnableDomain_DSI (void)

Function description

Enable PLLSAI2 output mapped on DSI domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2QEN LL_RCC_PLLSAI2_EnableDomain_DSI

`LL_RCC_PLLSAI2_DisableDomain_DSI`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_DisableDomain_DSI (void)

Function description

Disable PLLSAI2 output mapped on DSI domain clock.

Return values

- **None:**

Notes

- In order to save power, when of the PLLSAI2 is not used, Main PLLSAI2 should be 0

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2QEN LL_RCC_PLLSAI2_DisableDomain_DSI

`LL_RCC_PLLSAI2_EnableDomain_LTDC`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_EnableDomain_LTDC (void)

Function description

Enable PLLSAI2 output mapped on LTDC domain clock.

Return values

- **None:**

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2REN LL_RCC_PLLSAI2_EnableDomain_LTDC

`LL_RCC_PLLSAI2_DisableDomain_LTDC`

Function name

__STATIC_INLINE void LL_RCC_PLLSAI2_DisableDomain_LTDC (void)

Function description

Disable PLLSAI2 output mapped on LTDC domain clock.

Return values

- **None:**

Notes

- In order to save power, when of the PLLSAI2 is not used, Main PLLSAI2 should be 0

Reference Manual to LL API cross reference:

- PLLSAI2CFGR PLLSAI2REN LL_RCC_PLLSAI2_DisableDomain_LTDC

`LL_RCC_OCTOSPI1_DelayConfig`

Function name

__STATIC_INLINE void LL_RCC_OCTOSPI1_DelayConfig (uint32_t Delay)

Function description

Configure OCTOSPI1 DQS delay.

Parameters

- **Delay:** OCTOSPI1 DQS delay between 0 and 15

Return values

- **None:**

Reference Manual to LL API cross reference:

- DLYCFGR OCTOSPI1_DLY LL_RCC_OCTOSPI1_DelayConfig

`LL_RCC_OCTOSPI2_DelayConfig`

Function name

__STATIC_INLINE void LL_RCC_OCTOSPI2_DelayConfig (uint32_t Delay)

Function description

Configure OCTOSPI2 DQS delay.

Parameters

- **Delay:** OCTOSPI2 DQS delay between 0 and 15

Return values

- **None:**

Reference Manual to LL API cross reference:

- DLYCFGR OCTOSPI2_DLY LL_RCC_OCTOSPI2_DelayConfig

`LL_RCC_ClearFlag_LSIRDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_LSIRDY (void)

Function description

Clear LSI ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR LSIRDYC LL_RCC_ClearFlag_LSIRDY

`LL_RCC_ClearFlag_LSERDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_LSERDY (void)

Function description

Clear LSE ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR LSERDYC LL_RCC_ClearFlag_LSERDY

`LL_RCC_ClearFlag_MSIRDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_MSIRDY (void)

Function description

Clear MSI ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR MSIRDYC LL_RCC_ClearFlag_MSIRDY

`LL_RCC_ClearFlag_HSIRDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_HSIRDY (void)

Function description

Clear HSI ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR HSIRDYC LL_RCC_ClearFlag_HSIRDY

`LL_RCC_ClearFlag_HSERDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_HSERDY (void)

Function description

Clear HSE ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR HSERDYC LL_RCC_ClearFlag_HSERDY

`LL_RCC_ClearFlag_PLLRDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_PLLRDY (void)

Function description

Clear PLL ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR PLLRDYC LL_RCC_ClearFlag_PLLRDY

`LL_RCC_ClearFlag_HSI48RDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_HSI48RDY (void)

Function description

Clear HSI48 ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR HSI48RDYC LL_RCC_ClearFlag_HSI48RDY

`LL_RCC_ClearFlag_PLLSAI1RDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_PLLSAI1RDY (void)

Function description

Clear PLLSAI1 ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR PLLSAI1RDYC LL_RCC_ClearFlag_PLLSAI1RDY

`LL_RCC_ClearFlag_PLLSAI2RDY`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_PLLSAI2RDY (void)

Function description

Clear PLLSAI1 ready interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR PLLSAI2RDYC LL_RCC_ClearFlag_PLLSAI2RDY

`LL_RCC_ClearFlag_HSECSS`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_HSECSS (void)

Function description

Clear Clock security system interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR CSSC LL_RCC_ClearFlag_HSECSS

`LL_RCC_ClearFlag_LSECSS`

Function name

__STATIC_INLINE void LL_RCC_ClearFlag_LSECSS (void)

Function description

Clear LSE Clock security system interrupt flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CICR LSECSSC LL_RCC_ClearFlag_LSECSS

`LL_RCC_IsActiveFlag_LSIRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LSIRDY (void)

Function description

Check if LSI ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR LSIRDYF LL_RCC_IsActiveFlag_LSIRDY

`LL_RCC_IsActiveFlag_LSERDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LSERDY (void)

Function description

Check if LSE ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR LSERDYF LL_RCC_IsActiveFlag_LSERDY

`LL_RCC_IsActiveFlag_MSIRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_MSIRDY (void)

Function description

Check if MSI ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR MSIRDYF LL_RCC_IsActiveFlag_MSIRDY

`LL_RCC_IsActiveFlag_HSIRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSIRDY (void)

Function description

Check if HSI ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR HSIRDYF LL_RCC_IsActiveFlag_HSIRDY

`LL_RCC_IsActiveFlag_HSERDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSERDY (void)

Function description

Check if HSE ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR HSERDYF LL_RCC_IsActiveFlag_HSERDY

`LL_RCC_IsActiveFlag_PLLRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PLLRDY (void)

Function description

Check if PLL ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR PLLRDYF LL_RCC_IsActiveFlag_PLLRDY

`LL_RCC_IsActiveFlag_HSI48RDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSI48RDY (void)

Function description

Check if HSI48 ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIR HSI48RDYF LL_RCC_IsActiveFlag_HSI48RDY

`LL_RCC_IsActiveFlag_PLLSAI1RDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PLLSAI1RDY (void)

Function description

Check if PLLSAI1 ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR PLLSAI1RDYF LL_RCC_IsActiveFlag_PLLSAI1RDY

`LL_RCC_IsActiveFlag_PLLSAI2RDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PLLSAI2RDY (void)

Function description

Check if PLLSAI1 ready interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR PLLSAI2RDYF LL_RCC_IsActiveFlag_PLLSAI2RDY

`LL_RCC_IsActiveFlag_HSECSS`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_HSECSS (void)

Function description

Check if Clock security system interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR CSSF LL_RCC_IsActiveFlag_HSECSS

`LL_RCC_IsActiveFlag_LSECSS`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LSECSS (void)

Function description

Check if LSE Clock security system interrupt occurred or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIFR LSECSSF LL_RCC_IsActiveFlag_LSECSS

`LL_RCC_IsActiveFlag_FWRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_FWRST (void)

Function description

Check if RCC flag FW reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR FWRSTF LL_RCC_IsActiveFlag_FWRST

`LL_RCC_IsActiveFlag_IWDGRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_IWDGRST (void)

Function description

Check if RCC flag Independent Watchdog reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR IWDGRSTF LL_RCC_IsActiveFlag_IWDGRST

`LL_RCC_IsActiveFlag_LPWRRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_LPWRRST (void)

Function description

Check if RCC flag Low Power reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR LPWRRSTF LL_RCC_IsActiveFlag_LPWRRST

`LL_RCC_IsActiveFlag_OBLRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_OBLRST (void)

Function description

Check if RCC flag is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR OBLRSTF LL_RCC_IsActiveFlag_OBLRST

`LL_RCC_IsActiveFlag_PINRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PINRST (void)

Function description

Check if RCC flag Pin reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR PINRSTF LL_RCC_IsActiveFlag_PINRST

`LL_RCC_IsActiveFlag_SFTRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_SFTRST (void)

Function description

Check if RCC flag Software reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR SFTRSTF LL_RCC_IsActiveFlag_SFTRST

`LL_RCC_IsActiveFlag_WWDGRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_WWDGRST (void)

Function description

Check if RCC flag Window Watchdog reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR WWDGRSTF LL_RCC_IsActiveFlag_WWDGRST

`LL_RCC_IsActiveFlag_BORRST`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_BORRST (void)

Function description

Check if RCC flag BOR reset is set or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CSR BORRSTF LL_RCC_IsActiveFlag_BORRST

`LL_RCC_ClearResetFlags`

Function name

__STATIC_INLINE void LL_RCC_ClearResetFlags (void)

Function description

Set RMVF bit to clear the reset flags.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CSR RMVF LL_RCC_ClearResetFlags

`LL_RCC_EnableIT_LSIRDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_LSIRDY (void)

Function description

Enable LSI ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER LSIRDYIE LL_RCC_EnableIT_LSIRDY

`LL_RCC_EnableIT_LSERDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_LSERDY (void)

Function description

Enable LSE ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER LSERDYIE LL_RCC_EnableIT_LSERDY

`LL_RCC_EnableIT_MSIRDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_MSIRDY (void)

Function description

Enable MSI ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER MSIRDYIE LL_RCC_EnableIT_MSIRDY

`LL_RCC_EnableIT_HSIRDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_HSIRDY (void)

Function description

Enable HSI ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER HSIRDYIE LL_RCC_EnableIT_HSIRDY

`LL_RCC_EnableIT_HSERDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_HSERDY (void)

Function description

Enable HSE ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER HSERDYIE LL_RCC_EnableIT_HSERDY

`LL_RCC_EnableIT_PLLRDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_PLLRDY (void)

Function description

Enable PLL ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER PLLRDYIE LL_RCC_EnableIT_PLLRDY

`LL_RCC_EnableIT_HSI48RDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_HSI48RDY (void)

Function description

Enable HSI48 ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER HSI48RDYIE LL_RCC_EnableIT_HSI48RDY

`LL_RCC_EnableIT_PLLSAI1RDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_PLLSAI1RDY (void)

Function description

Enable PLLSAI1 ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER PLLSAI1RDYIE LL_RCC_EnableIT_PLLSAI1RDY

`LL_RCC_EnableIT_PLLSAI2RDY`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_PLLSAI2RDY (void)

Function description

Enable PLLSAI2 ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER PLLSAI2RDYIE LL_RCC_EnableIT_PLLSAI2RDY

`LL_RCC_EnableIT_LSECSS`

Function name

__STATIC_INLINE void LL_RCC_EnableIT_LSECSS (void)

Function description

Enable LSE clock security system interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER LSECSSIE LL_RCC_EnableIT_LSECSS

`LL_RCC_DisableIT_LSIRDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_LSIRDY (void)

Function description

Disable LSI ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER LSIRDYIE LL_RCC_DisableIT_LSIRDY

`LL_RCC_DisableIT_LSERDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_LSERDY (void)

Function description

Disable LSE ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER LSERDYIE LL_RCC_DisableIT_LSERDY

`LL_RCC_DisableIT_MSIRDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_MSIRDY (void)

Function description

Disable MSI ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER MSIRDYIE LL_RCC_DisableIT_MSIRDY

`LL_RCC_DisableIT_HSIRDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_HSIRDY (void)

Function description

Disable HSI ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER HSIRDYIE LL_RCC_DisableIT_HSIRDY

`LL_RCC_DisableIT_HSERDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_HSERDY (void)

Function description

Disable HSE ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER HSERDYIE LL_RCC_DisableIT_HSERDY

`LL_RCC_DisableIT_PLLRDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_PLLRDY (void)

Function description

Disable PLL ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER PLLRDYIE LL_RCC_DisableIT_PLLRDY

`LL_RCC_DisableIT_HSI48RDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_HSI48RDY (void)

Function description

Disable HSI48 ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER HSI48RDYIE LL_RCC_DisableIT_HSI48RDY

`LL_RCC_DisableIT_PLLSAI1RDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_PLLSAI1RDY (void)

Function description

Disable PLLSAI1 ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER PLLSAI1RDYIE LL_RCC_DisableIT_PLLSAI1RDY

`LL_RCC_DisableIT_PLLSAI2RDY`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_PLLSAI2RDY (void)

Function description

Disable PLLSAI2 ready interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER PLLSAI2RDYIE LL_RCC_DisableIT_PLLSAI2RDY

`LL_RCC_DisableIT_LSECSS`

Function name

__STATIC_INLINE void LL_RCC_DisableIT_LSECSS (void)

Function description

Disable LSE clock security system interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- CIER LSECSSIE LL_RCC_DisableIT_LSECSS

`LL_RCC_IsEnabledIT_LSIRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_LSIRDY (void)

Function description

Checks if LSI ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER LSIRDYIE LL_RCC_IsEnabledIT_LSIRDY

`LL_RCC_IsEnabledIT_LSERDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_LSERDY (void)

Function description

Checks if LSE ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER LSERDYIE LL_RCC_IsEnabledIT_LSERDY

`LL_RCC_IsEnabledIT_MSIRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_MSIRDY (void)

Function description

Checks if MSI ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER MSIRDYIE LL_RCC_IsEnabledIT_MSIRDY

`LL_RCC_IsEnabledIT_HSIRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_HSIRDY (void)

Function description

Checks if HSI ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER HSIRDYIE LL_RCC_IsEnabledIT_HSIRDY

`LL_RCC_IsEnabledIT_HSERDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_HSERDY (void)

Function description

Checks if HSE ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER HSERDYIE LL_RCC_IsEnabledIT_HSERDY

`LL_RCC_IsEnabledIT_PLLRDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_PLLRDY (void)

Function description

Checks if PLL ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER PLLRDYIE LL_RCC_IsEnabledIT_PLLRDY

`LL_RCC_IsEnabledIT_HSI48RDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_HSI48RDY (void)

Function description

Checks if HSI48 ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER HSI48RDYIE LL_RCC_IsEnabledIT_HSI48RDY

`LL_RCC_IsEnabledIT_PLLSAI1RDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_PLLSAI1RDY (void)

Function description

Checks if PLLSAI1 ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER PLLSAI1RDYIE LL_RCC_IsEnabledIT_PLLSAI1RDY

`LL_RCC_IsEnabledIT_PLLSAI2RDY`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_PLLSAI2RDY (void)

Function description

Checks if PLLSAI2 ready interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER PLLSAI2RDYIE LL_RCC_IsEnabledIT_PLLSAI2RDY

`LL_RCC_IsEnabledIT_LSECSS`

Function name

__STATIC_INLINE uint32_t LL_RCC_IsEnabledIT_LSECSS (void)

Function description

Checks if LSECSS interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CIER LSECSSIE LL_RCC_IsEnabledIT_LSECSS

`LL_RCC_DeInit`

Function name

ErrorStatus LL_RCC_DeInit (void)

Function description

Reset the RCC clock configuration to the default reset state.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RCC registers are de-initialized
  - ERROR: not applicable

Notes

- The default reset state of the clock configuration is given below: MSI ON and used as system clock sourceHSE, HSI, PLL, PLLSAI1 and PLLSAI2 OFFAHB, APB1 and APB2 prescaler set to 1.CSS, MCO OFFAll interrupts disabled
- This function doesn't modify the configuration of the Peripheral clocksLSI, LSE and RTC clocks

`LL_RCC_GetSystemClocksFreq`

Function name

void LL_RCC_GetSystemClocksFreq (LL_RCC_ClocksTypeDef * RCC_Clocks)

Function description

Return the frequencies of different on chip clocks; System, AHB, APB1 and APB2 buses clocks.

Parameters

- **RCC_Clocks:** pointer to a LL_RCC_ClocksTypeDef structure which will hold the clocks frequencies

Return values

- **None:**

Notes

- Each time SYSCLK, HCLK, PCLK1 and/or PCLK2 clock changes, this function must be called to update structure fields. Otherwise, any configuration based on this function will be incorrect.

`LL_RCC_GetUSARTClockFreq`

Function name

uint32_t LL_RCC_GetUSARTClockFreq (uint32_t USARTxSource)

Function description

Return USARTx clock frequency.

Parameters

- **USARTxSource:** This parameter can be one of the following values:
  - LL_RCC_USART1_CLKSOURCE
  - LL_RCC_USART2_CLKSOURCE
  - LL_RCC_USART3_CLKSOURCE (*)

  (*) value not defined in all devices.

Return values

- **USART:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI or LSE) is not ready

`LL_RCC_GetUARTClockFreq`

Function name

uint32_t LL_RCC_GetUARTClockFreq (uint32_t UARTxSource)

Function description

Return UARTx clock frequency.

Parameters

- **UARTxSource:** This parameter can be one of the following values:
  - LL_RCC_UART4_CLKSOURCE
  - LL_RCC_UART5_CLKSOURCE

Return values

- **UART:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI or LSE) is not ready

`LL_RCC_GetI2CClockFreq`

Function name

uint32_t LL_RCC_GetI2CClockFreq (uint32_t I2CxSource)

Function description

Return I2Cx clock frequency.

Parameters

- **I2CxSource:** This parameter can be one of the following values:
  - LL_RCC_I2C1_CLKSOURCE
  - LL_RCC_I2C2_CLKSOURCE (*)
  - LL_RCC_I2C3_CLKSOURCE
  - LL_RCC_I2C4_CLKSOURCE (*)

  (*) value not defined in all devices.

Return values

- **I2C:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that HSI oscillator is not ready

`LL_RCC_GetLPUARTClockFreq`

Function name

uint32_t LL_RCC_GetLPUARTClockFreq (uint32_t LPUARTxSource)

Function description

Return LPUARTx clock frequency.

Parameters

- **LPUARTxSource:** This parameter can be one of the following values:
  - LL_RCC_LPUART1_CLKSOURCE

Return values

- **LPUART:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI or LSE) is not ready

`LL_RCC_GetLPTIMClockFreq`

Function name

uint32_t LL_RCC_GetLPTIMClockFreq (uint32_t LPTIMxSource)

Function description

Return LPTIMx clock frequency.

Parameters

- **LPTIMxSource:** This parameter can be one of the following values:
  - LL_RCC_LPTIM1_CLKSOURCE
  - LL_RCC_LPTIM2_CLKSOURCE

Return values

- **LPTIM:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (HSI, LSI or LSE) is not ready

`LL_RCC_GetSAIClockFreq`

Function name

uint32_t LL_RCC_GetSAIClockFreq (uint32_t SAIxSource)

Function description

Return SAIx clock frequency.

Parameters

- **SAIxSource:** This parameter can be one of the following values:
  - LL_RCC_SAI1_CLKSOURCE
  - LL_RCC_SAI2_CLKSOURCE (*)

  (*) value not defined in all devices.

Return values

- **SAI:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that PLL is not ready

`LL_RCC_GetSDMMCKernelClockFreq`

Function name

uint32_t LL_RCC_GetSDMMCKernelClockFreq (uint32_t SDMMCxSource)

Function description

Return SDMMCx kernel clock frequency.

Parameters

- **SDMMCxSource:** This parameter can be one of the following values:
  - LL_RCC_SDMMC1_KERNELCLKSOURCE

Return values

- **SDMMC:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (MSI) or PLL is not ready
  - LL_RCC_PERIPH_FREQUENCY_NA indicates that no clock source selected

`LL_RCC_GetSDMMCClockFreq`

Function name

uint32_t LL_RCC_GetSDMMCClockFreq (uint32_t SDMMCxSource)

Function description

Return SDMMCx clock frequency.

Parameters

- **SDMMCxSource:** This parameter can be one of the following values:
  - LL_RCC_SDMMC1_CLKSOURCE

Return values

- **SDMMC:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (MSI) or PLL is not ready
  - LL_RCC_PERIPH_FREQUENCY_NA indicates that no clock source selected

`LL_RCC_GetRNGClockFreq`

Function name

uint32_t LL_RCC_GetRNGClockFreq (uint32_t RNGxSource)

Function description

Return RNGx clock frequency.

Parameters

- **RNGxSource:** This parameter can be one of the following values:
  - LL_RCC_RNG_CLKSOURCE

Return values

- **RNG:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (MSI) or PLL is not ready
  - LL_RCC_PERIPH_FREQUENCY_NA indicates that no clock source selected

`LL_RCC_GetUSBClockFreq`

Function name

uint32_t LL_RCC_GetUSBClockFreq (uint32_t USBxSource)

Function description

Return USBx clock frequency.

Parameters

- **USBxSource:** This parameter can be one of the following values:
  - LL_RCC_USB_CLKSOURCE

Return values

- **USB:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (MSI) or PLL is not ready
  - LL_RCC_PERIPH_FREQUENCY_NA indicates that no clock source selected

LL_RCC_GetADCClockFreq

Function name

uint32_t LL_RCC_GetADCClockFreq (uint32_t ADCxSource)

Function description

Return ADCx clock frequency.

Parameters

- **ADCxSource:** This parameter can be one of the following values:
  - LL_RCC_ADC_CLKSOURCE

Return values

- **ADC:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator (MSI) or PLL is not ready
  - LL_RCC_PERIPH_FREQUENCY_NA indicates that no clock source selected

LL_RCC_GetDFSDMClockFreq

Function name

uint32_t LL_RCC_GetDFSDMClockFreq (uint32_t DFSDMxSource)

Function description

Return DFSDMx clock frequency.

Parameters

- **DFSDMxSource:** This parameter can be one of the following values:
  - LL_RCC_DFSDM1_CLKSOURCE

Return values

- **DFSDM:** clock frequency (in Hz)

LL_RCC_GetDFSDMAudioClockFreq

Function name

uint32_t LL_RCC_GetDFSDMAudioClockFreq (uint32_t DFSDMxSource)

Function description

Return DFSDMx Audio clock frequency.

Parameters

- **DFSDMxSource:** This parameter can be one of the following values:
  - LL_RCC_DFSDM1_AUDIO_CLKSOURCE

Return values

- **DFSDM:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator is not ready

`LL_RCC_GetLTDCClockFreq`

Function name

uint32_t LL_RCC_GetLTDCClockFreq (uint32_t LTDCxSource)

Function description

Return LTDC clock frequency.

Parameters

- **LTDCxSource:** This parameter can be one of the following values:
  - LL_RCC_LTDC_CLKSOURCE

Return values

- **LTDC:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator PLLSAI is not ready

`LL_RCC_GetDSIClockFreq`

Function name

uint32_t LL_RCC_GetDSIClockFreq (uint32_t DSIxSource)

Function description

Return DSI clock frequency.

Parameters

- **DSIxSource:** This parameter can be one of the following values:
  - LL_RCC_DSI_CLKSOURCE

Return values

- **DSI:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator is not ready
  - LL_RCC_PERIPH_FREQUENCY_NA indicates that external clock is used

`LL_RCC_GetOCTOSPIClockFreq`

Function name

uint32_t LL_RCC_GetOCTOSPIClockFreq (uint32_t OCTOSPIxSource)

Function description

Return OCTOSPI clock frequency.

Parameters

- **OCTOSPIxSource:** This parameter can be one of the following values:
  - LL_RCC_OCTOSPI_CLKSOURCE

Return values

- **OCTOSPI:** clock frequency (in Hz)
  - LL_RCC_PERIPH_FREQUENCY_NO indicates that oscillator PLLSAI is not ready

99.3 RCC Firmware driver defines

The following section lists the various define and macros of the module.

99.3.1 RCC

RCC

Peripheral ADC get clock source

LL_RCC_ADC_CLKSOURCE

ADC Clock source selection

Peripheral ADC clock source selection

LL_RCC_ADC_CLKSOURCE_NONE

No clock used as ADC clock source

LL_RCC_ADC_CLKSOURCE_PLLSAI1

PLLSAI1 clock used as ADC clock source

LL_RCC_ADC_CLKSOURCE_SYSCLK

SYSCLK clock used as ADC clock source

APB low-speed prescaler (APB1)

LL_RCC_APB1_DIV_1

HCLK not divided

LL_RCC_APB1_DIV_2

HCLK divided by 2

LL_RCC_APB1_DIV_4

HCLK divided by 4

LL_RCC_APB1_DIV_8

HCLK divided by 8

LL_RCC_APB1_DIV_16

HCLK divided by 16

APB high-speed prescaler (APB2)

LL_RCC_APB2_DIV_1

HCLK not divided

LL_RCC_APB2_DIV_2

HCLK divided by 2

LL_RCC_APB2_DIV_4

HCLK divided by 4

LL_RCC_APB2_DIV_8

HCLK divided by 8

LL_RCC_APB2_DIV_16

HCLK divided by 16

Clear Flags Defines

LL_RCC_CICR_LSIRDYC

LSI Ready Interrupt Clear

LL_RCC_CICR_LSERDYC

LSE Ready Interrupt Clear

LL_RCC_CICR_MSIRDYC

MSI Ready Interrupt Clear

LL_RCC_CICR_HSIRDYC

HSI Ready Interrupt Clear

LL_RCC_CICR_HSERDYC

HSE Ready Interrupt Clear

LL_RCC_CICR_PLLRDYC

PLL Ready Interrupt Clear

LL_RCC_CICR_HSI48RDYC

HSI48 Ready Interrupt Clear

LL_RCC_CICR_PLLSAI1RDYC

PLLSAI1 Ready Interrupt Clear

LL_RCC_CICR_PLLSAI2RDYC

PLLSAI2 Ready Interrupt Clear

LL_RCC_CICR_LSECSSC

LSE Clock Security System Interrupt Clear

LL_RCC_CICR_CSSC

Clock Security System Interrupt Clear

Peripheral DFSDM1 get clock source

LL_RCC_DFSDM1_CLKSOURCE

DFSDM1 Clock source selection

Peripheral DFSDM1 Audio get clock source

LL_RCC_DFSDM1_AUDIO_CLKSOURCE

Peripheral DFSDM1 Audio clock source selection

LL_RCC_DFSDM1_AUDIO_CLKSOURCE_SAI1

SAI1 clock used as DFSDM1 Audio clock

LL_RCC_DFSDM1_AUDIO_CLKSOURCE_HSI

HSI clock used as DFSDM1 Audio clock

LL_RCC_DFSDM1_AUDIO_CLKSOURCE_MSI

MSI clock used as DFSDM1 Audio clock

Peripheral DFSDM1 clock source selection

LL_RCC_DFSDM1_CLKSOURCE_PCLK2

PCLK2 used as DFSDM1 clock source

LL_RCC_DFSDM1_CLKSOURCE_SYSCLK

SYSCLK used as DFSDM1 clock source

Peripheral DSI get clock source

LL_RCC_DSI_CLKSOURCE

DSI Clock source selection

Peripheral DSI clock source selection

LL_RCC_DSI_CLKSOURCE_PHY

DSI-PHY clock used as DSI byte lane clock source

LL_RCC_DSI_CLKSOURCE_PLL

PLL clock used as DSI byte lane clock source

Get Flags Defines

LL_RCC_CIFR_LSIRDYF

LSI Ready Interrupt flag

LL_RCC_CIFR_LSERDYF

LSE Ready Interrupt flag

LL_RCC_CIFR_MSIRDYF

MSI Ready Interrupt flag

LL_RCC_CIFR_HSIRDYF

HSI Ready Interrupt flag

LL_RCC_CIFR_HSERDYF

HSE Ready Interrupt flag

LL_RCC_CIFR_PLLRDYF

PLL Ready Interrupt flag

LL_RCC_CIFR_HSI48RDYF

HSI48 Ready Interrupt flag

LL_RCC_CIFR_PLLSAI1RDYF

PLLSAI1 Ready Interrupt flag

LL_RCC_CIFR_PLLSAI2RDYF

PLLSAI2 Ready Interrupt flag

LL_RCC_CIFR_LSECSSF

LSE Clock Security System Interrupt flag

LL_RCC_CIFR_CSSF

Clock Security System Interrupt flag

LL_RCC_CSR_FWRSTF

Firewall reset flag

LL_RCC_CSR_LPWRRSTF

Low-Power reset flag

LL_RCC_CSR_OBLRSTF

OBL reset flag

LL_RCC_CSR_PINRSTF

PIN reset flag

LL_RCC_CSR_SFTRSTF

Software Reset flag

LL_RCC_CSR_IWDGRSTF

Independent Watchdog reset flag

LL_RCC_CSR_WWDGRSTF

Window watchdog reset flag

LL_RCC_CSR_BORRSTF

BOR reset flag

Peripheral I2C get clock source

LL_RCC_I2C1_CLKSOURCE

I2C1 Clock source selection

LL_RCC_I2C2_CLKSOURCE

I2C2 Clock source selection

LL_RCC_I2C3_CLKSOURCE

I2C3 Clock source selection

LL_RCC_I2C4_CLKSOURCE

I2C4 Clock source selection

Peripheral I2C clock source selection

LL_RCC_I2C1_CLKSOURCE_PCLK1

PCLK1 clock used as I2C1 clock source

LL_RCC_I2C1_CLKSOURCE_SYSCLK

SYSCLK clock used as I2C1 clock source

LL_RCC_I2C1_CLKSOURCE_HSI

HSI clock used as I2C1 clock source

LL_RCC_I2C2_CLKSOURCE_PCLK1

PCLK1 clock used as I2C2 clock source

LL_RCC_I2C2_CLKSOURCE_SYSCLK

SYSCLK clock used as I2C2 clock source

LL_RCC_I2C2_CLKSOURCE_HSI

HSI clock used as I2C2 clock source

LL_RCC_I2C3_CLKSOURCE_PCLK1

PCLK1 clock used as I2C3 clock source

LL_RCC_I2C3_CLKSOURCE_SYSCLK

SYSCLK clock used as I2C3 clock source

LL_RCC_I2C3_CLKSOURCE_HSI

HSI clock used as I2C3 clock source

LL_RCC_I2C4_CLKSOURCE_PCLK1

PCLK1 clock used as I2C4 clock source

LL_RCC_I2C4_CLKSOURCE_SYSCLK

SYSCLK clock used as I2C4 clock source

LL_RCC_I2C4_CLKSOURCE_HSI

HSI clock used as I2C4 clock source

IT Defines

LL_RCC_CIER_LSIRDYIE

LSI Ready Interrupt Enable

LL_RCC_CIER_LSERDYIE

LSE Ready Interrupt Enable

LL_RCC_CIER_MSIRDYIE

MSI Ready Interrupt Enable

LL_RCC_CIER_HSIRDYIE

HSI Ready Interrupt Enable

LL_RCC_CIER_HSERDYIE

HSE Ready Interrupt Enable

LL_RCC_CIER_PLLRDYIE

PLL Ready Interrupt Enable

LL_RCC_CIER_HSI48RDYIE

HSI48 Ready Interrupt Enable

LL_RCC_CIER_PLLSAI1RDYIE

PLLSAI1 Ready Interrupt Enable

LL_RCC_CIER_PLLSAI2RDYIE

PLLSAI2 Ready Interrupt Enable

LL_RCC_CIER_LSECSSIE

LSE CSS Interrupt Enable

Peripheral LPTIM get clock source

LL_RCC_LPTIM1_CLKSOURCE

LPTIM1 Clock source selection

LL_RCC_LPTIM2_CLKSOURCE

LPTIM2 Clock source selection

Peripheral LPTIM clock source selection

LL_RCC_LPTIM1_CLKSOURCE_PCLK1

PCLK1 clock used as LPTIM1 clock source

LL_RCC_LPTIM1_CLKSOURCE_LSI

LSI clock used as LPTIM1 clock source

LL_RCC_LPTIM1_CLKSOURCE_HSI

HSI clock used as LPTIM1 clock source

LL_RCC_LPTIM1_CLKSOURCE_LSE

LSE clock used as LPTIM1 clock source

LL_RCC_LPTIM2_CLKSOURCE_PCLK1

PCLK1 clock used as LPTIM2 clock source

LL_RCC_LPTIM2_CLKSOURCE_LSI

LSI clock used as LPTIM2 clock source

LL_RCC_LPTIM2_CLKSOURCE_HSI

HSI clock used as LPTIM2 clock source

LL_RCC_LPTIM2_CLKSOURCE_LSE

LSE clock used as LPTIM2 clock source

Peripheral LPUART get clock source

LL_RCC_LPUART1_CLKSOURCE

LPUART1 Clock source selection

Peripheral LPUART clock source selection

LL_RCC_LPUART1_CLKSOURCE_PCLK1

PCLK1 clock used as LPUART1 clock source

LL_RCC_LPUART1_CLKSOURCE_SYSCLK

SYSCLK clock used as LPUART1 clock source

LL_RCC_LPUART1_CLKSOURCE_HSI

HSI clock used as LPUART1 clock source

LL_RCC_LPUART1_CLKSOURCE_LSE

LSE clock used as LPUART1 clock source

LSCO Selection

LL_RCC_LSCO_CLKSOURCE_LSI

LSI selection for low speed clock

LL_RCC_LSCO_CLKSOURCE_LSE

LSE selection for low speed clock

LSE oscillator drive capability

LL_RCC_LSEDRIVE_LOW

Xtal mode lower driving capability

LL_RCC_LSEDRIVE_MEDIUMLOW

Xtal mode medium low driving capability

LL_RCC_LSEDRIVE_MEDIUMHIGH

Xtal mode medium high driving capability

LL_RCC_LSEDRIVE_HIGH

Xtal mode higher driving capability

Peripheral LTDC get clock source

LL_RCC_LTDC_CLKSOURCE

LTDC Clock source selection

Peripheral LTDC clock source selection

LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV2

PLLSAI2DIVR divided by 2 used as LTDC clock source

LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV4

PLLSAI2DIVR divided by 4 used as LTDC clock source

LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV8

PLLSAI2DIVR divided by 8 used as LTDC clock source

LL_RCC_LTDC_CLKSOURCE_PLLSAI2R_DIV16

PLLSAI2DIVR divided by 16 used as LTDC clock source

MCO1 SOURCE selection

LL_RCC_MCO1SOURCE_NOCLOCK

MCO output disabled, no clock on MCO

LL_RCC_MCO1SOURCE_SYSCLK

SYSCLK selection as MCO1 source

LL_RCC_MCO1SOURCE_MSI

MSI selection as MCO1 source

LL_RCC_MCO1SOURCE_HSI

HSI16 selection as MCO1 source

LL_RCC_MCO1SOURCE_HSE

HSE selection as MCO1 source

LL_RCC_MCO1SOURCE_PLLCLK

Main PLL selection as MCO1 source

LL_RCC_MCO1SOURCE_LSI

LSI selection as MCO1 source

LL_RCC_MCO1SOURCE_LSE

LSE selection as MCO1 source

LL_RCC_MCO1SOURCE_HSI48

HSI48 selection as MCO1 source

MCO1 prescaler

LL_RCC_MCO1_DIV_1

MCO not divided

LL_RCC_MCO1_DIV_2

MCO divided by 2

LL_RCC_MCO1_DIV_4

MCO divided by 4

LL_RCC_MCO1_DIV_8

MCO divided by 8

LL_RCC_MCO1_DIV_16

MCO divided by 16

MSI clock ranges

LL_RCC_MSIRANGE_0

MSI = 100 KHz

LL_RCC_MSIRANGE_1

MSI = 200 KHz

LL_RCC_MSIRANGE_2

MSI = 400 KHz

LL_RCC_MSIRANGE_3

MSI = 800 KHz

LL_RCC_MSIRANGE_4

MSI = 1 MHz

LL_RCC_MSIRANGE_5

MSI = 2 MHz

LL_RCC_MSIRANGE_6

MSI = 4 MHz

LL_RCC_MSIRANGE_7

MSI = 8 MHz

LL_RCC_MSIRANGE_8

MSI = 16 MHz

LL_RCC_MSIRANGE_9

MSI = 24 MHz

LL_RCC_MSIRANGE_10

MSI = 32 MHz

LL_RCC_MSIRANGE_11

MSI = 48 MHz

MSI clock range selection

LL_RCC_MSIRANGESEL_STANDBY

MSI Range is provided by MSISRANGE

LL_RCC_MSIRANGESEL_RUN

MSI Range is provided by MSIRANGE

MSI range after Standby mode

LL_RCC_MSISRANGE_4

MSI = 1 MHz

LL_RCC_MSISRANGE_5

MSI = 2 MHz

LL_RCC_MSISRANGE_6

MSI = 4 MHz

LL_RCC_MSISRANGE_7

MSI = 8 MHz

Peripheral OCTOSPI get clock source

LL_RCC_OCTOSPI_CLKSOURCE_SYSCLK

SYSCLK used as OctoSPI clock source

LL_RCC_OCTOSPI_CLKSOURCE_MSI

MSI used as OctoSPI clock source

LL_RCC_OCTOSPI_CLKSOURCE_PLL

PLL used as OctoSPI clock source

LL_RCC_OCTOSPI_CLKSOURCE

OctoSPI Clock source selection

Oscillator Values adaptation

HSE_VALUE

Value of the HSE oscillator in Hz

HSI_VALUE

Value of the HSI oscillator in Hz

LSE_VALUE

Value of the LSE oscillator in Hz

LSI_VALUE

Value of the LSI oscillator in Hz

HSI48_VALUE

Value of the HSI48 oscillator in Hz

EXTERNAL_SAI1_CLOCK_VALUE

Value of the SAI1_EXTCLK external oscillator in Hz

EXTERNAL_SAI2_CLOCK_VALUE

Value of the SAI2_EXTCLK external oscillator in Hz

Peripheral clock frequency

LL_RCC_PERIPH_FREQUENCY_NO

No clock enabled for the peripheral

LL_RCC_PERIPH_FREQUENCY_NA

Frequency cannot be provided as external clock

PLL division factor

LL_RCC_PLLM_DIV_1

Main PLL division factor for PLLM input by 1

LL_RCC_PLLM_DIV_2

Main PLL division factor for PLLM input by 2

LL_RCC_PLLM_DIV_3

Main PLL division factor for PLLM input by 3

LL_RCC_PLLM_DIV_4

Main PLL division factor for PLLM input by 4

LL_RCC_PLLM_DIV_5

Main PLL division factor for PLLM input by 5

LL_RCC_PLLM_DIV_6

Main PLL division factor for PLLM input by 6

LL_RCC_PLLM_DIV_7

Main PLL division factor for PLLM input by 7

LL_RCC_PLLM_DIV_8

Main PLL division factor for PLLM input by 8

LL_RCC_PLLM_DIV_9

Main PLL division factor for PLLM input by 9

LL_RCC_PLLM_DIV_10

Main PLL division factor for PLLM input by 10

LL_RCC_PLLM_DIV_11

Main PLL division factor for PLLM input by 11

LL_RCC_PLLM_DIV_12

Main PLL division factor for PLLM input by 12

LL_RCC_PLLM_DIV_13

Main PLL division factor for PLLM input by 13

LL_RCC_PLLM_DIV_14

Main PLL division factor for PLLM input by 14

LL_RCC_PLLM_DIV_15

Main PLL division factor for PLLM input by 15

LL_RCC_PLLM_DIV_16

Main PLL division factor for PLLM input by 16

PLL division factor (PLLP)

LL_RCC_PLLP_DIV_2

Main PLL division factor for PLLP output by 2

LL_RCC_PLLP_DIV_3

Main PLL division factor for PLLP output by 3

LL_RCC_PLLP_DIV_4

Main PLL division factor for PLLP output by 4

LL_RCC_PLLP_DIV_5

Main PLL division factor for PLLP output by 5

LL_RCC_PLLP_DIV_6

Main PLL division factor for PLLP output by 6

LL_RCC_PLLP_DIV_7

Main PLL division factor for PLLP output by 7

LL_RCC_PLLP_DIV_8

Main PLL division factor for PLLP output by 8

LL_RCC_PLLP_DIV_9

Main PLL division factor for PLLP output by 9

LL_RCC_PLLP_DIV_10

Main PLL division factor for PLLP output by 10

LL_RCC_PLLP_DIV_11

Main PLL division factor for PLLP output by 11

LL_RCC_PLLP_DIV_12

Main PLL division factor for PLLP output by 12

LL_RCC_PLLP_DIV_13

Main PLL division factor for PLLP output by 13

LL_RCC_PLLP_DIV_14

Main PLL division factor for PLLP output by 14

LL_RCC_PLLP_DIV_15

Main PLL division factor for PLLP output by 15

LL_RCC_PLLP_DIV_16

Main PLL division factor for PLLP output by 16

LL_RCC_PLLP_DIV_17

Main PLL division factor for PLLP output by 17

LL_RCC_PLLP_DIV_18

Main PLL division factor for PLLP output by 18

LL_RCC_PLLP_DIV_19

Main PLL division factor for PLLP output by 19

LL_RCC_PLLP_DIV_20

Main PLL division factor for PLLP output by 20

LL_RCC_PLLP_DIV_21

Main PLL division factor for PLLP output by 21

LL_RCC_PLLP_DIV_22

Main PLL division factor for PLLP output by 22

LL_RCC_PLLP_DIV_23

Main PLL division factor for PLLP output by 23

LL_RCC_PLLP_DIV_24

Main PLL division factor for PLLP output by 24

LL_RCC_PLLP_DIV_25

Main PLL division factor for PLLP output by 25

LL_RCC_PLLP_DIV_26

Main PLL division factor for PLLP output by 26

LL_RCC_PLLP_DIV_27

Main PLL division factor for PLLP output by 27

LL_RCC_PLLP_DIV_28

Main PLL division factor for PLLP output by 28

LL_RCC_PLLP_DIV_29

Main PLL division factor for PLLP output by 29

LL_RCC_PLLP_DIV_30

Main PLL division factor for PLLP output by 30

LL_RCC_PLLP_DIV_31

Main PLL division factor for PLLP output by 31

PLL division factor (PLLQ)

LL_RCC_PLLQ_DIV_2

Main PLL division factor for PLLQ output by 2

LL_RCC_PLLQ_DIV_4

Main PLL division factor for PLLQ output by 4

LL_RCC_PLLQ_DIV_6

Main PLL division factor for PLLQ output by 6

LL_RCC_PLLQ_DIV_8

Main PLL division factor for PLLQ output by 8

PLL division factor (PLLR)

LL_RCC_PLLR_DIV_2

Main PLL division factor for PLLCLK (system clock) by 2

LL_RCC_PLLR_DIV_4

Main PLL division factor for PLLCLK (system clock) by 4

LL_RCC_PLLR_DIV_6

Main PLL division factor for PLLCLK (system clock) by 6

LL_RCC_PLLR_DIV_8

Main PLL division factor for PLLCLK (system clock) by 8

PLLSAI1 division factor (PLLSAI1M)

LL_RCC_PLLSAI1M_DIV_1

PLLSAI1 division factor for PLLSAI1M input by 1

LL_RCC_PLLSAI1M_DIV_2

PLLSAI1 division factor for PLLSAI1M input by 2

LL_RCC_PLLSAI1M_DIV_3

PLLSAI1 division factor for PLLSAI1M input by 3

LL_RCC_PLLSAI1M_DIV_4

PLLSAI1 division factor for PLLSAI1M input by 4

LL_RCC_PLLSAI1M_DIV_5

PLLSAI1 division factor for PLLSAI1M input by 5

LL_RCC_PLLSAI1M_DIV_6

PLLSAI1 division factor for PLLSAI1M input by 6

LL_RCC_PLLSAI1M_DIV_7

PLLSAI1 division factor for PLLSAI1M input by 7

LL_RCC_PLLSAI1M_DIV_8

PLLSAI1 division factor for PLLSAI1M input by 8

LL_RCC_PLLSAI1M_DIV_9

PLLSAI1 division factor for PLLSAI1M input by 9

LL_RCC_PLLSAI1M_DIV_10

PLLSAI1 division factor for PLLSAI1M input by 10

LL_RCC_PLLSAI1M_DIV_11

PLLSAI1 division factor for PLLSAI1M input by 11

LL_RCC_PLLSAI1M_DIV_12

PLLSAI1 division factor for PLLSAI1M input by 12

LL_RCC_PLLSAI1M_DIV_13

PLLSAI1 division factor for PLLSAI1M input by 13

LL_RCC_PLLSAI1M_DIV_14

PLLSAI1 division factor for PLLSAI1M input by 14

LL_RCC_PLLSAI1M_DIV_15

PLLSAI1 division factor for PLLSAI1M input by 15

LL_RCC_PLLSAI1M_DIV_16

PLLSAI1 division factor for PLLSAI1M input by 16

PLLSAI1 division factor (PLLSAI1P)

LL_RCC_PLLSAI1P_DIV_2

PLLSAI1 division factor for PLLSAI1P output by 2

LL_RCC_PLLSAI1P_DIV_3

PLLSAI1 division factor for PLLSAI1P output by 3

LL_RCC_PLLSAI1P_DIV_4

PLLSAI1 division factor for PLLSAI1P output by 4

LL_RCC_PLLSAI1P_DIV_5

PLLSAI1 division factor for PLLSAI1P output by 5

LL_RCC_PLLSAI1P_DIV_6

PLLSAI1 division factor for PLLSAI1P output by 6

LL_RCC_PLLSAI1P_DIV_7

PLLSAI1 division factor for PLLSAI1P output by 7

LL_RCC_PLLSAI1P_DIV_8

PLLSAI1 division factor for PLLSAI1P output by 8

LL_RCC_PLLSAI1P_DIV_9

PLLSAI1 division factor for PLLSAI1P output by 9

LL_RCC_PLLSAI1P_DIV_10

PLLSAI1 division factor for PLLSAI1P output by 10

LL_RCC_PLLSAI1P_DIV_11

PLLSAI1 division factor for PLLSAI1P output by 1

LL_RCC_PLLSAI1P_DIV_12

PLLSAI1 division factor for PLLSAI1P output by 12

LL_RCC_PLLSAI1P_DIV_13

PLLSAI1 division factor for PLLSAI1P output by 13

LL_RCC_PLLSAI1P_DIV_14

PLLSAI1 division factor for PLLSAI1P output by 14

LL_RCC_PLLSAI1P_DIV_15

PLLSAI1 division factor for PLLSAI1P output by 15

LL_RCC_PLLSAI1P_DIV_16

PLLSAI1 division factor for PLLSAI1P output by 16

LL_RCC_PLLSAI1P_DIV_17

PLLSAI1 division factor for PLLSAI1P output by 17

LL_RCC_PLLSAI1P_DIV_18

PLLSAI1 division factor for PLLSAI1P output by 18

LL_RCC_PLLSAI1P_DIV_19

PLLSAI1 division factor for PLLSAI1P output by 19

LL_RCC_PLLSAI1P_DIV_20

PLLSAI1 division factor for PLLSAI1P output by 20

LL_RCC_PLLSAI1P_DIV_21

PLLSAI1 division fctor for PLLSAI1P output by 21

LL_RCC_PLLSAI1P_DIV_22

PLLSAI1 division factor for PLLSAI1P output by 22

LL_RCC_PLLSAI1P_DIV_23

PLLSAI1 division factor for PLLSAI1P output by 23

LL_RCC_PLLSAI1P_DIV_24

PLLSAI1 division factor for PLLSAI1P output by 24

LL_RCC_PLLSAI1P_DIV_25

PLLSAI1 division factor for PLLSAI1P output by 25

LL_RCC_PLLSAI1P_DIV_26

PLLSAI1 division factor for PLLSAI1P output by 26

LL_RCC_PLLSAI1P_DIV_27

PLLSAI1 division factor for PLLSAI1P output by 27

LL_RCC_PLLSAI1P_DIV_28

PLLSAI1 division factor for PLLSAI1P output by 28

LL_RCC_PLLSAI1P_DIV_29

PLLSAI1 division factor for PLLSAI1P output by 29

LL_RCC_PLLSAI1P_DIV_30

PLLSAI1 division factor for PLLSAI1P output by 30

LL_RCC_PLLSAI1P_DIV_31

PLLSAI1 division factor for PLLSAI1P output by 31

PLLSAI1 division factor (PLLSAI1Q)

LL_RCC_PLLSAI1Q_DIV_2

PLLSAI1 division factor for PLLSAI1Q output by 2

LL_RCC_PLLSAI1Q_DIV_4

PLLSAI1 division factor for PLLSAI1Q output by 4

LL_RCC_PLLSAI1Q_DIV_6

PLLSAI1 division factor for PLLSAI1Q output by 6

LL_RCC_PLLSAI1Q_DIV_8

PLLSAI1 division factor for PLLSAI1Q output by 8

PLLSAI1 division factor (PLLSAI1R)

LL_RCC_PLLSAI1R_DIV_2

PLLSAI1 division factor for PLLSAI1R output by 2

LL_RCC_PLLSAI1R_DIV_4

PLLSAI1 division factor for PLLSAI1R output by 4

LL_RCC_PLLSAI1R_DIV_6

PLLSAI1 division factor for PLLSAI1R output by 6

LL_RCC_PLLSAI1R_DIV_8

PLLSAI1 division factor for PLLSAI1R output by 8

PLLSAI2DIVR division factor (PLLSAI2DIVR)

LL_RCC_PLLSAI2DIVR_DIV_2

PLLSAI2 division factor for PLLSAI2DIVR output by 2

LL_RCC_PLLSAI2DIVR_DIV_4

PLLSAI2 division factor for PLLSAI2DIVR output by 4

LL_RCC_PLLSAI2DIVR_DIV_8

PLLSAI2 division factor for PLLSAI2DIVR output by 8

LL_RCC_PLLSAI2DIVR_DIV_16

PLLSAI2 division factor for PLLSAI2DIVR output by 16

PLLSAI1 division factor (PLLSAI2M)

LL_RCC_PLLSAI2M_DIV_1

PLLSAI2 division factor for PLLSAI2M input by 1

LL_RCC_PLLSAI2M_DIV_2

PLLSAI2 division factor for PLLSAI2M input by 2

LL_RCC_PLLSAI2M_DIV_3

PLLSAI2 division factor for PLLSAI2M input by 3

LL_RCC_PLLSAI2M_DIV_4

PLLSAI2 division factor for PLLSAI2M input by 4

LL_RCC_PLLSAI2M_DIV_5

PLLSAI2 division factor for PLLSAI2M input by 5

LL_RCC_PLLSAI2M_DIV_6

PLLSAI2 division factor for PLLSAI2M input by 6

LL_RCC_PLLSAI2M_DIV_7

PLLSAI2 division factor for PLLSAI2M input by 7

LL_RCC_PLLSAI2M_DIV_8

PLLSAI2 division factor for PLLSAI2M input by 8

LL_RCC_PLLSAI2M_DIV_9

PLLSAI2 division factor for PLLSAI2M input by 9

LL_RCC_PLLSAI2M_DIV_10

PLLSAI2 division factor for PLLSAI2M input by 10

LL_RCC_PLLSAI2M_DIV_11

PLLSAI2 division factor for PLLSAI2M input by 11

LL_RCC_PLLSAI2M_DIV_12

PLLSAI2 division factor for PLLSAI2M input by 12

LL_RCC_PLLSAI2M_DIV_13

PLLSAI2 division factor for PLLSAI2M input by 13

LL_RCC_PLLSAI2M_DIV_14

PLLSAI2 division factor for PLLSAI2M input by 14

LL_RCC_PLLSAI2M_DIV_15

PLLSAI2 division factor for PLLSAI2M input by 15

LL_RCC_PLLSAI2M_DIV_16

PLLSAI2 division factor for PLLSAI2M input by 16

PLLSAI2 division factor (PLLSAI2P)

LL_RCC_PLLSAI2P_DIV_2

PLLSAI2 division factor for PLLSAI2P output by 2

LL_RCC_PLLSAI2P_DIV_3

PLLSAI2 division factor for PLLSAI2P output by 3

LL_RCC_PLLSAI2P_DIV_4

PLLSAI2 division factor for PLLSAI2P output by 4

LL_RCC_PLLSAI2P_DIV_5

PLLSAI2 division factor for PLLSAI2P output by 5

LL_RCC_PLLSAI2P_DIV_6

PLLSAI2 division factor for PLLSAI2P output by 6

LL_RCC_PLLSAI2P_DIV_7

PLLSAI2 division factor for PLLSAI2P output by 7

LL_RCC_PLLSAI2P_DIV_8

PLLSAI2 division factor for PLLSAI2P output by 8

LL_RCC_PLLSAI2P_DIV_9

PLLSAI2 division factor for PLLSAI2P output by 9

LL_RCC_PLLSAI2P_DIV_10

PLLSAI2 division factor for PLLSAI2P output by 10

LL_RCC_PLLSAI2P_DIV_11

PLLSAI2 division factor for PLLSAI2P output by 1

LL_RCC_PLLSAI2P_DIV_12

PLLSAI2 division factor for PLLSAI2P output by 12

LL_RCC_PLLSAI2P_DIV_13

PLLSAI2 division factor for PLLSAI2P output by 13

LL_RCC_PLLSAI2P_DIV_14

PLLSAI2 division factor for PLLSAI2P output by 14

LL_RCC_PLLSAI2P_DIV_15

PLLSAI2 division factor for PLLSAI2P output by 15

LL_RCC_PLLSAI2P_DIV_16

PLLSAI2 division factor for PLLSAI2P output by 16

LL_RCC_PLLSAI2P_DIV_17

PLLSAI2 division factor for PLLSAI2P output by 17

LL_RCC_PLLSAI2P_DIV_18

PLLSAI2 division factor for PLLSAI2P output by 18

LL_RCC_PLLSAI2P_DIV_19

PLLSAI2 division factor for PLLSAI2P output by 19

LL_RCC_PLLSAI2P_DIV_20

PLLSAI2 division factor for PLLSAI2P output by 20

LL_RCC_PLLSAI2P_DIV_21

PLLSAI2 division fctor for PLLSAI2P output by 21

LL_RCC_PLLSAI2P_DIV_22

PLLSAI2 division factor for PLLSAI2P output by 22

LL_RCC_PLLSAI2P_DIV_23

PLLSAI2 division factor for PLLSAI2P output by 23

LL_RCC_PLLSAI2P_DIV_24

PLLSAI2 division factor for PLLSAI2P output by 24

LL_RCC_PLLSAI2P_DIV_25

PLLSAI2 division factor for PLLSAI2P output by 25

LL_RCC_PLLSAI2P_DIV_26

PLLSAI2 division factor for PLLSAI2P output by 26

LL_RCC_PLLSAI2P_DIV_27

PLLSAI2 division factor for PLLSAI2P output by 27

LL_RCC_PLLSAI2P_DIV_28

PLLSAI2 division factor for PLLSAI2P output by 28

LL_RCC_PLLSAI2P_DIV_29

PLLSAI2 division factor for PLLSAI2P output by 29

LL_RCC_PLLSAI2P_DIV_30

PLLSAI2 division factor for PLLSAI2P output by 30

LL_RCC_PLLSAI2P_DIV_31

PLLSAI1 division factor for PLLSAI1P output by 31

PLLSAI2 division factor (PLLSAI2Q)

LL_RCC_PLLSAI2Q_DIV_2

PLLSAI2 division factor for PLLSAI2Q output by 2

LL_RCC_PLLSAI2Q_DIV_4

PLLSAI2 division factor for PLLSAI2Q output by 4

LL_RCC_PLLSAI2Q_DIV_6

PLLSAI2 division factor for PLLSAI2Q output by 6

LL_RCC_PLLSAI2Q_DIV_8

PLLSAI2 division factor for PLLSAI2Q output by 8

PLLSAI2 division factor (PLLSAI2R)

LL_RCC_PLLSAI2R_DIV_2

PLLSAI2 division factor for PLLSAI2R output by 2

LL_RCC_PLLSAI2R_DIV_4

PLLSAI2 division factor for PLLSAI2R output by 4

LL_RCC_PLLSAI2R_DIV_6

PLLSAI2 division factor for PLLSAI2R output by 6

LL_RCC_PLLSAI2R_DIV_8

PLLSAI2 division factor for PLLSAI2R output by 8

PLL, PLLSAI1 and PLLSAI2 entry clock source

LL_RCC_PLLSOURCE_NONE

No clock

LL_RCC_PLLSOURCE_MSI

MSI clock selected as PLL entry clock source

LL_RCC_PLLSOURCE_HSI

HSI16 clock selected as PLL entry clock source

LL_RCC_PLLSOURCE_HSE

HSE clock selected as PLL entry clock source

Peripheral RNG get clock source

LL_RCC_RNG_CLKSOURCE

RNG Clock source selection

Peripheral RNG clock source selection

LL_RCC_RNG_CLKSOURCE_HSI48

HSI48 clock used as RNG clock source

LL_RCC_RNG_CLKSOURCE_PLLSAI1

PLLSAI1 clock used as RNG clock source

LL_RCC_RNG_CLKSOURCE_PLL

PLL clock used as RNG clock source

LL_RCC_RNG_CLKSOURCE_MSI

MSI clock used as RNG clock source

RTC clock source selection

LL_RCC_RTC_CLKSOURCE_NONE

No clock used as RTC clock

LL_RCC_RTC_CLKSOURCE_LSE

LSE oscillator clock used as RTC clock

LL_RCC_RTC_CLKSOURCE_LSI

LSI oscillator clock used as RTC clock

LL_RCC_RTC_CLKSOURCE_HSE_DIV32

HSE oscillator clock divided by 32 used as RTC clock

Peripheral SAI get clock source

LL_RCC_SAI1_CLKSOURCE

SAI1 Clock source selection

LL_RCC_SAI2_CLKSOURCE

SAI2 Clock source selection

Peripheral SAI clock source selection

LL_RCC_SAI1_CLKSOURCE_PLL

PLL clock used as SAI1 clock source

LL_RCC_SAI1_CLKSOURCE_PLLSAI1

PLLSAI1 clock used as SAI1 clock source

LL_RCC_SAI1_CLKSOURCE_PLLSAI2

PLLSAI2 clock used as SAI1 clock source

LL_RCC_SAI1_CLKSOURCE_HSI

HSI clock used as SAI1 clock source

LL_RCC_SAI1_CLKSOURCE_PIN

External input clock used as SAI1 clock source

LL_RCC_SAI2_CLKSOURCE_PLL

PLL clock used as SAI2 clock source

LL_RCC_SAI2_CLKSOURCE_PLLSAI1

PLLSAI1 clock used as SAI2 clock source

LL_RCC_SAI2_CLKSOURCE_PLLSAI2

PLLSAI2 clock used as SAI2 clock source

LL_RCC_SAI2_CLKSOURCE_HSI

HSI clock used as SAI2 clock source

LL_RCC_SAI2_CLKSOURCE_PIN

External input clock used as SAI2 clock source

Peripheral SDMMC get clock source

LL_RCC_SDMMC1_CLKSOURCE

SDMMC1 Clock source selection

Peripheral SDMMC clock source selection

LL_RCC_SDMMC1_CLKSOURCE_HSI48

HSI48 clock used as SDMMC1 clock source

LL_RCC_SDMMC1_CLKSOURCE_PLLSAI1

PLLSAI1 clock used as SDMMC1 clock source

LL_RCC_SDMMC1_CLKSOURCE_PLL

PLL clock used as SDMMC1 clock source

LL_RCC_SDMMC1_CLKSOURCE_MSI

MSI clock used as SDMMC1 clock source

Peripheral SDMMC get kernel clock source

LL_RCC_SDMMC1_KERNELCLKSOURCE

SDMMC1 Kernel Clock source selection

Peripheral SDMMC kernel clock source selection

LL_RCC_SDMMC1_KERNELCLKSOURCE_48CLK

48MHz clock from internal multiplexor used as SDMMC1 clock source

LL_RCC_SDMMC1_KERNELCLKSOURCE_PLLP

PLLSAI3CLK clock used as SDMMC1 clock source

Wakeup from Stop and CSS backup clock selection

LL_RCC_STOP_WAKEUPCLOCK_MSI

MSI selection after wake-up from STOP

LL_RCC_STOP_WAKEUPCLOCK_HSI

HSI selection after wake-up from STOP

AHB prescaler

LL_RCC_SYSCLK_DIV_1

SYSCLK not divided

LL_RCC_SYSCLK_DIV_2

SYSCLK divided by 2

LL_RCC_SYSCLK_DIV_4

SYSCLK divided by 4

LL_RCC_SYSCLK_DIV_8

SYSCLK divided by 8

LL_RCC_SYSCLK_DIV_16

SYSCLK divided by 16

LL_RCC_SYSCLK_DIV_64

SYSCLK divided by 64

LL_RCC_SYSCLK_DIV_128

SYSCLK divided by 128

LL_RCC_SYSCLK_DIV_256

SYSCLK divided by 256

LL_RCC_SYSCLK_DIV_512

SYSCLK divided by 512

System clock switch

LL_RCC_SYS_CLKSOURCE_MSI

MSI selection as system clock

LL_RCC_SYS_CLKSOURCE_HSI

HSI selection as system clock

LL_RCC_SYS_CLKSOURCE_HSE

HSE selection as system clock

LL_RCC_SYS_CLKSOURCE_PLL

PLL selection as system clock

System clock switch status

LL_RCC_SYS_CLKSOURCE_STATUS_MSI

MSI used as system clock

LL_RCC_SYS_CLKSOURCE_STATUS_HSI

HSI used as system clock

LL_RCC_SYS_CLKSOURCE_STATUS_HSE

HSE used as system clock

LL_RCC_SYS_CLKSOURCE_STATUS_PLL

PLL used as system clock

Peripheral UART get clock source

LL_RCC_UART4_CLKSOURCE

UART4 Clock source selection

LL_RCC_UART5_CLKSOURCE

UART5 Clock source selection

Peripheral UART clock source selection

LL_RCC_UART4_CLKSOURCE_PCLK1

PCLK1 clock used as UART4 clock source

LL_RCC_UART4_CLKSOURCE_SYSCLK

SYSCLK clock used as UART4 clock source

LL_RCC_UART4_CLKSOURCE_HSI

HSI clock used as UART4 clock source

LL_RCC_UART4_CLKSOURCE_LSE

LSE clock used as UART4 clock source

LL_RCC_UART5_CLKSOURCE_PCLK1

PCLK1 clock used as UART5 clock source

LL_RCC_UART5_CLKSOURCE_SYSCLK

SYSCLK clock used as UART5 clock source

LL_RCC_UART5_CLKSOURCE_HSI

HSI clock used as UART5 clock source

LL_RCC_UART5_CLKSOURCE_LSE

LSE clock used as UART5 clock source

Peripheral USART get clock source

LL_RCC_USART1_CLKSOURCE

USART1 Clock source selection

LL_RCC_USART2_CLKSOURCE

USART2 Clock source selection

LL_RCC_USART3_CLKSOURCE

USART3 Clock source selection

Peripheral USART clock source selection

LL_RCC_USART1_CLKSOURCE_PCLK2

PCLK2 clock used as USART1 clock source

LL_RCC_USART1_CLKSOURCE_SYSCLK

SYSCLK clock used as USART1 clock source

LL_RCC_USART1_CLKSOURCE_HSI

HSI clock used as USART1 clock source

LL_RCC_USART1_CLKSOURCE_LSE

LSE clock used as USART1 clock source

LL_RCC_USART2_CLKSOURCE_PCLK1

PCLK1 clock used as USART2 clock source

LL_RCC_USART2_CLKSOURCE_SYSCLK

SYSCLK clock used as USART2 clock source

LL_RCC_USART2_CLKSOURCE_HSI

HSI clock used as USART2 clock source

LL_RCC_USART2_CLKSOURCE_LSE

LSE clock used as USART2 clock source

LL_RCC_USART3_CLKSOURCE_PCLK1

PCLK1 clock used as USART3 clock source

LL_RCC_USART3_CLKSOURCE_SYSCLK

SYSCLK clock used as USART3 clock source

LL_RCC_USART3_CLKSOURCE_HSI

HSI clock used as USART3 clock source

LL_RCC_USART3_CLKSOURCE_LSE

LSE clock used as USART3 clock source

Peripheral USB get clock source

LL_RCC_USB_CLKSOURCE

USB Clock source selection

Peripheral USB clock source selection

LL_RCC_USB_CLKSOURCE_HSI48

HSI48 clock used as USB clock source

LL_RCC_USB_CLKSOURCE_PLLSAI1

PLLSAI1 clock used as USB clock source

LL_RCC_USB_CLKSOURCE_PLL

PLL clock used as USB clock source

LL_RCC_USB_CLKSOURCE_MSI

MSI clock used as USB clock source

Calculate frequencies

__LL_RCC_CALC_PLLCLK_FREQ

Description:

- Helper macro to calculate the PLLCLK frequency on system domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLM__: This parameter can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)
- __PLLN__: Between 8 and 86
- __PLLR__: This parameter can be one of the following values:
  - LL_RCC_PLLR_DIV_2
  - LL_RCC_PLLR_DIV_4
  - LL_RCC_PLLR_DIV_6
  - LL_RCC_PLLR_DIV_8

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLCLK_FREQ (HSE_VALUE,LL_RCC_PLL_GetDivider (), LL_RCC_PLL_GetN (), LL_RCC_PLL_GetR ());

__LL_RCC_CALC_PLLCLK_SAI_FREQ

Description:

- Helper macro to calculate the PLLCLK frequency used on SAI domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLM__: This parameter can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)
- __PLLN__: Between 8 and 86
- __PLLP__: This parameter can be one of the following values:
  - LL_RCC_PLLP_DIV_2
  - LL_RCC_PLLP_DIV_3
  - LL_RCC_PLLP_DIV_4
  - LL_RCC_PLLP_DIV_5
  - LL_RCC_PLLP_DIV_6
  - LL_RCC_PLLP_DIV_7
  - LL_RCC_PLLP_DIV_8
  - LL_RCC_PLLP_DIV_9
  - LL_RCC_PLLP_DIV_10
  - LL_RCC_PLLP_DIV_11
  - LL_RCC_PLLP_DIV_12
  - LL_RCC_PLLP_DIV_13
  - LL_RCC_PLLP_DIV_14
  - LL_RCC_PLLP_DIV_15
  - LL_RCC_PLLP_DIV_16
  - LL_RCC_PLLP_DIV_17
  - LL_RCC_PLLP_DIV_18
  - LL_RCC_PLLP_DIV_19
  - LL_RCC_PLLP_DIV_20
  - LL_RCC_PLLP_DIV_21
  - LL_RCC_PLLP_DIV_22
  - LL_RCC_PLLP_DIV_23
  - LL_RCC_PLLP_DIV_24
  - LL_RCC_PLLP_DIV_25
  - LL_RCC_PLLP_DIV_26

- LL_RCC_PLLP_DIV_27
- LL_RCC_PLLP_DIV_28
- LL_RCC_PLLP_DIV_29
- LL_RCC_PLLP_DIV_30
- LL_RCC_PLLP_DIV_31

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLCLK_SAI_FREQ (HSE_VALUE,LL_RCC_PLL_GetDivider (), LL_RCC_PLL_GetN (), LL_RCC_PLL_GetP ());

__LL_RCC_CALC_PLLCLK_48M_FREQ

Description:

- Helper macro to calculate the PLLCLK frequency used on 48M domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLM__: This parameter can be one of the following values:
  - LL_RCC_PLLM_DIV_1
  - LL_RCC_PLLM_DIV_2
  - LL_RCC_PLLM_DIV_3
  - LL_RCC_PLLM_DIV_4
  - LL_RCC_PLLM_DIV_5
  - LL_RCC_PLLM_DIV_6
  - LL_RCC_PLLM_DIV_7
  - LL_RCC_PLLM_DIV_8
  - LL_RCC_PLLM_DIV_9 (*)
  - LL_RCC_PLLM_DIV_10 (*)
  - LL_RCC_PLLM_DIV_11 (*)
  - LL_RCC_PLLM_DIV_12 (*)
  - LL_RCC_PLLM_DIV_13 (*)
  - LL_RCC_PLLM_DIV_14 (*)
  - LL_RCC_PLLM_DIV_15 (*)
  - LL_RCC_PLLM_DIV_16 (*)
- __PLLN__: Between 8 and 86
- __PLLQ__: This parameter can be one of the following values:
  - LL_RCC_PLLQ_DIV_2
  - LL_RCC_PLLQ_DIV_4
  - LL_RCC_PLLQ_DIV_6
  - LL_RCC_PLLQ_DIV_8

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLCLK_48M_FREQ (HSE_VALUE,LL_RCC_PLL_GetDivider (), LL_RCC_PLL_GetN (), LL_RCC_PLL_GetQ ());

__LL_RCC_CALC_PLLSAI1_SAI_FREQ

Description:

- Helper macro to calculate the PLLSAI1 frequency used for SAI domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLSAI1M__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16
- __PLLSAI1N__: Between 8 and 86
- __PLLSAI1P__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI1P_DIV_2
  - LL_RCC_PLLSAI1P_DIV_3
  - LL_RCC_PLLSAI1P_DIV_4
  - LL_RCC_PLLSAI1P_DIV_5
  - LL_RCC_PLLSAI1P_DIV_6
  - LL_RCC_PLLSAI1P_DIV_7
  - LL_RCC_PLLSAI1P_DIV_8
  - LL_RCC_PLLSAI1P_DIV_9
  - LL_RCC_PLLSAI1P_DIV_10
  - LL_RCC_PLLSAI1P_DIV_11
  - LL_RCC_PLLSAI1P_DIV_12
  - LL_RCC_PLLSAI1P_DIV_13
  - LL_RCC_PLLSAI1P_DIV_14
  - LL_RCC_PLLSAI1P_DIV_15
  - LL_RCC_PLLSAI1P_DIV_16
  - LL_RCC_PLLSAI1P_DIV_17
  - LL_RCC_PLLSAI1P_DIV_18
  - LL_RCC_PLLSAI1P_DIV_19
  - LL_RCC_PLLSAI1P_DIV_20
  - LL_RCC_PLLSAI1P_DIV_21
  - LL_RCC_PLLSAI1P_DIV_22
  - LL_RCC_PLLSAI1P_DIV_23
  - LL_RCC_PLLSAI1P_DIV_24
  - LL_RCC_PLLSAI1P_DIV_25
  - LL_RCC_PLLSAI1P_DIV_26

- LL_RCC_PLLSAI1P_DIV_27
- LL_RCC_PLLSAI1P_DIV_28
- LL_RCC_PLLSAI1P_DIV_29
- LL_RCC_PLLSAI1P_DIV_30
- LL_RCC_PLLSAI1P_DIV_31

Return value:

- PLLSAI1: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLSAI1_SAI_FREQ (HSE_VALUE,LL_RCC_PLLSAI1_GetDivider (), LL_RCC_PLLSAI1_GetN (), LL_RCC_PLLSAI1_GetP ());

__LL_RCC_CALC_PLLSAI1_48M_FREQ

Description:

- Helper macro to calculate the PLLSAI1 frequency used on 48M domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLSAI1M__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16
- __PLLSAI1N__: Between 8 and 86
- __PLLSAI1Q__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI1Q_DIV_2
  - LL_RCC_PLLSAI1Q_DIV_4
  - LL_RCC_PLLSAI1Q_DIV_6
  - LL_RCC_PLLSAI1Q_DIV_8

Return value:

- PLLSAI1: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLSAI1_48M_FREQ (HSE_VALUE,LL_RCC_PLLSAI1_GetDivider (), LL_RCC_PLLSAI1_GetN (), LL_RCC_PLLSAI1_GetQ ());

__LL_RCC_CALC_PLLSAI1_ADC_FREQ

Description:

- Helper macro to calculate the PLLSAI1 frequency used on ADC domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLSAI1M__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI1M_DIV_1
  - LL_RCC_PLLSAI1M_DIV_2
  - LL_RCC_PLLSAI1M_DIV_3
  - LL_RCC_PLLSAI1M_DIV_4
  - LL_RCC_PLLSAI1M_DIV_5
  - LL_RCC_PLLSAI1M_DIV_6
  - LL_RCC_PLLSAI1M_DIV_7
  - LL_RCC_PLLSAI1M_DIV_8
  - LL_RCC_PLLSAI1M_DIV_9
  - LL_RCC_PLLSAI1M_DIV_10
  - LL_RCC_PLLSAI1M_DIV_11
  - LL_RCC_PLLSAI1M_DIV_12
  - LL_RCC_PLLSAI1M_DIV_13
  - LL_RCC_PLLSAI1M_DIV_14
  - LL_RCC_PLLSAI1M_DIV_15
  - LL_RCC_PLLSAI1M_DIV_16
- __PLLSAI1N__: Between 8 and 86
- __PLLSAI1R__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI1R_DIV_2
  - LL_RCC_PLLSAI1R_DIV_4
  - LL_RCC_PLLSAI1R_DIV_6
  - LL_RCC_PLLSAI1R_DIV_8

Return value:

- PLLSAI1: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLSAI1_ADC_FREQ (HSE_VALUE,LL_RCC_PLLSAI1_GetDivider (), LL_RCC_PLLSAI1_GetN (), LL_RCC_PLLSAI1_GetR ());

__LL_RCC_CALC_PLLSAI2_SAI_FREQ

Description:

- Helper macro to calculate the PLLSAI2 frequency used for SAI domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLSAI2M__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16
- __PLLSAI2N__: Between 8 and 86
- __PLLSAI2P__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2P_DIV_2
  - LL_RCC_PLLSAI2P_DIV_3
  - LL_RCC_PLLSAI2P_DIV_4
  - LL_RCC_PLLSAI2P_DIV_5
  - LL_RCC_PLLSAI2P_DIV_6
  - LL_RCC_PLLSAI2P_DIV_7
  - LL_RCC_PLLSAI2P_DIV_8
  - LL_RCC_PLLSAI2P_DIV_9
  - LL_RCC_PLLSAI2P_DIV_10
  - LL_RCC_PLLSAI2P_DIV_11
  - LL_RCC_PLLSAI2P_DIV_12
  - LL_RCC_PLLSAI2P_DIV_13
  - LL_RCC_PLLSAI2P_DIV_14
  - LL_RCC_PLLSAI2P_DIV_15
  - LL_RCC_PLLSAI2P_DIV_16
  - LL_RCC_PLLSAI2P_DIV_17
  - LL_RCC_PLLSAI2P_DIV_18
  - LL_RCC_PLLSAI2P_DIV_19
  - LL_RCC_PLLSAI2P_DIV_20
  - LL_RCC_PLLSAI2P_DIV_21
  - LL_RCC_PLLSAI2P_DIV_22
  - LL_RCC_PLLSAI2P_DIV_23
  - LL_RCC_PLLSAI2P_DIV_24
  - LL_RCC_PLLSAI2P_DIV_25
  - LL_RCC_PLLSAI2P_DIV_26

- LL_RCC_PLLSAI2P_DIV_27
- LL_RCC_PLLSAI2P_DIV_28
- LL_RCC_PLLSAI2P_DIV_29
- LL_RCC_PLLSAI2P_DIV_30
- LL_RCC_PLLSAI2P_DIV_31

Return value:

- PLLSAI2: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLSAI2_SAI_FREQ (HSE_VALUE,LL_RCC_PLLSAI2_GetDivider (), LL_RCC_PLLSAI2_GetN (), LL_RCC_PLLSAI2_GetP ());

__LL_RCC_CALC_PLLSAI2_LTDC_FREQ

Description:

- Helper macro to calculate the PLLSAI2 frequency used for LTDC domain.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on HSE/HSI/MSI)
- __PLLSAI2M__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16
- __PLLSAI2N__: Between 8 and 86
- __PLLSAI2R__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2R_DIV_2
  - LL_RCC_PLLSAI2R_DIV_4
  - LL_RCC_PLLSAI2R_DIV_6
  - LL_RCC_PLLSAI2R_DIV_8
- __PLLSAI2DIVR__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2DIVR_DIV_2
  - LL_RCC_PLLSAI2DIVR_DIV_4
  - LL_RCC_PLLSAI2DIVR_DIV_8
  - LL_RCC_PLLSAI2DIVR_DIV_16

Return value:

- PLLSAI2: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLSAI2_LTDC_FREQ (HSE_VALUE,LL_RCC_PLLSAI2_GetDivider (), LL_RCC_PLLSAI2_GetN (), LL_RCC_PLLSAI2_GetR (), LL_RCC_PLLSAI2_GetDIVR ());

__LL_RCC_CALC_PLLSAI2_DSI_FREQ

Description:

- Helper macro to calculate the PLLDSICLK frequency used on DSI.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on HSE/HSI/MSI)
- __PLLSAI2M__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2M_DIV_1
  - LL_RCC_PLLSAI2M_DIV_2
  - LL_RCC_PLLSAI2M_DIV_3
  - LL_RCC_PLLSAI2M_DIV_4
  - LL_RCC_PLLSAI2M_DIV_5
  - LL_RCC_PLLSAI2M_DIV_6
  - LL_RCC_PLLSAI2M_DIV_7
  - LL_RCC_PLLSAI2M_DIV_8
  - LL_RCC_PLLSAI2M_DIV_9
  - LL_RCC_PLLSAI2M_DIV_10
  - LL_RCC_PLLSAI2M_DIV_11
  - LL_RCC_PLLSAI2M_DIV_12
  - LL_RCC_PLLSAI2M_DIV_13
  - LL_RCC_PLLSAI2M_DIV_14
  - LL_RCC_PLLSAI2M_DIV_15
  - LL_RCC_PLLSAI2M_DIV_16
- __PLLSAI2N__: Between 8 and 86
- __PLLSAI2Q__: This parameter can be one of the following values:
  - LL_RCC_PLLSAI2Q_DIV_2
  - LL_RCC_PLLSAI2Q_DIV_4
  - LL_RCC_PLLSAI2Q_DIV_6
  - LL_RCC_PLLSAI2Q_DIV_8

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLSAI2_DSI_FREQ (HSE_VALUE,LL_RCC_PLLSAI2_GetDivider (), LL_RCC_PLLSAI2_GetN (), LL_RCC_PLLSAI2_GetQ ());

__LL_RCC_CALC_HCLK_FREQ

Description:

- Helper macro to calculate the HCLK frequency.

Parameters:

- __SYSCLKFREQ__: SYSCLK frequency (based on MSI/HSE/HSI/PLLCLK)
- __AHBPRESCALER__: This parameter can be one of the following values:
  - LL_RCC_SYSCLK_DIV_1
  - LL_RCC_SYSCLK_DIV_2
  - LL_RCC_SYSCLK_DIV_4
  - LL_RCC_SYSCLK_DIV_8
  - LL_RCC_SYSCLK_DIV_16
  - LL_RCC_SYSCLK_DIV_64
  - LL_RCC_SYSCLK_DIV_128
  - LL_RCC_SYSCLK_DIV_256
  - LL_RCC_SYSCLK_DIV_512

Return value:

- HCLK: clock frequency (in Hz)

__LL_RCC_CALC_PCLK1_FREQ

Description:

- Helper macro to calculate the PCLK1 frequency (ABP1)

Parameters:

- __HCLKFREQ__: HCLK frequency
- __APB1PRESCALER__: This parameter can be one of the following values:
  - LL_RCC_APB1_DIV_1
  - LL_RCC_APB1_DIV_2
  - LL_RCC_APB1_DIV_4
  - LL_RCC_APB1_DIV_8
  - LL_RCC_APB1_DIV_16

Return value:

- PCLK1: clock frequency (in Hz)

__LL_RCC_CALC_PCLK2_FREQ

Description:

- Helper macro to calculate the PCLK2 frequency (ABP2)

Parameters:

- __HCLKFREQ__: HCLK frequency
- __APB2PRESCALER__: This parameter can be one of the following values:
  - LL_RCC_APB2_DIV_1
  - LL_RCC_APB2_DIV_2
  - LL_RCC_APB2_DIV_4
  - LL_RCC_APB2_DIV_8
  - LL_RCC_APB2_DIV_16

Return value:

- PCLK2: clock frequency (in Hz)

__LL_RCC_CALC_MSI_FREQ

Description:

- Helper macro to calculate the MSI frequency (in Hz)

Parameters:

- __MSISEL__: This parameter can be one of the following values:
  - LL_RCC_MSIRANGESEL_STANDBY
  - LL_RCC_MSIRANGESEL_RUN
- __MSIRANGE__: This parameter can be one of the following values:
  - LL_RCC_MSIRANGE_0
  - LL_RCC_MSIRANGE_1
  - LL_RCC_MSIRANGE_2
  - LL_RCC_MSIRANGE_3
  - LL_RCC_MSIRANGE_4
  - LL_RCC_MSIRANGE_5
  - LL_RCC_MSIRANGE_6
  - LL_RCC_MSIRANGE_7
  - LL_RCC_MSIRANGE_8
  - LL_RCC_MSIRANGE_9
  - LL_RCC_MSIRANGE_10
  - LL_RCC_MSIRANGE_11
  - LL_RCC_MSISRANGE_4
  - LL_RCC_MSISRANGE_5
  - LL_RCC_MSISRANGE_6
  - LL_RCC_MSISRANGE_7

Return value:

- MSI: clock frequency (in Hz)

Notes:

- __MSISEL__ can be retrieved thanks to function LL_RCC_MSI_IsEnabledRangeSelect() if __MSISEL__ is equal to LL_RCC_MSIRANGESEL_STANDBY, __MSIRANGE__can be retrieved by LL_RCC_MSI_GetRangeAfterStandby() else by LL_RCC_MSI_GetRange() ex: __LL_RCC_CALC_MSI_FREQ(LL_RCC_MSI_IsEnabledRangeSelect(), (LL_RCC_MSI_IsEnabledRangeSelect()? LL_RCC_MSI_GetRange(): LL_RCC_MSI_GetRangeAfterStandby()))

Common Write and read registers Macros

LL_RCC_WriteReg

Description:

- Write a value in RCC register.

Parameters:

- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_RCC_ReadReg

Description:

- Read a value in RCC register.

Parameters:

- __REG__: Register to be read

Return value:

- Register: value

100 LL RNG Generic Driver

100.1 RNG Firmware driver registers structures

100.1.1 LL_RNG_InitTypeDef

LL_RNG_InitTypeDef is defined in the stm32l4xx_ll_rng.h

Data Fields

- ***uint32_t ClockErrorDetection***

Field Documentation

- ***uint32_t LL_RNG_InitTypeDef::ClockErrorDetection***
  Clock error detection. This parameter can be one value of ***RNG_LL_CED***.This parameter can be modified using unitary functions **LL_RNG_EnableClkErrorDetect()**.

100.2 RNG Firmware driver API description

The following section lists the various functions of the RNG library.

100.2.1 Detailed description of functions

`LL_RNG_Enable`

Function name

__STATIC_INLINE void LL_RNG_Enable (RNG_TypeDef * RNGx)

Function description

Enable Random Number Generation.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNGEN LL_RNG_Enable

`LL_RNG_Disable`

Function name

__STATIC_INLINE void LL_RNG_Disable (RNG_TypeDef * RNGx)

Function description

Disable Random Number Generation.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNGEN LL_RNG_Disable

`LL_RNG_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsEnabled (RNG_TypeDef * RNGx)

Function description

Check if Random Number Generator is enabled.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR RNGEN LL_RNG_IsEnabled

`LL_RNG_EnableClkErrorDetect`

Function name

__STATIC_INLINE void LL_RNG_EnableClkErrorDetect (RNG_TypeDef * RNGx)

Function description

Enable Clock Error Detection.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CED LL_RNG_EnableClkErrorDetect

`LL_RNG_DisableClkErrorDetect`

Function name

__STATIC_INLINE void LL_RNG_DisableClkErrorDetect (RNG_TypeDef * RNGx)

Function description

Disable RNG Clock Error Detection.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CED LL_RNG_DisableClkErrorDetect

`LL_RNG_IsEnabledClkErrorDetect`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsEnabledClkErrorDetect (RNG_TypeDef * RNGx)

Function description

Check if RNG Clock Error Detection is enabled.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CED LL_RNG_IsEnabledClkErrorDetect

`LL_RNG_SetConditioningResetBit`

Function name

__STATIC_INLINE void LL_RNG_SetConditioningResetBit (RNG_TypeDef * RNGx)

Function description

Set RNG Conditioning Soft Reset bit.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CONDRST LL_RNG_SetConditioningResetBit

`LL_RNG_ResetConditioningResetBit`

Function name

__STATIC_INLINE void LL_RNG_ResetConditioningResetBit (RNG_TypeDef * RNGx)

Function description

Reset RNG Conditioning Soft Reset bit.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CONDRST LL_RNG_ResetConditioningResetBit

`LL_RNG_IsResetConditioningBitSet`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsResetConditioningBitSet (RNG_TypeDef * RNGx)

Function description

Check if RNG Conditioning Soft Reset bit is set.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CONDRST LL_RNG_IsResetConditioningBitSet

`LL_RNG_ConfigLock`

Function name

__STATIC_INLINE void LL_RNG_ConfigLock (RNG_TypeDef * RNGx)

Function description

Enable RNG Config Lock.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CONFIGLOCK LL_RNG_ConfigLock

`LL_RNG_IsConfigLocked`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsConfigLocked (RNG_TypeDef * RNGx)

Function description

Check if RNG Config Lock is enabled.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR CONFIGLOCK LL_RNG_IsConfigLocked

`LL_RNG_EnableNistCompliance`

Function name

__STATIC_INLINE void LL_RNG_EnableNistCompliance (RNG_TypeDef * RNGx)

Function description

Enable NIST Compliance.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR NISTC LL_RNG_EnableNistCompliance

`LL_RNG_DisableNistCompliance`

Function name

__STATIC_INLINE void LL_RNG_DisableNistCompliance (RNG_TypeDef * RNGx)

Function description

Disable NIST Compliance.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR NISTC LL_RNG_DisableNistCompliance

`LL_RNG_IsNistComplianceEnabled`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsNistComplianceEnabled (RNG_TypeDef * RNGx)

Function description

Check if NIST Compliance is enabled.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR NISTC LL_RNG_IsNistComplianceEnabled

`LL_RNG_SetConfig1`

Function name

__STATIC_INLINE void LL_RNG_SetConfig1 (RNG_TypeDef * RNGx, uint32_t Config1)

Function description

Set RNG Config1 Configuration field value.

Parameters

- **RNGx:** RNG Instance
- **Config1:** Value between 0 and 0x3F

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNG_CONFIG1 LL_RNG_SetConfig1

`LL_RNG_GetConfig1`

Function name

__STATIC_INLINE uint32_t LL_RNG_GetConfig1 (RNG_TypeDef * RNGx)

Function description

Get RNG Config1 Configuration field value.

Parameters

- **RNGx:** RNG Instance

Return values

- **Returned:** Value expressed on 6 bits : Value between 0 and 0x3F

Reference Manual to LL API cross reference:

- CR RNG_CONFIG1 LL_RNG_GetConfig1

`LL_RNG_SetConfig2`

Function name

__STATIC_INLINE void LL_RNG_SetConfig2 (RNG_TypeDef * RNGx, uint32_t Config2)

Function description

Set RNG Config2 Configuration field value.

Parameters

- **RNGx:** RNG Instance
- **Config2:** Value between 0 and 0x7

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNG_CONFIG2 LL_RNG_SetConfig2

`LL_RNG_GetConfig2`

Function name

__STATIC_INLINE uint32_t LL_RNG_GetConfig2 (RNG_TypeDef * RNGx)

Function description

Get RNG Config2 Configuration field value.

Parameters

- **RNGx:** RNG Instance

Return values

- **Returned:** Value expressed on 3 bits : Value between 0 and 0x7

Reference Manual to LL API cross reference:

- CR RNG_CONFIG2 LL_RNG_GetConfig2

`LL_RNG_SetConfig3`

Function name

__STATIC_INLINE void LL_RNG_SetConfig3 (RNG_TypeDef * RNGx, uint32_t Config3)

Function description

Set RNG Config3 Configuration field value.

Parameters

- **RNGx:** RNG Instance
- **Config3:** Value between 0 and 0xF

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR RNG_CONFIG3 LL_RNG_SetConfig3

`LL_RNG_GetConfig3`

Function name

__STATIC_INLINE uint32_t LL_RNG_GetConfig3 (RNG_TypeDef * RNGx)

Function description

Get RNG Config3 Configuration field value.

Parameters

- **RNGx:** RNG Instance

Return values

- **Returned:** Value expressed on 4 bits : Value between 0 and 0xF

Reference Manual to LL API cross reference:

- CR RNG_CONFIG3 LL_RNG_GetConfig3

`LL_RNG_SetClockDivider`

Function name

__STATIC_INLINE void LL_RNG_SetClockDivider (RNG_TypeDef * RNGx, uint32_t Divider)

Function description

Set RNG Clock divider factor.

Parameters

- **RNGx:** RNG Instance
- **Divider:** can be one of the following values:
  - LL_RNG_CLKDIV_BY_1
  - LL_RNG_CLKDIV_BY_2
  - LL_RNG_CLKDIV_BY_4
  - LL_RNG_CLKDIV_BY_8
  - LL_RNG_CLKDIV_BY_16
  - LL_RNG_CLKDIV_BY_32
  - LL_RNG_CLKDIV_BY_64
  - LL_RNG_CLKDIV_BY_128
  - LL_RNG_CLKDIV_BY_256
  - LL_RNG_CLKDIV_BY_512
  - LL_RNG_CLKDIV_BY_1024
  - LL_RNG_CLKDIV_BY_2048
  - LL_RNG_CLKDIV_BY_4096
  - LL_RNG_CLKDIV_BY_8192
  - LL_RNG_CLKDIV_BY_16384
  - LL_RNG_CLKDIV_BY_32768

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR CLKDIV LL_RNG_SetClockDivider

`LL_RNG_GetClockDivider`

Function name

__STATIC_INLINE uint32_t LL_RNG_GetClockDivider (RNG_TypeDef * RNGx)

Function description

Get RNG Clock divider factor.

Parameters

- **RNGx:** RNG Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RNG_CLKDIV_BY_1
  - LL_RNG_CLKDIV_BY_2
  - LL_RNG_CLKDIV_BY_4
  - LL_RNG_CLKDIV_BY_8
  - LL_RNG_CLKDIV_BY_16
  - LL_RNG_CLKDIV_BY_32
  - LL_RNG_CLKDIV_BY_64
  - LL_RNG_CLKDIV_BY_128
  - LL_RNG_CLKDIV_BY_256
  - LL_RNG_CLKDIV_BY_512
  - LL_RNG_CLKDIV_BY_1024
  - LL_RNG_CLKDIV_BY_2048
  - LL_RNG_CLKDIV_BY_4096
  - LL_RNG_CLKDIV_BY_8192
  - LL_RNG_CLKDIV_BY_16384
  - LL_RNG_CLKDIV_BY_32768

Reference Manual to LL API cross reference:

- CR CLKDIV LL_RNG_GetClockDivider

`LL_RNG_IsActiveFlag_DRDY`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_DRDY (RNG_TypeDef * RNGx)

Function description

Indicate if the RNG Data ready Flag is set or not.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR DRDY LL_RNG_IsActiveFlag_DRDY

`LL_RNG_IsActiveFlag_CECS`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_CECS (RNG_TypeDef * RNGx)

Function description

Indicate if the Clock Error Current Status Flag is set or not.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CECS LL_RNG_IsActiveFlag_CECS

`LL_RNG_IsActiveFlag_SECS`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_SECS (RNG_TypeDef * RNGx)

Function description

Indicate if the Seed Error Current Status Flag is set or not.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR SECS LL_RNG_IsActiveFlag_SECS

`LL_RNG_IsActiveFlag_CEIS`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_CEIS (RNG_TypeDef * RNGx)

Function description

Indicate if the Clock Error Interrupt Status Flag is set or not.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CEIS LL_RNG_IsActiveFlag_CEIS

`LL_RNG_IsActiveFlag_SEIS`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsActiveFlag_SEIS (RNG_TypeDef * RNGx)

Function description

Indicate if the Seed Error Interrupt Status Flag is set or not.

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR SEIS LL_RNG_IsActiveFlag_SEIS

`LL_RNG_ClearFlag_CEIS`

Function name

__STATIC_INLINE void LL_RNG_ClearFlag_CEIS (RNG_TypeDef * RNGx)

Function description

Clear Clock Error interrupt Status (CEIS) Flag.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CEIS LL_RNG_ClearFlag_CEIS

`LL_RNG_ClearFlag_SEIS`

Function name

__STATIC_INLINE void LL_RNG_ClearFlag_SEIS (RNG_TypeDef * RNGx)

Function description

Clear Seed Error interrupt Status (SEIS) Flag.

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR SEIS LL_RNG_ClearFlag_SEIS

`LL_RNG_EnableIT`

Function name

__STATIC_INLINE void LL_RNG_EnableIT (RNG_TypeDef * RNGx)

Function description

Enable Random Number Generator Interrupt (applies for either Seed error, Clock Error or Data ready interrupts)

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR IE LL_RNG_EnableIT

`LL_RNG_DisableIT`

Function name

__STATIC_INLINE void LL_RNG_DisableIT (RNG_TypeDef * RNGx)

Function description

Disable Random Number Generator Interrupt (applies for either Seed error, Clock Error or Data ready interrupts)

Parameters

- **RNGx:** RNG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR IE LL_RNG_DisableIT

`LL_RNG_IsEnabledIT`

Function name

__STATIC_INLINE uint32_t LL_RNG_IsEnabledIT (RNG_TypeDef * RNGx)

Function description

Check if Random Number Generator Interrupt is enabled (applies for either Seed error, Clock Error or Data ready interrupts)

Parameters

- **RNGx:** RNG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR IE LL_RNG_IsEnabledIT

`LL_RNG_ReadRandData32`

Function name

__STATIC_INLINE uint32_t LL_RNG_ReadRandData32 (RNG_TypeDef * RNGx)

Function description

Return32-bit Random Number value.

Parameters

- **RNGx:** RNG Instance

Return values

- **Generated:** 32-bit random value

Reference Manual to LL API cross reference:

- DR RNDATA LL_RNG_ReadRandData32

`LL_RNG_SetHealthconfiguration`

Function name

__STATIC_INLINE void LL_RNG_SetHealthconfiguration (RNG_TypeDef * RNGx, uint32_t HTCFG)

Function description

Set RNG Health Test Control.

Parameters

- **RNGx:** RNG Instance
- **HTCFG:** can be values of 32 bits

Return values

- **None:**

Reference Manual to LL API cross reference:

- HTCR HTCFG LL_RNG_SetHealthconfiguration

`LL_RNG_GetHealthconfiguration`

Function name

__STATIC_INLINE uint32_t LL_RNG_GetHealthconfiguration (RNG_TypeDef * RNGx)

Function description

Get RNG Health Test Control.

Parameters

- **RNGx:** RNG Instance

Return values

- **Return:** 32-bit RNG Health Test configuration

Reference Manual to LL API cross reference:

- HTCR HTCFG LL_RNG_GetHealthconfiguration

`LL_RNG_Init`

Function name

ErrorStatus LL_RNG_Init (RNG_TypeDef * RNGx, LL_RNG_InitTypeDef * RNG_InitStruct)

Function description

Initialize RNG registers according to the specified parameters in RNG_InitStruct.

Parameters

- **RNGx:** RNG Instance
- **RNG_InitStruct:** pointer to a LL_RNG_InitTypeDef structure that contains the configuration information for the specified RNG peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RNG registers are initialized according to RNG_InitStruct content
  - ERROR: not applicable

`LL_RNG_StructInit`

Function name

void LL_RNG_StructInit (LL_RNG_InitTypeDef * RNG_InitStruct)

Function description

Set each LL_RNG_InitTypeDef field to default value.

Parameters

- **RNG_InitStruct:** pointer to a LL_RNG_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

`LL_RNG_DeInit`

Function name

ErrorStatus LL_RNG_DeInit (RNG_TypeDef * RNGx)

Function description

De-initialize RNG registers (Registers restored to their default values).

Parameters

- **RNGx:** RNG Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RNG registers are de-initialized
  - ERROR: not applicable

100.3 RNG Firmware driver defines

The following section lists the various define and macros of the module.

100.3.1 RNG

RNG

Clock Error Detection

LL_RNG_CED_ENABLE

Clock error detection enabled

LL_RNG_CED_DISABLE

Clock error detection disabled

Value used to configure an internal

LL_RNG_CLKDIV_BY_1

No clock division

LL_RNG_CLKDIV_BY_2

2 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_4

4 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_8

8 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_16

16 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_32

32 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_64

64 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_128

128 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_256

256 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_512

512 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_1024

1024 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_2048

2048 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_4096

4096 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_8192

8192 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_16384

16384 RNG clock cycles per internal RNG clock

LL_RNG_CLKDIV_BY_32768

32768 RNG clock cycles per internal RNG clock

Get Flags Defines

LL_RNG_SR_DRDY

Register contains valid random data

LL_RNG_SR_CECS

Clock error current status

LL_RNG_SR_SECS

Seed error current status

LL_RNG_SR_CEIS

Clock error interrupt status

LL_RNG_SR_SEIS

Seed error interrupt status

IT Defines

LL_RNG_CR_IE

RNG Interrupt enable

Common Write and read registers Macros

LL_RNG_WriteReg

Description:

- Write a value in RNG register.

Parameters:

- __INSTANCE__: RNG Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_RNG_ReadReg

Description:

- Read a value in RNG register.

Parameters:

- __INSTANCE__: RNG Instance
- __REG__: Register to be read

Return value:

- Register: value

NIST Compliance configuration

LL_RNG_NIST_COMPLIANT

NIST compliant configuration

LL_RNG_NOTNIST_COMPLIANT

Non NIST compliant configuration

101 LL RTC Generic Driver

101.1 RTC Firmware driver registers structures

101.1.1 LL_RTC_InitTypeDef

LL_RTC_InitTypeDef is defined in the stm32l4xx_ll_rtc.h

Data Fields

- ***uint32_t HourFormat***
- ***uint32_t AsynchPrescaler***
- ***uint32_t SynchPrescaler***

Field Documentation

- ***uint32_t LL_RTC_InitTypeDef::HourFormat***

  Specifies the RTC Hours Format. This parameter can be a value of ***RTC_LL_EC_HOURFORMAT***This feature can be modified afterwards using unitary function **LL_RTC_SetHourFormat()**.
- ***uint32_t LL_RTC_InitTypeDef::AsynchPrescaler***

  Specifies the RTC Asynchronous Predivider value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7FThis feature can be modified afterwards using unitary function **LL_RTC_SetAsynchPrescaler()**.
- ***uint32_t LL_RTC_InitTypeDef::SynchPrescaler***

  Specifies the RTC Synchronous Predivider value. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x7FFFThis feature can be modified afterwards using unitary function **LL_RTC_SetSynchPrescaler()**.

101.1.2 LL_RTC_TimeTypeDef

LL_RTC_TimeTypeDef is defined in the stm32l4xx_ll_rtc.h

Data Fields

- ***uint32_t TimeFormat***
- ***uint8_t Hours***
- ***uint8_t Minutes***
- ***uint8_t Seconds***

Field Documentation

- ***uint32_t LL_RTC_TimeTypeDef::TimeFormat***

  Specifies the RTC AM/PM Time. This parameter can be a value of ***RTC_LL_EC_TIME_FORMAT***This feature can be modified afterwards using unitary function **LL_RTC_TIME_SetFormat()**.
- ***uint8_t LL_RTC_TimeTypeDef::Hours***

  Specifies the RTC Time Hours. This parameter must be a number between Min_Data = 0 and Max_Data = 12 if the **LL_RTC_TIME_FORMAT_PM** is selected. This parameter must be a number between Min_Data = 0 and Max_Data = 23 if the **LL_RTC_TIME_FORMAT_AM_OR_24** is selected.This feature can be modified afterwards using unitary function **LL_RTC_TIME_SetHour()**.
- ***uint8_t LL_RTC_TimeTypeDef::Minutes***

  Specifies the RTC Time Minutes. This parameter must be a number between Min_Data = 0 and Max_Data = 59This feature can be modified afterwards using unitary function **LL_RTC_TIME_SetMinute()**.
- ***uint8_t LL_RTC_TimeTypeDef::Seconds***

  Specifies the RTC Time Seconds. This parameter must be a number between Min_Data = 0 and Max_Data = 59This feature can be modified afterwards using unitary function **LL_RTC_TIME_SetSecond()**.

101.1.3 LL_RTC_DateTypeDef

LL_RTC_DateTypeDef is defined in the stm32l4xx_ll_rtc.h

Data Fields

- ***uint8_t WeekDay***

- ***uint8_t Month***
- ***uint8_t Day***
- ***uint8_t Year***

Field Documentation

- ***uint8_t LL_RTC_DateTypeDef::WeekDay***

  Specifies the RTC Date WeekDay. This parameter can be a value of ***RTC_LL_EC_WEEKDAY***This feature can be modified afterwards using unitary function **LL_RTC_DATE_SetWeekDay()**.
- ***uint8_t LL_RTC_DateTypeDef::Month***

  Specifies the RTC Date Month. This parameter can be a value of ***RTC_LL_EC_MONTH***This feature can be modified afterwards using unitary function **LL_RTC_DATE_SetMonth()**.
- ***uint8_t LL_RTC_DateTypeDef::Day***

  Specifies the RTC Date Day. This parameter must be a number between Min_Data = 1 and Max_Data = 31This feature can be modified afterwards using unitary function **LL_RTC_DATE_SetDay()**.
- ***uint8_t LL_RTC_DateTypeDef::Year***

  Specifies the RTC Date Year. This parameter must be a number between Min_Data = 0 and Max_Data = 99This feature can be modified afterwards using unitary function **LL_RTC_DATE_SetYear()**.

101.1.4 LL_RTC_AlarmTypeDef

LL_RTC_AlarmTypeDef is defined in the stm32l4xx_ll_rtc.h

Data Fields

- ***LL_RTC_TimeTypeDef AlarmTime***
- ***uint32_t AlarmMask***
- ***uint32_t AlarmDateWeekDaySel***
- ***uint8_t AlarmDateWeekDay***

Field Documentation

- ***LL_RTC_TimeTypeDef LL_RTC_AlarmTypeDef::AlarmTime***

  Specifies the RTC Alarm Time members.
- ***uint32_t LL_RTC_AlarmTypeDef::AlarmMask***

  Specifies the RTC Alarm Masks. This parameter can be a value of ***RTC_LL_EC_ALMA_MASK*** for ALARM A or ***RTC_LL_EC_ALMB_MASK*** for ALARM B.This feature can be modified afterwards using unitary function **LL_RTC_ALMA_SetMask()** for ALARM A or **LL_RTC_ALMB_SetMask()** for ALARM B
- ***uint32_t LL_RTC_AlarmTypeDef::AlarmDateWeekDaySel***

  Specifies the RTC Alarm is on day or WeekDay. This parameter can be a value of ***RTC_LL_EC_ALMA_WEEKDAY_SELECTION*** for ALARM A or ***RTC_LL_EC_ALMB_WEEKDAY_SELECTION*** for ALARM BThis feature can be modified afterwards using unitary function **LL_RTC_ALMA_EnableWeekday()** or **LL_RTC_ALMA_DisableWeekday()** for ALARM A or **LL_RTC_ALMB_EnableWeekday()** or **LL_RTC_ALMB_DisableWeekday()** for ALARM B
- ***uint8_t LL_RTC_AlarmTypeDef::AlarmDateWeekDay***

  Specifies the RTC Alarm Day/WeekDay. If AlarmDateWeekDaySel set to day, this parameter must be a number between Min_Data = 1 and Max_Data = 31.This feature can be modified afterwards using unitary function **LL_RTC_ALMA_SetDay()** for ALARM A or **LL_RTC_ALMB_SetDay()** for ALARM B.If AlarmDateWeekDaySel set to Weekday, this parameter can be a value of ***RTC_LL_EC_WEEKDAY***.This feature can be modified afterwards using unitary function **LL_RTC_ALMA_SetWeekDay()** for ALARM A or **LL_RTC_ALMB_SetWeekDay()** for ALARM B.

101.2 RTC Firmware driver API description

The following section lists the various functions of the RTC library.

101.2.1 Detailed description of functions

`LL_RTC_SetHourFormat`

Function name

__STATIC_INLINE void LL_RTC_SetHourFormat (RTC_TypeDef * RTCx, uint32_t HourFormat)

Function description

Set Hours format (24 hour/day or AM/PM hour format)

Parameters

- **RTCx:** RTC Instance
- **HourFormat:** This parameter can be one of the following values:
  - LL_RTC_HOURFORMAT_24HOUR
  - LL_RTC_HOURFORMAT_AMPM

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- RTC_CR FMT LL_RTC_SetHourFormat

`LL_RTC_GetHourFormat`

Function name

__STATIC_INLINE uint32_t LL_RTC_GetHourFormat (RTC_TypeDef * RTCx)

Function description

Get Hours format (24 hour/day or AM/PM hour format)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_HOURFORMAT_24HOUR
  - LL_RTC_HOURFORMAT_AMPM

Reference Manual to LL API cross reference:

- RTC_CR FMT LL_RTC_GetHourFormat

`LL_RTC_SetAlarmOutEvent`

Function name

__STATIC_INLINE void LL_RTC_SetAlarmOutEvent (RTC_TypeDef * RTCx, uint32_t AlarmOutput)

Function description

Select the flag to be routed to RTC_ALARM output.

Parameters

- **RTCx:** RTC Instance
- **AlarmOutput:** This parameter can be one of the following values:
  - LL_RTC_ALARMOUT_DISABLE
  - LL_RTC_ALARMOUT_ALMA
  - LL_RTC_ALARMOUT_ALMB
  - LL_RTC_ALARMOUT_WAKEUP

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR OSEL LL_RTC_SetAlarmOutEvent

`LL_RTC_GetAlarmOutEvent`

Function name

__STATIC_INLINE uint32_t LL_RTC_GetAlarmOutEvent (RTC_TypeDef * RTCx)

Function description

Get the flag to be routed to RTC_ALARM output.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_ALARMOUT_DISABLE
  - LL_RTC_ALARMOUT_ALMA
  - LL_RTC_ALARMOUT_ALMB
  - LL_RTC_ALARMOUT_WAKEUP

Reference Manual to LL API cross reference:

- RTC_CR OSEL LL_RTC_GetAlarmOutEvent

`LL_RTC_SetAlarmOutputType`

Function name

__STATIC_INLINE void LL_RTC_SetAlarmOutputType (RTC_TypeDef * RTCx, uint32_t Output)

Function description

Set RTC_ALARM output type (ALARM in push-pull or open-drain output)

Parameters

- **RTCx:** RTC Instance
- **Output:** This parameter can be one of the following values:
  - LL_RTC_ALARM_OUTPUTTYPE_OPENDRAIN
  - LL_RTC_ALARM_OUTPUTTYPE_PUSHPULL

Return values

- **None:**

Notes

- Used only when RTC_ALARM is mapped on PC13

Reference Manual to LL API cross reference:

- OR ALARMOUTTYPE LL_RTC_SetAlarmOutputType

`LL_RTC_GetAlarmOutputType`

Function name

__STATIC_INLINE uint32_t LL_RTC_GetAlarmOutputType (RTC_TypeDef * RTCx)

Function description

Get RTC_ALARM output type (ALARM in push-pull or open-drain output)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_ALARM_OUTPUTTYPE_OPENDRAIN
  - LL_RTC_ALARM_OUTPUTTYPE_PUSHPULL

Notes

- used only when RTC_ALARM is mapped on PC13

Reference Manual to LL API cross reference:

- OR ALARMOUTTYPE LL_RTC_GetAlarmOutputType

`LL_RTC_EnableInitMode`

Function name

__STATIC_INLINE void LL_RTC_EnableInitMode (RTC_TypeDef * RTCx)

Function description

Enable initialization mode.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Initialization mode is used to program time and date register (RTC_TR and RTC_DR) and prescaler register (RTC_PRER). Counters are stopped and start counting from the new value when INIT is reset.

Reference Manual to LL API cross reference:

- ISR INIT LL_RTC_EnableInitMode

`LL_RTC_DisableInitMode`

Function name

__STATIC_INLINE void LL_RTC_DisableInitMode (RTC_TypeDef * RTCx)

Function description

Disable initialization mode (Free running mode)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR INIT LL_RTC_DisableInitMode

`LL_RTC_SetOutputPolarity`

Function name

__STATIC_INLINE void LL_RTC_SetOutputPolarity (RTC_TypeDef * RTCx, uint32_t Polarity)

Function description

Set Output polarity (pin is low when ALRAF/ALRBF/WUTF is asserted)

Parameters

- **RTCx:** RTC Instance
- **Polarity:** This parameter can be one of the following values:
  - LL_RTC_OUTPUTPOLARITY_PIN_HIGH
  - LL_RTC_OUTPUTPOLARITY_PIN_LOW

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR POL LL_RTC_SetOutputPolarity

`LL_RTC_GetOutputPolarity`

Function name

__STATIC_INLINE uint32_t LL_RTC_GetOutputPolarity (RTC_TypeDef * RTCx)

Function description

Get Output polarity.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_OUTPUTPOLARITY_PIN_HIGH
  - LL_RTC_OUTPUTPOLARITY_PIN_LOW

Reference Manual to LL API cross reference:

- RTC_CR POL LL_RTC_GetOutputPolarity

`LL_RTC_EnableShadowRegBypass`

Function name

__STATIC_INLINE void LL_RTC_EnableShadowRegBypass (RTC_TypeDef * RTCx)

Function description

Enable Bypass the shadow registers.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR BYPSHAD LL_RTC_EnableShadowRegBypass

`LL_RTC_DisableShadowRegBypass`

Function name

__STATIC_INLINE void LL_RTC_DisableShadowRegBypass (RTC_TypeDef * RTCx)

Function description

Disable Bypass the shadow registers.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_CR BYPSHAD LL_RTC_DisableShadowRegBypass

`LL_RTC_IsShadowRegBypassEnabled`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsShadowRegBypassEnabled (RTC_TypeDef * RTCx)

Function description

Check if Shadow registers bypass is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RTC_CR BYPSHAD LL_RTC_IsShadowRegBypassEnabled

`LL_RTC_EnableRefClock`

Function name

__STATIC_INLINE void LL_RTC_EnableRefClock (RTC_TypeDef * RTCx)

Function description

Enable RTC_REFIN reference clock detection (50 or 60 Hz)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- RTC_CR REFCKON LL_RTC_EnableRefClock

`LL_RTC_DisableRefClock`

Function name

__STATIC_INLINE void LL_RTC_DisableRefClock (RTC_TypeDef * RTCx)

Function description

Disable RTC_REFIN reference clock detection (50 or 60 Hz)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- RTC_CR REFCKON LL_RTC_DisableRefClock

`LL_RTC_SetAsynchPrescaler`

Function name

__STATIC_INLINE void LL_RTC_SetAsynchPrescaler (RTC_TypeDef * RTCx, uint32_t AsynchPrescaler)

Function description

Set Asynchronous prescaler factor.

Parameters

- **RTCx:** RTC Instance
- **AsynchPrescaler:** Value between Min_Data = 0 and Max_Data = 0x7F

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_PRER PREDIV_A LL_RTC_SetAsynchPrescaler

`LL_RTC_SetSynchPrescaler`

Function name

__STATIC_INLINE void LL_RTC_SetSynchPrescaler (RTC_TypeDef * RTCx, uint32_t SynchPrescaler)

Function description

Set Synchronous prescaler factor.

Parameters

- **RTCx:** RTC Instance
- **SynchPrescaler:** Value between Min_Data = 0 and Max_Data = 0x7FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_PRER PREDIV_S LL_RTC_SetSynchPrescaler

`LL_RTC_GetAsynchPrescaler`

Function name

__STATIC_INLINE uint32_t LL_RTC_GetAsynchPrescaler (RTC_TypeDef * RTCx)

Function description

Get Asynchronous prescaler factor.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data = 0 and Max_Data = 0x7F

Reference Manual to LL API cross reference:

- RTC_PRER PREDIV_A LL_RTC_GetAsynchPrescaler

`LL_RTC_GetSynchPrescaler`

Function name

__STATIC_INLINE uint32_t LL_RTC_GetSynchPrescaler (RTC_TypeDef * RTCx)

Function description

Get Synchronous prescaler factor.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data = 0 and Max_Data = 0x7FFF

Reference Manual to LL API cross reference:

- RTC_PRER PREDIV_S LL_RTC_GetSynchPrescaler

`LL_RTC_EnableWriteProtection`

Function name

__STATIC_INLINE void LL_RTC_EnableWriteProtection (RTC_TypeDef * RTCx)

Function description

Enable the write protection for RTC registers.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_WPR KEY LL_RTC_EnableWriteProtection

`LL_RTC_DisableWriteProtection`

Function name

__STATIC_INLINE void LL_RTC_DisableWriteProtection (RTC_TypeDef * RTCx)

Function description

Disable the write protection for RTC registers.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_WPR KEY LL_RTC_DisableWriteProtection

`LL_RTC_EnableOutRemap`

Function name

__STATIC_INLINE void LL_RTC_EnableOutRemap (RTC_TypeDef * RTCx)

Function description

Enable RTC_OUT remap.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- OR OUT_RMP LL_RTC_EnableOutRemap

`LL_RTC_DisableOutRemap`

Function name

__STATIC_INLINE void LL_RTC_DisableOutRemap (RTC_TypeDef * RTCx)

Function description

Disable RTC_OUT remap.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- OR OUT_RMP LL_RTC_DisableOutRemap

`LL_RTC_TIME_SetFormat`

Function name

__STATIC_INLINE void LL_RTC_TIME_SetFormat (RTC_TypeDef * RTCx, uint32_t TimeFormat)

Function description

Set time format (AM/24-hour or PM notation)

Parameters

- **RTCx:** RTC Instance
- **TimeFormat:** This parameter can be one of the following values:
  - LL_RTC_TIME_FORMAT_AM_OR_24
  - LL_RTC_TIME_FORMAT_PM

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)

Reference Manual to LL API cross reference:

- RTC_TR PM LL_RTC_TIME_SetFormat

`LL_RTC_TIME_GetFormat`

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_GetFormat (RTC_TypeDef * RTCx)

Function description

Get time format (AM or PM notation)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_TIME_FORMAT_AM_OR_24
  - LL_RTC_TIME_FORMAT_PM

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).

Reference Manual to LL API cross reference:

- RTC_TR PM LL_RTC_TIME_GetFormat

`LL_RTC_TIME_SetHour`

Function name

__STATIC_INLINE void LL_RTC_TIME_SetHour (RTC_TypeDef * RTCx, uint32_t Hours)

Function description

Set Hours in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)
- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert hour from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_TR HT LL_RTC_TIME_SetHour
- RTC_TR HU LL_RTC_TIME_SetHour

LL_RTC_TIME_GetHour

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_GetHour (RTC_TypeDef * RTCx)

Function description

Get Hours in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).
- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert hour from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TR HT LL_RTC_TIME_GetHour
- RTC_TR HU LL_RTC_TIME_GetHour

LL_RTC_TIME_SetMinute

Function name

__STATIC_INLINE void LL_RTC_TIME_SetMinute (RTC_TypeDef * RTCx, uint32_t Minutes)

Function description

Set Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)
- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Minutes from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_TR MNT LL_RTC_TIME_SetMinute
- RTC_TR MNU LL_RTC_TIME_SetMinute

LL_RTC_TIME_GetMinute

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_GetMinute (RTC_TypeDef * RTCx)

Function description

Get Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).
- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert minute from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TR MNT LL_RTC_TIME_GetMinute
- RTC_TR MNU LL_RTC_TIME_GetMinute

LL_RTC_TIME_SetSecond

Function name

__STATIC_INLINE void LL_RTC_TIME_SetSecond (RTC_TypeDef * RTCx, uint32_t Seconds)

Function description

Set Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)
- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Seconds from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_TR ST LL_RTC_TIME_SetSecond
- RTC_TR SU LL_RTC_TIME_SetSecond

`LL_RTC_TIME_GetSecond`

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_GetSecond (RTC_TypeDef * RTCx)

Function description

Get Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).
- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Seconds from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TR ST LL_RTC_TIME_GetSecond
- RTC_TR SU LL_RTC_TIME_GetSecond

`LL_RTC_TIME_Config`

Function name

__STATIC_INLINE void LL_RTC_TIME_Config (RTC_TypeDef * RTCx, uint32_t Format12_24, uint32_t Hours, uint32_t Minutes, uint32_t Seconds)

Function description

Set time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Format12_24:** This parameter can be one of the following values:
  - LL_RTC_TIME_FORMAT_AM_OR_24
  - LL_RTC_TIME_FORMAT_PM
- **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
- **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59
- **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- It can be written in initialization mode only (LL_RTC_EnableInitMode function)
- TimeFormat and Hours should follow the same format

Reference Manual to LL API cross reference:

- RTC_TR PM LL_RTC_TIME_Config
- RTC_TR HT LL_RTC_TIME_Config
- RTC_TR HU LL_RTC_TIME_Config
- RTC_TR MNT LL_RTC_TIME_Config
- RTC_TR MNU LL_RTC_TIME_Config
- RTC_TR ST LL_RTC_TIME_Config
- RTC_TR SU LL_RTC_TIME_Config

`LL_RTC_TIME_Get`

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_Get (RTC_TypeDef * RTCx)

Function description

Get time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Combination:** of hours, minutes and seconds (Format: 0x00HHMMSS).

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- Read either RTC_SSR or RTC_TR locks the values in the higher-order calendar shadow registers until RTC_DR is read (LL_RTC_ReadReg(RTC, DR)).
- helper macros __LL_RTC_GET_HOUR, __LL_RTC_GET_MINUTE and __LL_RTC_GET_SECOND are available to get independently each parameter.

Reference Manual to LL API cross reference:

- RTC_TR HT LL_RTC_TIME_Get
- RTC_TR HU LL_RTC_TIME_Get
- RTC_TR MNT LL_RTC_TIME_Get
- RTC_TR MNU LL_RTC_TIME_Get
- RTC_TR ST LL_RTC_TIME_Get
- RTC_TR SU LL_RTC_TIME_Get

`LL_RTC_TIME_EnableDayLightStore`

Function name

__STATIC_INLINE void LL_RTC_TIME_EnableDayLightStore (RTC_TypeDef * RTCx)

Function description

Memorize whether the daylight saving time change has been performed.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR BKP LL_RTC_TIME_EnableDayLightStore

`LL_RTC_TIME_DisableDayLightStore`

Function name

__STATIC_INLINE void LL_RTC_TIME_DisableDayLightStore (RTC_TypeDef * RTCx)

Function description

Disable memorization whether the daylight saving time change has been performed.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR BKP LL_RTC_TIME_DisableDayLightStore

`LL_RTC_TIME_IsDayLightStoreEnabled`

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_IsDayLightStoreEnabled (RTC_TypeDef * RTCx)

Function description

Check if RTC Day Light Saving stored operation has been enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RTC_CR BKP LL_RTC_TIME_IsDayLightStoreEnabled

`LL_RTC_TIME_DecHour`

Function name

__STATIC_INLINE void LL_RTC_TIME_DecHour (RTC_TypeDef * RTCx)

Function description

Subtract 1 hour (winter time change)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR SUB1H LL_RTC_TIME_DecHour

`LL_RTC_TIME_IncHour`

Function name

__STATIC_INLINE void LL_RTC_TIME_IncHour (RTC_TypeDef * RTCx)

Function description

Add 1 hour (summer time change)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ADD1H LL_RTC_TIME_IncHour

`LL_RTC_TIME_GetSubSecond`

Function name

__STATIC_INLINE uint32_t LL_RTC_TIME_GetSubSecond (RTC_TypeDef * RTCx)

Function description

Get Sub second value in the synchronous prescaler counter.

Parameters

- **RTCx:** RTC Instance

Return values

- **If:** binary mode is none, Value between Min_Data=0x0 and Max_Data=0x7FFF else Value between Min_Data=0x0 and Max_Data=0xFFFFFFFF

Notes

- You can use both SubSeconds value and SecondFraction (PREDIV_S through LL_RTC_GetSynchPrescaler function) terms returned to convert Calendar SubSeconds value in second fraction ratio with time unit following generic formula: Seconds fraction ratio * time_unit= [(SecondFraction-SubSeconds)/(SecondFraction+1)] * time_unit This conversion can be performed only if no shift operation is pending (ie. SHFP=0) when PREDIV_S ≥ SS.

Reference Manual to LL API cross reference:

- RTC_SSR SS LL_RTC_TIME_GetSubSecond

`LL_RTC_TIME_Synchronize`

Function name

__STATIC_INLINE void LL_RTC_TIME_Synchronize (RTC_TypeDef * RTCx, uint32_t ShiftSecond, uint32_t Fraction)

Function description

Synchronize to a remote clock with a high degree of precision.

Parameters

- **RTCx:** RTC Instance
- **ShiftSecond:** This parameter can be one of the following values:
  - LL_RTC_SHIFT_SECOND_DELAY
  - LL_RTC_SHIFT_SECOND_ADVANCE
- **Fraction:** Number of Seconds Fractions (any value from 0 to 0x7FFF)

Return values

- **None:**

Notes

- This operation effectively subtracts from (delays) or advance the clock of a fraction of a second.
- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- When REFCKON is set, firmware must not write to Shift control register.

Reference Manual to LL API cross reference:

- RTC_SHIFTR ADD1S LL_RTC_TIME_Synchronize
- RTC_SHIFTR SUBFS LL_RTC_TIME_Synchronize

`LL_RTC_DATE_SetYear`

Function name

__STATIC_INLINE void LL_RTC_DATE_SetYear (RTC_TypeDef * RTCx, uint32_t Year)

Function description

Set Year in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Year:** Value between Min_Data=0x00 and Max_Data=0x99

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Year from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_DR YT LL_RTC_DATE_SetYear
- RTC_DR YU LL_RTC_DATE_SetYear

`LL_RTC_DATE_GetYear`

Function name

__STATIC_INLINE uint32_t LL_RTC_DATE_GetYear (RTC_TypeDef * RTCx)

Function description

Get Year in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x99

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Year from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_DR YT LL_RTC_DATE_GetYear
- RTC_DR YU LL_RTC_DATE_GetYear

`LL_RTC_DATE_SetWeekDay`

Function name

__STATIC_INLINE void LL_RTC_DATE_SetWeekDay (RTC_TypeDef * RTCx, uint32_t WeekDay)

Function description

Set Week day.

Parameters

- **RTCx:** RTC Instance
- **WeekDay:** This parameter can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_DR WDU LL_RTC_DATE_SetWeekDay

`LL_RTC_DATE_GetWeekDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_DATE_GetWeekDay (RTC_TypeDef * RTCx)

Function description

Get Week day.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit

Reference Manual to LL API cross reference:

- RTC_DR WDU LL_RTC_DATE_GetWeekDay

`LL_RTC_DATE_SetMonth`

Function name

__STATIC_INLINE void LL_RTC_DATE_SetMonth (RTC_TypeDef * RTCx, uint32_t Month)

Function description

Set Month in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Month:** This parameter can be one of the following values:
  - LL_RTC_MONTH_JANUARY
  - LL_RTC_MONTH_FEBRUARY
  - LL_RTC_MONTH_MARCH
  - LL_RTC_MONTH_APRIL
  - LL_RTC_MONTH_MAY
  - LL_RTC_MONTH_JUNE
  - LL_RTC_MONTH_JULY
  - LL_RTC_MONTH_AUGUST
  - LL_RTC_MONTH_SEPTEMBER
  - LL_RTC_MONTH_OCTOBER
  - LL_RTC_MONTH_NOVEMBER
  - LL_RTC_MONTH_DECEMBER

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Month from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_DR MT LL_RTC_DATE_SetMonth
- RTC_DR MU LL_RTC_DATE_SetMonth

`LL_RTC_DATE_GetMonth`

Function name

__STATIC_INLINE uint32_t LL_RTC_DATE_GetMonth (RTC_TypeDef * RTCx)

Function description

Get Month in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_MONTH_JANUARY
  - LL_RTC_MONTH_FEBRUARY
  - LL_RTC_MONTH_MARCH
  - LL_RTC_MONTH_APRIL
  - LL_RTC_MONTH_MAY
  - LL_RTC_MONTH_JUNE
  - LL_RTC_MONTH_JULY
  - LL_RTC_MONTH_AUGUST
  - LL_RTC_MONTH_SEPTEMBER
  - LL_RTC_MONTH_OCTOBER
  - LL_RTC_MONTH_NOVEMBER
  - LL_RTC_MONTH_DECEMBER

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Month from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_DR MT LL_RTC_DATE_GetMonth
- RTC_DR MU LL_RTC_DATE_GetMonth

`LL_RTC_DATE_SetDay`

Function name

__STATIC_INLINE void LL_RTC_DATE_SetDay (RTC_TypeDef * RTCx, uint32_t Day)

Function description

Set Day in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Day:** Value between Min_Data=0x01 and Max_Data=0x31

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Day from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_DR DT LL_RTC_DATE_SetDay
- RTC_DR DU LL_RTC_DATE_SetDay

`LL_RTC_DATE_GetDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_DATE_GetDay (RTC_TypeDef * RTCx)

Function description

Get Day in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x31

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Day from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_DR DT LL_RTC_DATE_GetDay
- RTC_DR DU LL_RTC_DATE_GetDay

LL_RTC_DATE_Config

Function name

__STATIC_INLINE void LL_RTC_DATE_Config (RTC_TypeDef * RTCx, uint32_t WeekDay, uint32_t Day, uint32_t Month, uint32_t Year)

Function description

Set date (WeekDay, Day, Month and Year) in BCD format.

Parameters

- **RTCx:** RTC Instance
- **WeekDay:** This parameter can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY
- **Day:** Value between Min_Data=0x01 and Max_Data=0x31
- **Month:** This parameter can be one of the following values:
  - LL_RTC_MONTH_JANUARY
  - LL_RTC_MONTH_FEBRUARY
  - LL_RTC_MONTH_MARCH
  - LL_RTC_MONTH_APRIL
  - LL_RTC_MONTH_MAY
  - LL_RTC_MONTH_JUNE
  - LL_RTC_MONTH_JULY
  - LL_RTC_MONTH_AUGUST
  - LL_RTC_MONTH_SEPTEMBER
  - LL_RTC_MONTH_OCTOBER
  - LL_RTC_MONTH_NOVEMBER
  - LL_RTC_MONTH_DECEMBER
- **Year:** Value between Min_Data=0x00 and Max_Data=0x99

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_DR WDU LL_RTC_DATE_Config
- RTC_DR MT LL_RTC_DATE_Config
- RTC_DR MU LL_RTC_DATE_Config
- RTC_DR DT LL_RTC_DATE_Config
- RTC_DR DU LL_RTC_DATE_Config
- RTC_DR YT LL_RTC_DATE_Config
- RTC_DR YU LL_RTC_DATE_Config

`LL_RTC_DATE_Get`

Function name

__STATIC_INLINE uint32_t LL_RTC_DATE_Get (RTC_TypeDef * RTCx)

Function description

Get date (WeekDay, Day, Month and Year) in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Combination:** of WeekDay, Day, Month and Year (Format: 0xWWDDMMYY).

Notes

- if shadow mode is disabled (BYPSHAD=0), need to check if RSF flag is set before reading this bit
- helper macros __LL_RTC_GET_WEEKDAY, __LL_RTC_GET_YEAR, __LL_RTC_GET_MONTH, and __LL_RTC_GET_DAY are available to get independently each parameter.

Reference Manual to LL API cross reference:

- RTC_DR WDU LL_RTC_DATE_Get
- RTC_DR MT LL_RTC_DATE_Get
- RTC_DR MU LL_RTC_DATE_Get
- RTC_DR DT LL_RTC_DATE_Get
- RTC_DR DU LL_RTC_DATE_Get
- RTC_DR YT LL_RTC_DATE_Get
- RTC_DR YU LL_RTC_DATE_Get

`LL_RTC_ALMA_Enable`

Function name

__STATIC_INLINE void LL_RTC_ALMA_Enable (RTC_TypeDef * RTCx)

Function description

Enable Alarm A.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRAE LL_RTC_ALMA_Enable

`LL_RTC_ALMA_Disable`

Function name

__STATIC_INLINE void LL_RTC_ALMA_Disable (RTC_TypeDef * RTCx)

Function description

Disable Alarm A.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRAE LL_RTC_ALMA_Disable

`LL_RTC_ALMA_SetMask`

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetMask (RTC_TypeDef * RTCx, uint32_t Mask)

Function description

Specify the Alarm A masks.

Parameters

- **RTCx:** RTC Instance
- **Mask:** This parameter can be a combination of the following values:
  - LL_RTC_ALMA_MASK_NONE
  - LL_RTC_ALMA_MASK_DATEWEEKDAY
  - LL_RTC_ALMA_MASK_HOURS
  - LL_RTC_ALMA_MASK_MINUTES
  - LL_RTC_ALMA_MASK_SECONDS
  - LL_RTC_ALMA_MASK_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMAR MSK4 LL_RTC_ALMA_SetMask
- RTC_ALRMAR MSK3 LL_RTC_ALMA_SetMask
- RTC_ALRMAR MSK2 LL_RTC_ALMA_SetMask
- RTC_ALRMAR MSK1 LL_RTC_ALMA_SetMask

`LL_RTC_ALMA_GetMask`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetMask (RTC_TypeDef * RTCx)

Function description

Get the Alarm A masks.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be can be a combination of the following values:
  - LL_RTC_ALMA_MASK_NONE
  - LL_RTC_ALMA_MASK_DATEWEEKDAY
  - LL_RTC_ALMA_MASK_HOURS
  - LL_RTC_ALMA_MASK_MINUTES
  - LL_RTC_ALMA_MASK_SECONDS
  - LL_RTC_ALMA_MASK_ALL

Reference Manual to LL API cross reference:

- RTC_ALRMAR MSK4 LL_RTC_ALMA_GetMask
- RTC_ALRMAR MSK3 LL_RTC_ALMA_GetMask
- RTC_ALRMAR MSK2 LL_RTC_ALMA_GetMask
- RTC_ALRMAR MSK1 LL_RTC_ALMA_GetMask

`LL_RTC_ALMA_EnableWeekday`

Function name

__STATIC_INLINE void LL_RTC_ALMA_EnableWeekday (RTC_TypeDef * RTCx)

Function description

Enable AlarmA Week day selection (DU[3:0] represents the week day.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMAR WDSEL LL_RTC_ALMA_EnableWeekday

`LL_RTC_ALMA_DisableWeekday`

Function name

__STATIC_INLINE void LL_RTC_ALMA_DisableWeekday (RTC_TypeDef * RTCx)

Function description

Disable AlarmA Week day selection (DU[3:0] represents the date)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMAR WDSEL LL_RTC_ALMA_DisableWeekday

LL_RTC_ALMA_SetDay

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetDay (RTC_TypeDef * RTCx, uint32_t Day)

Function description

Set ALARM A Day in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Day:** Value between Min_Data=0x01 and Max_Data=0x31

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Day from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMAR DT LL_RTC_ALMA_SetDay
- RTC_ALRMAR DU LL_RTC_ALMA_SetDay

LL_RTC_ALMA_GetDay

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetDay (RTC_TypeDef * RTCx)

Function description

Get ALARM A Day in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x31

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Day from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMAR DT LL_RTC_ALMA_GetDay
- RTC_ALRMAR DU LL_RTC_ALMA_GetDay

LL_RTC_ALMA_SetWeekDay

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetWeekDay (RTC_TypeDef * RTCx, uint32_t WeekDay)

Function description

Set ALARM A Weekday.

Parameters

- **RTCx:** RTC Instance
- **WeekDay:** This parameter can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMAR DU LL_RTC_ALMA_SetWeekDay

`LL_RTC_ALMA_GetWeekDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetWeekDay (RTC_TypeDef * RTCx)

Function description

Get ALARM A Weekday.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Reference Manual to LL API cross reference:

- RTC_ALRMAR DU LL_RTC_ALMA_GetWeekDay

`LL_RTC_ALMA_SetTimeFormat`

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetTimeFormat (RTC_TypeDef * RTCx, uint32_t TimeFormat)

Function description

Set Alarm A time format (AM/24-hour or PM notation)

Parameters

- **RTCx:** RTC Instance
- **TimeFormat:** This parameter can be one of the following values:
  - LL_RTC_ALMA_TIME_FORMAT_AM
  - LL_RTC_ALMA_TIME_FORMAT_PM

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMAR PM LL_RTC_ALMA_SetTimeFormat

`LL_RTC_ALMA_GetTimeFormat`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetTimeFormat (RTC_TypeDef * RTCx)

Function description

Get Alarm A time format (AM or PM notation)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_ALMA_TIME_FORMAT_AM
  - LL_RTC_ALMA_TIME_FORMAT_PM

Reference Manual to LL API cross reference:

- RTC_ALRMAR PM LL_RTC_ALMA_GetTimeFormat

`LL_RTC_ALMA_SetHour`

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetHour (RTC_TypeDef * RTCx, uint32_t Hours)

Function description

Set ALARM A Hours in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Hours from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMAR HT LL_RTC_ALMA_SetHour
- RTC_ALRMAR HU LL_RTC_ALMA_SetHour

`LL_RTC_ALMA_GetHour`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetHour (RTC_TypeDef * RTCx)

Function description

Get ALARM A Hours in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Hours from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMAR HT LL_RTC_ALMA_GetHour
- RTC_ALRMAR HU LL_RTC_ALMA_GetHour

`LL_RTC_ALMA_SetMinute`

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetMinute (RTC_TypeDef * RTCx, uint32_t Minutes)

Function description

Set ALARM A Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Minutes from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMAR MNT LL_RTC_ALMA_SetMinute
- RTC_ALRMAR MNU LL_RTC_ALMA_SetMinute

`LL_RTC_ALMA_GetMinute`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetMinute (RTC_TypeDef * RTCx)

Function description

Get ALARM A Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Minutes from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMAR MNT LL_RTC_ALMA_GetMinute
- RTC_ALRMAR MNU LL_RTC_ALMA_GetMinute

LL_RTC_ALMA_SetSecond

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetSecond (RTC_TypeDef * RTCx, uint32_t Seconds)

Function description

Set ALARM A Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Seconds from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMAR ST LL_RTC_ALMA_SetSecond
- RTC_ALRMAR SU LL_RTC_ALMA_SetSecond

LL_RTC_ALMA_GetSecond

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetSecond (RTC_TypeDef * RTCx)

Function description

Get ALARM A Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Seconds from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMAR ST LL_RTC_ALMA_GetSecond
- RTC_ALRMAR SU LL_RTC_ALMA_GetSecond

LL_RTC_ALMA_ConfigTime

Function name

__STATIC_INLINE void LL_RTC_ALMA_ConfigTime (RTC_TypeDef * RTCx, uint32_t Format12_24, uint32_t Hours, uint32_t Minutes, uint32_t Seconds)

Function description

Set Alarm A Time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Format12_24:** This parameter can be one of the following values:
  - LL_RTC_ALMA_TIME_FORMAT_AM
  - LL_RTC_ALMA_TIME_FORMAT_PM
- **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
- **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59
- **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMAR PM LL_RTC_ALMA_ConfigTime
- RTC_ALRMAR HT LL_RTC_ALMA_ConfigTime
- RTC_ALRMAR HU LL_RTC_ALMA_ConfigTime
- RTC_ALRMAR MNT LL_RTC_ALMA_ConfigTime
- RTC_ALRMAR MNU LL_RTC_ALMA_ConfigTime
- RTC_ALRMAR ST LL_RTC_ALMA_ConfigTime
- RTC_ALRMAR SU LL_RTC_ALMA_ConfigTime

LL_RTC_ALMA_GetTime

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetTime (RTC_TypeDef * RTCx)

Function description

Get Alarm B Time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Combination:** of hours, minutes and seconds.

Notes

- helper macros __LL_RTC_GET_HOUR, __LL_RTC_GET_MINUTE and __LL_RTC_GET_SECOND are available to get independently each parameter.

Reference Manual to LL API cross reference:

- RTC_ALRMAR HT LL_RTC_ALMA_GetTime
- RTC_ALRMAR HU LL_RTC_ALMA_GetTime
- RTC_ALRMAR MNT LL_RTC_ALMA_GetTime
- RTC_ALRMAR MNU LL_RTC_ALMA_GetTime
- RTC_ALRMAR ST LL_RTC_ALMA_GetTime
- RTC_ALRMAR SU LL_RTC_ALMA_GetTime

LL_RTC_ALMA_SetSubSecondMask

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetSubSecondMask (RTC_TypeDef * RTCx, uint32_t Mask)

Function description

Set Alarm A Mask the most-significant bits starting at this bit.

Parameters

- **RTCx:** RTC Instance
- **Mask:** If binary mode is none, Value between Min_Data=0x0 and Max_Data=0xF else Value between Min_Data=0x0 and Max_Data=0x3F

Return values

- **None:**

Notes

- This register can be written only when ALRAE is reset in RTC_CR register, or in initialization mode.

Reference Manual to LL API cross reference:

- RTC_ALRMASSR MASKSS LL_RTC_ALMA_SetSubSecondMask

LL_RTC_ALMA_GetSubSecondMask

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetSubSecondMask (RTC_TypeDef * RTCx)

Function description

Get Alarm A Mask the most-significant bits starting at this bit.

Parameters

- **RTCx:** RTC Instance

Return values

- **If:** binary mode is none, Value between Min_Data=0x0 and Max_Data=0xF else Value between Min_Data=0x0 and Max_Data=0x3F

Reference Manual to LL API cross reference:

- RTC_ALRMASSR MASKSS LL_RTC_ALMA_GetSubSecondMask

LL_RTC_ALMA_SetSubSecond

Function name

__STATIC_INLINE void LL_RTC_ALMA_SetSubSecond (RTC_TypeDef * RTCx, uint32_t Subsecond)

Function description

Set Alarm A Sub seconds value.

Parameters

- **RTCx:** RTC Instance
- **Subsecond:** Value between Min_Data=0x00 and Max_Data=0x7FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- RCT_ALRMASSR SS LL_RTC_ALMA_SetSubSecond

LL_RTC_ALMA_GetSubSecond

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMA_GetSubSecond (RTC_TypeDef * RTCx)

Function description

Get Alarm A Sub seconds value.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x7FFF

Reference Manual to LL API cross reference:

- RCT_ALRMASSR SS LL_RTC_ALMA_GetSubSecond

`LL_RTC_ALMB_Enable`

Function name

__STATIC_INLINE void LL_RTC_ALMB_Enable (RTC_TypeDef * RTCx)

Function description

Enable Alarm B.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRBE LL_RTC_ALMB_Enable

`LL_RTC_ALMB_Disable`

Function name

__STATIC_INLINE void LL_RTC_ALMB_Disable (RTC_TypeDef * RTCx)

Function description

Disable Alarm B.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRBE LL_RTC_ALMB_Disable

`LL_RTC_ALMB_SetMask`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetMask (RTC_TypeDef * RTCx, uint32_t Mask)

Function description

Specify the Alarm B masks.

Parameters

- **RTCx:** RTC Instance
- **Mask:** This parameter can be a combination of the following values:
  - LL_RTC_ALMB_MASK_NONE
  - LL_RTC_ALMB_MASK_DATEWEEKDAY
  - LL_RTC_ALMB_MASK_HOURS
  - LL_RTC_ALMB_MASK_MINUTES
  - LL_RTC_ALMB_MASK_SECONDS
  - LL_RTC_ALMB_MASK_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBR MSK4 LL_RTC_ALMB_SetMask
- RTC_ALRMBR MSK3 LL_RTC_ALMB_SetMask
- RTC_ALRMBR MSK2 LL_RTC_ALMB_SetMask
- RTC_ALRMBR MSK1 LL_RTC_ALMB_SetMask

LL_RTC_ALMB_GetMask

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetMask (RTC_TypeDef * RTCx)

Function description

Get the Alarm B masks.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be can be a combination of the following values:
  - LL_RTC_ALMB_MASK_NONE
  - LL_RTC_ALMB_MASK_DATEWEEKDAY
  - LL_RTC_ALMB_MASK_HOURS
  - LL_RTC_ALMB_MASK_MINUTES
  - LL_RTC_ALMB_MASK_SECONDS
  - LL_RTC_ALMB_MASK_ALL

Reference Manual to LL API cross reference:

- RTC_ALRMBR MSK4 LL_RTC_ALMB_GetMask
- RTC_ALRMBR MSK3 LL_RTC_ALMB_GetMask
- RTC_ALRMBR MSK2 LL_RTC_ALMB_GetMask
- RTC_ALRMBR MSK1 LL_RTC_ALMB_GetMask

LL_RTC_ALMB_EnableWeekday

Function name

__STATIC_INLINE void LL_RTC_ALMB_EnableWeekday (RTC_TypeDef * RTCx)

Function description

Enable AlarmB Week day selection (DU[3:0] represents the week day.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBR WDSEL LL_RTC_ALMB_EnableWeekday

`LL_RTC_ALMB_DisableWeekday`

Function name

__STATIC_INLINE void LL_RTC_ALMB_DisableWeekday (RTC_TypeDef * RTCx)

Function description

Disable AlarmB Week day selection (DU[3:0] represents the date)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBR WDSEL LL_RTC_ALMB_DisableWeekday

`LL_RTC_ALMB_SetDay`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetDay (RTC_TypeDef * RTCx, uint32_t Day)

Function description

Set ALARM B Day in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Day:** Value between Min_Data=0x01 and Max_Data=0x31

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Day from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMBR DT LL_RTC_ALMB_SetDay
- RTC_ALRMBR DU LL_RTC_ALMB_SetDay

`LL_RTC_ALMB_GetDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetDay (RTC_TypeDef * RTCx)

Function description

Get ALARM B Day in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x31

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Day from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMBR DT LL_RTC_ALMB_GetDay
- RTC_ALRMBR DU LL_RTC_ALMB_GetDay

`LL_RTC_ALMB_SetWeekDay`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetWeekDay (RTC_TypeDef * RTCx, uint32_t WeekDay)

Function description

Set ALARM B Weekday.

Parameters

- **RTCx:** RTC Instance
- **WeekDay:** This parameter can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBR DU LL_RTC_ALMB_SetWeekDay

`LL_RTC_ALMB_GetWeekDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetWeekDay (RTC_TypeDef * RTCx)

Function description

Get ALARM B Weekday.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Reference Manual to LL API cross reference:

- RTC_ALRMBR DU LL_RTC_ALMB_GetWeekDay

`LL_RTC_ALMB_SetTimeFormat`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetTimeFormat (RTC_TypeDef * RTCx, uint32_t TimeFormat)

Function description

Set ALARM B time format (AM/24-hour or PM notation)

Parameters

- **RTCx:** RTC Instance
- **TimeFormat:** This parameter can be one of the following values:
  - LL_RTC_ALMB_TIME_FORMAT_AM
  - LL_RTC_ALMB_TIME_FORMAT_PM

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBR PM LL_RTC_ALMB_SetTimeFormat

`LL_RTC_ALMB_GetTimeFormat`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetTimeFormat (RTC_TypeDef * RTCx)

Function description

Get ALARM B time format (AM or PM notation)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_ALMB_TIME_FORMAT_AM
  - LL_RTC_ALMB_TIME_FORMAT_PM

Reference Manual to LL API cross reference:

- RTC_ALRMBR PM LL_RTC_ALMB_GetTimeFormat

`LL_RTC_ALMB_SetHour`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetHour (RTC_TypeDef * RTCx, uint32_t Hours)

Function description

Set ALARM B Hours in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Hours from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMBR HT LL_RTC_ALMB_SetHour
- RTC_ALRMBR HU LL_RTC_ALMB_SetHour

`LL_RTC_ALMB_GetHour`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetHour (RTC_TypeDef * RTCx)

Function description

Get ALARM B Hours in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Hours from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMBR HT LL_RTC_ALMB_GetHour
- RTC_ALRMBR HU LL_RTC_ALMB_GetHour

`LL_RTC_ALMB_SetMinute`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetMinute (RTC_TypeDef * RTCx, uint32_t Minutes)

Function description

Set ALARM B Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Minutes:** between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Minutes from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMBR MNT LL_RTC_ALMB_SetMinute
- RTC_ALRMBR MNU LL_RTC_ALMB_SetMinute

`LL_RTC_ALMB_GetMinute`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetMinute (RTC_TypeDef * RTCx)

Function description

Get ALARM B Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Minutes from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMBR MNT LL_RTC_ALMB_GetMinute
- RTC_ALRMBR MNU LL_RTC_ALMB_GetMinute

`LL_RTC_ALMB_SetSecond`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetSecond (RTC_TypeDef * RTCx, uint32_t Seconds)

Function description

Set ALARM B Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Notes

- helper macro __LL_RTC_CONVERT_BIN2BCD is available to convert Seconds from binary to BCD format

Reference Manual to LL API cross reference:

- RTC_ALRMBR ST LL_RTC_ALMB_SetSecond
- RTC_ALRMBR SU LL_RTC_ALMB_SetSecond

LL_RTC_ALMB_GetSecond

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetSecond (RTC_TypeDef * RTCx)

Function description

Get ALARM B Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Seconds from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_ALRMBR ST LL_RTC_ALMB_GetSecond
- RTC_ALRMBR SU LL_RTC_ALMB_GetSecond

LL_RTC_ALMB_ConfigTime

Function name

__STATIC_INLINE void LL_RTC_ALMB_ConfigTime (RTC_TypeDef * RTCx, uint32_t Format12_24, uint32_t Hours, uint32_t Minutes, uint32_t Seconds)

Function description

Set Alarm B Time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance
- **Format12_24:** This parameter can be one of the following values:
  - LL_RTC_ALMB_TIME_FORMAT_AM
  - LL_RTC_ALMB_TIME_FORMAT_PM
- **Hours:** Value between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23
- **Minutes:** Value between Min_Data=0x00 and Max_Data=0x59
- **Seconds:** Value between Min_Data=0x00 and Max_Data=0x59

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBR PM LL_RTC_ALMB_ConfigTime
- RTC_ALRMBR HT LL_RTC_ALMB_ConfigTime
- RTC_ALRMBR HU LL_RTC_ALMB_ConfigTime
- RTC_ALRMBR MNT LL_RTC_ALMB_ConfigTime
- RTC_ALRMBR MNU LL_RTC_ALMB_ConfigTime
- RTC_ALRMBR ST LL_RTC_ALMB_ConfigTime
- RTC_ALRMBR SU LL_RTC_ALMB_ConfigTime

LL_RTC_ALMB_GetTime

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetTime (RTC_TypeDef * RTCx)

Function description

Get Alarm B Time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Combination:** of hours, minutes and seconds.

Notes

- helper macros __LL_RTC_GET_HOUR, __LL_RTC_GET_MINUTE and __LL_RTC_GET_SECOND are available to get independently each parameter.

Reference Manual to LL API cross reference:

- RTC_ALRMBR HT LL_RTC_ALMB_GetTime
- RTC_ALRMBR HU LL_RTC_ALMB_GetTime
- RTC_ALRMBR MNT LL_RTC_ALMB_GetTime
- RTC_ALRMBR MNU LL_RTC_ALMB_GetTime
- RTC_ALRMBR ST LL_RTC_ALMB_GetTime
- RTC_ALRMBR SU LL_RTC_ALMB_GetTime

LL_RTC_ALMB_SetSubSecondMask

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetSubSecondMask (RTC_TypeDef * RTCx, uint32_t Mask)

Function description

Set Alarm B Mask the most-significant bits starting at this bit.

Parameters

- **RTCx:** RTC Instance
- **Mask:** If binary mode is none, Value between Min_Data=0x0 and Max_Data=0xF else Value between Min_Data=0x0 and Max_Data=0x3F

Return values

- **None:**

Notes

- This register can be written only when ALRBE is reset in RTC_CR register, or in initialization mode.

Reference Manual to LL API cross reference:

- RTC_ALRMBSSR MASKSS LL_RTC_ALMB_SetSubSecondMask

LL_RTC_ALMB_GetSubSecondMask

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetSubSecondMask (RTC_TypeDef * RTCx)

Function description

Get Alarm B Mask the most-significant bits starting at this bit.

Parameters

- **RTCx:** RTC Instance

Return values

- **If:** binary mode is none, Value between Min_Data=0x0 and Max_Data=0xF else Value between Min_Data=0x0 and Max_Data=0x3F

Reference Manual to LL API cross reference:

- RTC_ALRMBSSR MASKSS LL_RTC_ALMB_GetSubSecondMask

`LL_RTC_ALMB_SetSubSecond`

Function name

__STATIC_INLINE void LL_RTC_ALMB_SetSubSecond (RTC_TypeDef * RTCx, uint32_t Subsecond)

Function description

Set Alarm B Sub seconds value.

Parameters

- **RTCx:** RTC Instance
- **Subsecond:** Value between Min_Data=0x00 and Max_Data=0x7FFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_ALRMBSSR SS LL_RTC_ALMB_SetSubSecond

`LL_RTC_ALMB_GetSubSecond`

Function name

__STATIC_INLINE uint32_t LL_RTC_ALMB_GetSubSecond (RTC_TypeDef * RTCx)

Function description

Get Alarm B Sub seconds value.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x7FFF

Reference Manual to LL API cross reference:

- RTC_ALRMBSSR SS LL_RTC_ALMB_GetSubSecond

`LL_RTC_TS_EnableInternalEvent`

Function name

__STATIC_INLINE void LL_RTC_TS_EnableInternalEvent (RTC_TypeDef * RTCx)

Function description

Enable internal event timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ITSE LL_RTC_TS_EnableInternalEvent

`LL_RTC_TS_DisableInternalEvent`

Function name

__STATIC_INLINE void LL_RTC_TS_DisableInternalEvent (RTC_TypeDef * RTCx)

Function description

Disable internal event timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ITSE LL_RTC_TS_DisableInternalEvent

`LL_RTC_TS_Enable`

Function name

__STATIC_INLINE void LL_RTC_TS_Enable (RTC_TypeDef * RTCx)

Function description

Enable Timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ITSE LL_RTC_TS_Enable

`LL_RTC_TS_Disable`

Function name

__STATIC_INLINE void LL_RTC_TS_Disable (RTC_TypeDef * RTCx)

Function description

Disable Timestamp.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ITSE LL_RTC_TS_Disable

`LL_RTC_TS_SetActiveEdge`

Function name

__STATIC_INLINE void LL_RTC_TS_SetActiveEdge (RTC_TypeDef * RTCx, uint32_t Edge)

Function description

Set Time-stamp event active edge.

Parameters

- **RTCx:** RTC Instance
- **Edge:** This parameter can be one of the following values:
  - LL_RTC_TIMESTAMP_EDGE_RISING
  - LL_RTC_TIMESTAMP_EDGE_FALLING

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- TSE must be reset when TSEDGE is changed to avoid unwanted TSF setting

Reference Manual to LL API cross reference:

- RTC_CR ITSEDGE LL_RTC_TS_SetActiveEdge

`LL_RTC_TS_GetActiveEdge`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetActiveEdge (RTC_TypeDef * RTCx)

Function description

Get Time-stamp event active edge.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_TIMESTAMP_EDGE_RISING
  - LL_RTC_TIMESTAMP_EDGE_FALLING

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ITSEDGE LL_RTC_TS_GetActiveEdge

`LL_RTC_TS_GetTimeFormat`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetTimeFormat (RTC_TypeDef * RTCx)

Function description

Get Timestamp AM/PM notation (AM or 24-hour format)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_TS_TIME_FORMAT_AM
  - LL_RTC_TS_TIME_FORMAT_PM

Reference Manual to LL API cross reference:

- RTC_TSTR PM LL_RTC_TS_GetTimeFormat

`LL_RTC_TS_GetHour`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetHour (RTC_TypeDef * RTCx)

Function description

Get Timestamp Hours in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x12 or between Min_Data=0x00 and Max_Data=0x23

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Hours from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TSTR HT LL_RTC_TS_GetHour
- RTC_TSTR HU LL_RTC_TS_GetHour

`LL_RTC_TS_GetMinute`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetMinute (RTC_TypeDef * RTCx)

Function description

Get Timestamp Minutes in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Minutes from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TSTR MNT LL_RTC_TS_GetMinute
- RTC_TSTR HU LL_RTC_TS_GetMinute

`LL_RTC_TS_GetSecond`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetSecond (RTC_TypeDef * RTCx)

Function description

Get Timestamp Seconds in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x59

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Seconds from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TSTR ST LL_RTC_TS_GetSecond
- RTC_TSTR HU LL_RTC_TS_GetSecond

`LL_RTC_TS_GetTime`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetTime (RTC_TypeDef * RTCx)

Function description

Get Timestamp time (hour, minute and second) in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Combination:** of hours, minutes and seconds.

Notes

- helper macros __LL_RTC_GET_HOUR, __LL_RTC_GET_MINUTE and __LL_RTC_GET_SECOND are available to get independently each parameter.

Reference Manual to LL API cross reference:

- RTC_TSTR HT LL_RTC_TS_GetTime
- RTC_TSTR HU LL_RTC_TS_GetTime
- RTC_TSTR MNT LL_RTC_TS_GetTime
- RTC_TSTR MNU LL_RTC_TS_GetTime
- RTC_TSTR ST LL_RTC_TS_GetTime
- RTC_TSTR SU LL_RTC_TS_GetTime

`LL_RTC_TS_GetWeekDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetWeekDay (RTC_TypeDef * RTCx)

Function description

Get Timestamp Week day.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

Reference Manual to LL API cross reference:

- RTC_TSDR WDU LL_RTC_TS_GetWeekDay

`LL_RTC_TS_GetMonth`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetMonth (RTC_TypeDef * RTCx)

Function description

Get Timestamp Month in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_MONTH_JANUARY
  - LL_RTC_MONTH_FEBRUARY
  - LL_RTC_MONTH_MARCH
  - LL_RTC_MONTH_APRIL
  - LL_RTC_MONTH_MAY
  - LL_RTC_MONTH_JUNE
  - LL_RTC_MONTH_JULY
  - LL_RTC_MONTH_AUGUST
  - LL_RTC_MONTH_SEPTEMBER
  - LL_RTC_MONTH_OCTOBER
  - LL_RTC_MONTH_NOVEMBER
  - LL_RTC_MONTH_DECEMBER

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Month from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TSDR MT LL_RTC_TS_GetMonth
- RTC_TSDR MU LL_RTC_TS_GetMonth

`LL_RTC_TS_GetDay`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetDay (RTC_TypeDef * RTCx)

Function description

Get Timestamp Day in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x01 and Max_Data=0x31

Notes

- helper macro __LL_RTC_CONVERT_BCD2BIN is available to convert Day from BCD to Binary format

Reference Manual to LL API cross reference:

- RTC_TSDR DT LL_RTC_TS_GetDay
- RTC_TSDR DU LL_RTC_TS_GetDay

`LL_RTC_TS_GetDate`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetDate (RTC_TypeDef * RTCx)

Function description

Get Timestamp date (WeekDay, Day and Month) in BCD format.

Parameters

- **RTCx:** RTC Instance

Return values

- **Combination:** of Weekday, Day and Month

Notes

- helper macros __LL_RTC_GET_WEEKDAY, __LL_RTC_GET_MONTH, and __LL_RTC_GET_DAY are available to get independently each parameter.

Reference Manual to LL API cross reference:

- RTC_TSDR WDU LL_RTC_TS_GetDate
- RTC_TSDR MT LL_RTC_TS_GetDate
- RTC_TSDR MU LL_RTC_TS_GetDate
- RTC_TSDR DT LL_RTC_TS_GetDate
- RTC_TSDR DU LL_RTC_TS_GetDate

`LL_RTC_TS_GetSubSecond`

Function name

__STATIC_INLINE uint32_t LL_RTC_TS_GetSubSecond (RTC_TypeDef * RTCx)

Function description

Get time-stamp sub second value.

Parameters

- **RTCx:** RTC Instance

Return values

- **If:** binary mode is none, Value between Min_Data=0x0 and Max_Data=0x7FFF else Value between Min_Data=0x0 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- RTC_TSSSR SS LL_RTC_TS_GetSubSecond

`LL_RTC_WAKEUP_Enable`

Function name

__STATIC_INLINE void LL_RTC_WAKEUP_Enable (RTC_TypeDef * RTCx)

Function description

Enable Wakeup timer.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR WUTE LL_RTC_WAKEUP_Enable

`LL_RTC_WAKEUP_Disable`

Function name

__STATIC_INLINE void LL_RTC_WAKEUP_Disable (RTC_TypeDef * RTCx)

Function description

Disable Wakeup timer.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR WUTE LL_RTC_WAKEUP_Disable

`LL_RTC_WAKEUP_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_RTC_WAKEUP_IsEnabled (RTC_TypeDef * RTCx)

Function description

Check if Wakeup timer is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RTC_CR WUTE LL_RTC_WAKEUP_IsEnabled

LL_RTC_WAKEUP_SetClock

Function name

__STATIC_INLINE void LL_RTC_WAKEUP_SetClock (RTC_TypeDef * RTCx, uint32_t WakeupClock)

Function description

Select Wakeup clock.

Parameters

- **RTCx:** RTC Instance
- **WakeupClock:** This parameter can be one of the following values:
  - LL_RTC_WAKEUPCLOCK_DIV_16
  - LL_RTC_WAKEUPCLOCK_DIV_8
  - LL_RTC_WAKEUPCLOCK_DIV_4
  - LL_RTC_WAKEUPCLOCK_DIV_2
  - LL_RTC_WAKEUPCLOCK_CKSPRE
  - LL_RTC_WAKEUPCLOCK_CKSPRE_WUT

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- Bit can be written only when RTC_CR WUTE bit = 0 and RTC_ISR WUTWF bit = 1

Reference Manual to LL API cross reference:

- RTC_CR WUCKSEL LL_RTC_WAKEUP_SetClock

LL_RTC_WAKEUP_GetClock

Function name

__STATIC_INLINE uint32_t LL_RTC_WAKEUP_GetClock (RTC_TypeDef * RTCx)

Function description

Get Wakeup clock.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_WAKEUPCLOCK_DIV_16
  - LL_RTC_WAKEUPCLOCK_DIV_8
  - LL_RTC_WAKEUPCLOCK_DIV_4
  - LL_RTC_WAKEUPCLOCK_DIV_2
  - LL_RTC_WAKEUPCLOCK_CKSPRE
  - LL_RTC_WAKEUPCLOCK_CKSPRE_WUT

Reference Manual to LL API cross reference:

- RTC_CR WUCKSEL LL_RTC_WAKEUP_GetClock

`LL_RTC_WAKEUP_SetAutoReload`

Function name

__STATIC_INLINE void LL_RTC_WAKEUP_SetAutoReload (RTC_TypeDef * RTCx, uint32_t Value)

Function description

Set Wakeup auto-reload value.

Parameters

- **RTCx:** RTC Instance
- **Value:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Return values

- **None:**

Notes

- Bit can be written only when WUTWF is set to 1 in RTC_ISR

Reference Manual to LL API cross reference:

- RTC_WUTR WUT LL_RTC_WAKEUP_SetAutoReload

`LL_RTC_WAKEUP_GetAutoReload`

Function name

__STATIC_INLINE uint32_t LL_RTC_WAKEUP_GetAutoReload (RTC_TypeDef * RTCx)

Function description

Get Wakeup auto-reload value.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- RTC_WUTR WUT LL_RTC_WAKEUP_GetAutoReload

`LL_RTC_CAL_SetOutputFreq`

Function name

__STATIC_INLINE void LL_RTC_CAL_SetOutputFreq (RTC_TypeDef * RTCx, uint32_t Frequency)

Function description

Set Calibration output frequency (1 Hz or 512 Hz)

Parameters

- **RTCx:** RTC Instance
- **Frequency:** This parameter can be one of the following values:
  - LL_RTC_CALIB_OUTPUT_NONE
  - LL_RTC_CALIB_OUTPUT_1HZ
  - LL_RTC_CALIB_OUTPUT_512HZ

Return values

- **None:**

Notes

- Bits are write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR COE LL_RTC_CAL_SetOutputFreq
- RTC_CR COSEL LL_RTC_CAL_SetOutputFreq

LL_RTC_CAL_GetOutputFreq

Function name

__STATIC_INLINE uint32_t LL_RTC_CAL_GetOutputFreq (RTC_TypeDef * RTCx)

Function description

Get Calibration output frequency (1 Hz or 512 Hz)

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_CALIB_OUTPUT_NONE
  - LL_RTC_CALIB_OUTPUT_1HZ
  - LL_RTC_CALIB_OUTPUT_512HZ

Reference Manual to LL API cross reference:

- RTC_CR COE LL_RTC_CAL_GetOutputFreq
- RTC_CR COSEL LL_RTC_CAL_GetOutputFreq

LL_RTC_CAL_SetPulse

Function name

__STATIC_INLINE void LL_RTC_CAL_SetPulse (RTC_TypeDef * RTCx, uint32_t Pulse)

Function description

Insert or not One RTCCLK pulse every 2exp11 pulses (frequency increased by 488.5 ppm)

Parameters

- **RTCx:** RTC Instance
- **Pulse:** This parameter can be one of the following values:
  - LL_RTC_CALIB_INSERTPULSE_NONE
  - LL_RTC_CALIB_INSERTPULSE_SET

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- Bit can be written only when RECALPF is set to 0

Reference Manual to LL API cross reference:

- RTC_CALR CALP LL_RTC_CAL_SetPulse

LL_RTC_CAL_IsPulseInserted

Function name

__STATIC_INLINE uint32_t LL_RTC_CAL_IsPulseInserted (RTC_TypeDef * RTCx)

Function description

Check if one RTCCLK has been inserted or not every 2exp11 pulses (frequency increased by 488.5 ppm)

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RTC_CALR CALP LL_RTC_CAL_IsPulseInserted

LL_RTC_CAL_SetPeriod

Function name

__STATIC_INLINE void LL_RTC_CAL_SetPeriod (RTC_TypeDef * RTCx, uint32_t Period)

Function description

Set the calibration cycle period.

Parameters

- **RTCx:** RTC Instance
- **Period:** This parameter can be one of the following values:
  - LL_RTC_CALIB_PERIOD_32SEC
  - LL_RTC_CALIB_PERIOD_16SEC
  - LL_RTC_CALIB_PERIOD_8SEC

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- Bit can be written only when RECALPF is set to 0

Reference Manual to LL API cross reference:

- RTC_CALR CALW8 LL_RTC_CAL_SetPeriod
- RTC_CALR CALW16 LL_RTC_CAL_SetPeriod

LL_RTC_CAL_GetPeriod

Function name

__STATIC_INLINE uint32_t LL_RTC_CAL_GetPeriod (RTC_TypeDef * RTCx)

Function description

Get the calibration cycle period.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_CALIB_PERIOD_32SEC
  - LL_RTC_CALIB_PERIOD_16SEC
  - LL_RTC_CALIB_PERIOD_8SEC

Reference Manual to LL API cross reference:

- RTC_CALR CALW8 LL_RTC_CAL_GetPeriod
- RTC_CALR CALW16 LL_RTC_CAL_GetPeriod

LL_RTC_CAL_SetMinus

Function name

__STATIC_INLINE void LL_RTC_CAL_SetMinus (RTC_TypeDef * RTCx, uint32_t CalibMinus)

Function description

Set Calibration minus.

Parameters

- **RTCx:** RTC Instance
- **CalibMinus:** Value between Min_Data=0x00 and Max_Data=0x1FF

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.
- Bit can be written only when RECALPF is set to 0

Reference Manual to LL API cross reference:

- RTC_CALR CALM LL_RTC_CAL_SetMinus

LL_RTC_CAL_GetMinus

Function name

__STATIC_INLINE uint32_t LL_RTC_CAL_GetMinus (RTC_TypeDef * RTCx)

Function description

Get Calibration minus.

Parameters

- **RTCx:** RTC Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data= 0x1FF

Reference Manual to LL API cross reference:

- RTC_CALR CALM LL_RTC_CAL_GetMinus

`LL_RTC_TS_EnableOnTamper`

Function name

__STATIC_INLINE void LL_RTC_TS_EnableOnTamper (RTC_TypeDef * RTCx)

Function description

Activate timestamp on tamper detection event.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_CR TAMPTS LL_RTC_TS_EnableOnTamper

`LL_RTC_TS_DisableOnTamper`

Function name

__STATIC_INLINE void LL_RTC_TS_DisableOnTamper (RTC_TypeDef * RTCx)

Function description

Disable timestamp on tamper detection event.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTC_CR TAMPTS LL_RTC_TS_DisableOnTamper

`LL_RTC_TAMPER_Enable`

Function name

__STATIC_INLINE void LL_RTC_TAMPER_Enable (RTC_TypeDef * RTCx, uint32_t Tamper)

Function description

Enable RTC_TAMPx input detection.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_1
  - LL_RTC_TAMPER_2
  - LL_RTC_TAMPER_3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1E LL_RTC_TAMPER_Enable
- TAMPCR TAMP2E LL_RTC_TAMPER_Enable
- TAMPCR TAMP3E LL_RTC_TAMPER_Enable

LL_RTC_TAMPER_Disable

Function name

__STATIC_INLINE void LL_RTC_TAMPER_Disable (RTC_TypeDef * RTCx, uint32_t Tamper)

Function description

Clear RTC_TAMPx input detection.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_1
  - LL_RTC_TAMPER_2
  - LL_RTC_TAMPER_3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1E LL_RTC_TAMPER_Disable
- TAMPCR TAMP2E LL_RTC_TAMPER_Disable
- TAMPCR TAMP3E LL_RTC_TAMPER_Disable

LL_RTC_TAMPER_EnableMask

Function name

__STATIC_INLINE void LL_RTC_TAMPER_EnableMask (RTC_TypeDef * RTCx, uint32_t Mask)

Function description

Enable Tamper mask flag.

Parameters

- **RTCx:** RTC Instance
- **Mask:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_MASK_TAMPER1
  - LL_RTC_TAMPER_MASK_TAMPER2
  - LL_RTC_TAMPER_MASK_TAMPER3

Return values

- **None:**

Notes

- Associated Tamper IT must not enabled when tamper mask is set.

Reference Manual to LL API cross reference:

- TAMPCR TAMP1MF LL_RTC_TAMPER_EnableMask
- TAMPCR TAMP2MF LL_RTC_TAMPER_EnableMask
- TAMPCR TAMP3MF LL_RTC_TAMPER_EnableMask

LL_RTC_TAMPER_DisableMask

Function name

__STATIC_INLINE void LL_RTC_TAMPER_DisableMask (RTC_TypeDef * RTCx, uint32_t Mask)

Function description

Disable Tamper mask flag.

Parameters

- **RTCx:** RTC Instance
- **Mask:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_MASK_TAMPER1
  - LL_RTC_TAMPER_MASK_TAMPER2
  - LL_RTC_TAMPER_MASK_TAMPER3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1MF LL_RTC_TAMPER_DisableMask
- TAMPCR TAMP2MF LL_RTC_TAMPER_DisableMask
- TAMPCR TAMP3MF LL_RTC_TAMPER_DisableMask

LL_RTC_TAMPER_EnableEraseBKP

Function name

__STATIC_INLINE void LL_RTC_TAMPER_EnableEraseBKP (RTC_TypeDef * RTCx, uint32_t Tamper)

Function description

Enable backup register erase after Tamper event detection.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_NOERASE_TAMPER1
  - LL_RTC_TAMPER_NOERASE_TAMPER2
  - LL_RTC_TAMPER_NOERASE_TAMPER3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1NOERASE LL_RTC_TAMPER_EnableEraseBKP
- TAMPCR TAMP2NOERASE LL_RTC_TAMPER_EnableEraseBKP
- TAMPCR TAMP3NOERASE LL_RTC_TAMPER_EnableEraseBKP

LL_RTC_TAMPER_DisableEraseBKP

Function name

__STATIC_INLINE void LL_RTC_TAMPER_DisableEraseBKP (RTC_TypeDef * RTCx, uint32_t Tamper)

Function description

Disable backup register erase after Tamper event detection.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_NOERASE_TAMPER1
  - LL_RTC_TAMPER_NOERASE_TAMPER2
  - LL_RTC_TAMPER_NOERASE_TAMPER3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1NOERASE LL_RTC_TAMPER_DisableEraseBKP
- TAMPCR TAMP2NOERASE LL_RTC_TAMPER_DisableEraseBKP
- TAMPCR TAMP3NOERASE LL_RTC_TAMPER_DisableEraseBKP

LL_RTC_TAMPER_DisablePullUp

Function name

__STATIC_INLINE void LL_RTC_TAMPER_DisablePullUp (RTC_TypeDef * RTCx)

Function description

Disable RTC_TAMPx pull-up disable (Disable precharge of RTC_TAMPx pins)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPPUDIS LL_RTC_TAMPER_DisablePullUp

LL_RTC_TAMPER_EnablePullUp

Function name

__STATIC_INLINE void LL_RTC_TAMPER_EnablePullUp (RTC_TypeDef * RTCx)

Function description

Enable RTC_TAMPx pull-up disable (Precharge RTC_TAMPx pins before sampling)

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPPUDIS LL_RTC_TAMPER_EnablePullUp

LL_RTC_TAMPER_SetPrecharge

Function name

__STATIC_INLINE void LL_RTC_TAMPER_SetPrecharge (RTC_TypeDef * RTCx, uint32_t Duration)

Function description

Set RTC_TAMPx precharge duration.

Parameters

- **RTCx:** RTC Instance
- **Duration:** This parameter can be one of the following values:
  - LL_RTC_TAMPER_DURATION_1RTCCLK
  - LL_RTC_TAMPER_DURATION_2RTCCLK
  - LL_RTC_TAMPER_DURATION_4RTCCLK
  - LL_RTC_TAMPER_DURATION_8RTCCLK

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPPRCH LL_RTC_TAMPER_SetPrecharge

`LL_RTC_TAMPER_GetPrecharge`

Function name

__STATIC_INLINE uint32_t LL_RTC_TAMPER_GetPrecharge (RTC_TypeDef * RTCx)

Function description

Get RTC_TAMPx precharge duration.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_TAMPER_DURATION_1RTCCLK
  - LL_RTC_TAMPER_DURATION_2RTCCLK
  - LL_RTC_TAMPER_DURATION_4RTCCLK
  - LL_RTC_TAMPER_DURATION_8RTCCLK

Reference Manual to LL API cross reference:

- TAMPCR TAMPPRCH LL_RTC_TAMPER_GetPrecharge

`LL_RTC_TAMPER_SetFilterCount`

Function name

__STATIC_INLINE void LL_RTC_TAMPER_SetFilterCount (RTC_TypeDef * RTCx, uint32_t FilterCount)

Function description

Set RTC_TAMPx filter count.

Parameters

- **RTCx:** RTC Instance
- **FilterCount:** This parameter can be one of the following values:
  - LL_RTC_TAMPER_FILTER_DISABLE
  - LL_RTC_TAMPER_FILTER_2SAMPLE
  - LL_RTC_TAMPER_FILTER_4SAMPLE
  - LL_RTC_TAMPER_FILTER_8SAMPLE

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPFLT LL_RTC_TAMPER_SetFilterCount

`LL_RTC_TAMPER_GetFilterCount`

Function name

__STATIC_INLINE uint32_t LL_RTC_TAMPER_GetFilterCount (RTC_TypeDef * RTCx)

Function description

Get RTC_TAMPx filter count.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_TAMPER_FILTER_DISABLE
  - LL_RTC_TAMPER_FILTER_2SAMPLE
  - LL_RTC_TAMPER_FILTER_4SAMPLE
  - LL_RTC_TAMPER_FILTER_8SAMPLE

Reference Manual to LL API cross reference:

- TAMPCR TAMPFLT LL_RTC_TAMPER_GetFilterCount

`LL_RTC_TAMPER_SetSamplingFreq`

Function name

__STATIC_INLINE void LL_RTC_TAMPER_SetSamplingFreq (RTC_TypeDef * RTCx, uint32_t SamplingFreq)

Function description

Set Tamper sampling frequency.

Parameters

- **RTCx:** RTC Instance
- **SamplingFreq:** This parameter can be one of the following values:
  - LL_RTC_TAMPER_SAMPLFREQDIV_32768
  - LL_RTC_TAMPER_SAMPLFREQDIV_16384
  - LL_RTC_TAMPER_SAMPLFREQDIV_8192
  - LL_RTC_TAMPER_SAMPLFREQDIV_4096
  - LL_RTC_TAMPER_SAMPLFREQDIV_2048
  - LL_RTC_TAMPER_SAMPLFREQDIV_1024
  - LL_RTC_TAMPER_SAMPLFREQDIV_512
  - LL_RTC_TAMPER_SAMPLFREQDIV_256

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPFREQ LL_RTC_TAMPER_SetSamplingFreq

`LL_RTC_TAMPER_GetSamplingFreq`

Function name

__STATIC_INLINE uint32_t LL_RTC_TAMPER_GetSamplingFreq (RTC_TypeDef * RTCx)

Function description

Get Tamper sampling frequency.

Parameters

- **RTCx:** RTC Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_RTC_TAMPER_SAMPLFREQDIV_32768
  - LL_RTC_TAMPER_SAMPLFREQDIV_16384
  - LL_RTC_TAMPER_SAMPLFREQDIV_8192
  - LL_RTC_TAMPER_SAMPLFREQDIV_4096
  - LL_RTC_TAMPER_SAMPLFREQDIV_2048
  - LL_RTC_TAMPER_SAMPLFREQDIV_1024
  - LL_RTC_TAMPER_SAMPLFREQDIV_512
  - LL_RTC_TAMPER_SAMPLFREQDIV_256

Reference Manual to LL API cross reference:

- TAMPCR TAMPFREQ LL_RTC_TAMPER_GetSamplingFreq

`LL_RTC_TAMPER_EnableActiveLevel`

Function name

__STATIC_INLINE void LL_RTC_TAMPER_EnableActiveLevel (RTC_TypeDef * RTCx, uint32_t Tamper)

Function description

Enable Active level for Tamper input.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_ACTIVELEVEL_TAMP1
  - LL_RTC_TAMPER_ACTIVELEVEL_TAMP2
  - LL_RTC_TAMPER_ACTIVELEVEL_TAMP3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1TRG LL_RTC_TAMPER_EnableActiveLevel
- TAMPCR TAMP2TRG LL_RTC_TAMPER_EnableActiveLevel
- TAMPCR TAMP3TRG LL_RTC_TAMPER_EnableActiveLevel

`LL_RTC_TAMPER_DisableActiveLevel`

Function name

__STATIC_INLINE void LL_RTC_TAMPER_DisableActiveLevel (RTC_TypeDef * RTCx, uint32_t Tamper)

Function description

Disable Active level for Tamper input.

Parameters

- **RTCx:** RTC Instance
- **Tamper:** This parameter can be a combination of the following values:
  - LL_RTC_TAMPER_ACTIVELEVEL_TAMP1
  - LL_RTC_TAMPER_ACTIVELEVEL_TAMP2
  - LL_RTC_TAMPER_ACTIVELEVEL_TAMP3

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1TRG LL_RTC_TAMPER_DisableActiveLevel
- TAMPCR TAMP2TRG LL_RTC_TAMPER_DisableActiveLevel
- TAMPCR TAMP3TRG LL_RTC_TAMPER_DisableActiveLevel

`LL_RTC_BAK_SetRegister`

Function name

__STATIC_INLINE void LL_RTC_BAK_SetRegister (RTC_TypeDef * RTCx, uint32_t BackupRegister, uint32_t Data)

Function description

Writes a data in a specified RTC Backup data register.

Parameters

- **RTCx:** RTC Instance
- **BackupRegister:** This parameter can be one of the following values:
  - LL_RTC_BKP_DR0
  - LL_RTC_BKP_DR1
  - LL_RTC_BKP_DR2
  - LL_RTC_BKP_DR3
  - LL_RTC_BKP_DR4
  - LL_RTC_BKP_DR5
  - LL_RTC_BKP_DR6
  - LL_RTC_BKP_DR7
  - LL_RTC_BKP_DR8
  - LL_RTC_BKP_DR9
  - LL_RTC_BKP_DR10
  - LL_RTC_BKP_DR11
  - LL_RTC_BKP_DR12
  - LL_RTC_BKP_DR13
  - LL_RTC_BKP_DR14
  - LL_RTC_BKP_DR15
  - LL_RTC_BKP_DR16
  - LL_RTC_BKP_DR17
  - LL_RTC_BKP_DR18
  - LL_RTC_BKP_DR19
  - LL_RTC_BKP_DR20
  - LL_RTC_BKP_DR21
  - LL_RTC_BKP_DR22
  - LL_RTC_BKP_DR23
  - LL_RTC_BKP_DR24
  - LL_RTC_BKP_DR25
  - LL_RTC_BKP_DR26
  - LL_RTC_BKP_DR27
  - LL_RTC_BKP_DR28
  - LL_RTC_BKP_DR29
  - LL_RTC_BKP_DR30
  - LL_RTC_BKP_DR31
- **Data:** Value between Min_Data=0x00 and Max_Data=0xFFFFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- BKPxR BKP LL_RTC_BAK_SetRegister

`LL_RTC_BAK_GetRegister`

Function name

__STATIC_INLINE uint32_t LL_RTC_BAK_GetRegister (RTC_TypeDef * RTCx, uint32_t BackupRegister)

Function description

Reads data from the specified RTC Backup data Register.

Parameters

- **RTCx:** RTC Instance
- **BackupRegister:** This parameter can be one of the following values:
  - LL_RTC_BKP_DR0
  - LL_RTC_BKP_DR1
  - LL_RTC_BKP_DR2
  - LL_RTC_BKP_DR3
  - LL_RTC_BKP_DR4
  - LL_RTC_BKP_DR5
  - LL_RTC_BKP_DR6
  - LL_RTC_BKP_DR7
  - LL_RTC_BKP_DR8
  - LL_RTC_BKP_DR9
  - LL_RTC_BKP_DR10
  - LL_RTC_BKP_DR11
  - LL_RTC_BKP_DR12
  - LL_RTC_BKP_DR13
  - LL_RTC_BKP_DR14
  - LL_RTC_BKP_DR15
  - LL_RTC_BKP_DR16
  - LL_RTC_BKP_DR17
  - LL_RTC_BKP_DR18
  - LL_RTC_BKP_DR19
  - LL_RTC_BKP_DR20
  - LL_RTC_BKP_DR21
  - LL_RTC_BKP_DR22
  - LL_RTC_BKP_DR23
  - LL_RTC_BKP_DR24
  - LL_RTC_BKP_DR25
  - LL_RTC_BKP_DR26
  - LL_RTC_BKP_DR27
  - LL_RTC_BKP_DR28
  - LL_RTC_BKP_DR29
  - LL_RTC_BKP_DR30
  - LL_RTC_BKP_DR31

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFFFFFFFF

Reference Manual to LL API cross reference:

- BKPxR BKP LL_RTC_BAK_GetRegister

LL_RTC_IsActiveFlag_ITS

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ITS (RTC_TypeDef * RTCx)

Function description

Get Internal Time-stamp flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- RTC_SR ITSF LL_RTC_IsActiveFlag_ITS

`LL_RTC_IsActiveFlag_RECALP`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_RECALP (RTC_TypeDef * RTCx)

Function description

Get Recalibration pending Flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RECALPF LL_RTC_IsActiveFlag_RECALP

`LL_RTC_IsActiveFlag_TAMP3`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TAMP3 (RTC_TypeDef * RTCx)

Function description

Get RTC_TAMP3 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TAMP3F LL_RTC_IsActiveFlag_TAMP3

`LL_RTC_IsActiveFlag_TAMP2`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TAMP2 (RTC_TypeDef * RTCx)

Function description

Get RTC_TAMP2 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TAMP2F LL_RTC_IsActiveFlag_TAMP2

`LL_RTC_IsActiveFlag_TAMP1`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TAMP1 (RTC_TypeDef * RTCx)

Function description

Get RTC_TAMP1 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TAMP1F LL_RTC_IsActiveFlag_TAMP1

`LL_RTC_IsActiveFlag_TSOV`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TSOV (RTC_TypeDef * RTCx)

Function description

Get Time-stamp overflow flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TSOVF LL_RTC_IsActiveFlag_TSOV

`LL_RTC_IsActiveFlag_TS`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_TS (RTC_TypeDef * RTCx)

Function description

Get Time-stamp flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TSF LL_RTC_IsActiveFlag_TS

`LL_RTC_IsActiveFlag_WUT`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_WUT (RTC_TypeDef * RTCx)

Function description

Get Wakeup timer flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR WUTF LL_RTC_IsActiveFlag_WUT

`LL_RTC_IsActiveFlag_ALRB`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRB (RTC_TypeDef * RTCx)

Function description

Get Alarm B flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ALRBF LL_RTC_IsActiveFlag_ALRB

`LL_RTC_IsActiveFlag_ALRA`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRA (RTC_TypeDef * RTCx)

Function description

Get Alarm A flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ALRAF LL_RTC_IsActiveFlag_ALRA

`LL_RTC_ClearFlag_ITS`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_ITS (RTC_TypeDef * RTCx)

Function description

Clear Internal Time-stamp flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR ITSF LL_RTC_ClearFlag_ITS

`LL_RTC_ClearFlag_TAMP3`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_TAMP3 (RTC_TypeDef * RTCx)

Function description

Clear RTC_TAMP3 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR TAMP3F LL_RTC_ClearFlag_TAMP3

`LL_RTC_ClearFlag_TAMP2`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_TAMP2 (RTC_TypeDef * RTCx)

Function description

Clear RTC_TAMP2 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR TAMP2F LL_RTC_ClearFlag_TAMP2

`LL_RTC_ClearFlag_TAMP1`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_TAMP1 (RTC_TypeDef * RTCx)

Function description

Clear RTC_TAMP1 detection flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR TAMP1F LL_RTC_ClearFlag_TAMP1

`LL_RTC_ClearFlag_TSOV`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_TSOV (RTC_TypeDef * RTCx)

Function description

Clear Time-stamp overflow flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR TSOVF LL_RTC_ClearFlag_TSOV

`LL_RTC_ClearFlag_TS`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_TS (RTC_TypeDef * RTCx)

Function description

Clear Time-stamp flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR TSF LL_RTC_ClearFlag_TS

`LL_RTC_ClearFlag_WUT`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_WUT (RTC_TypeDef * RTCx)

Function description

Clear Wakeup timer flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR WUTF LL_RTC_ClearFlag_WUT

`LL_RTC_ClearFlag_ALRB`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_ALRB (RTC_TypeDef * RTCx)

Function description

Clear Alarm B flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR ALRBF LL_RTC_ClearFlag_ALRB

`LL_RTC_ClearFlag_ALRA`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_ALRA (RTC_TypeDef * RTCx)

Function description

Clear Alarm A flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR ALRAF LL_RTC_ClearFlag_ALRA

`LL_RTC_IsActiveFlag_INIT`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_INIT (RTC_TypeDef * RTCx)

Function description

Get Initialization flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR INITF LL_RTC_IsActiveFlag_INIT

`LL_RTC_IsActiveFlag_RS`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_RS (RTC_TypeDef * RTCx)

Function description

Get Registers synchronization flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RSF LL_RTC_IsActiveFlag_RS

`LL_RTC_ClearFlag_RS`

Function name

__STATIC_INLINE void LL_RTC_ClearFlag_RS (RTC_TypeDef * RTCx)

Function description

Clear Registers synchronization flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ISR RSF LL_RTC_ClearFlag_RS

`LL_RTC_IsActiveFlag_INITS`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_INITS (RTC_TypeDef * RTCx)

Function description

Get Initialization status flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR INITS LL_RTC_IsActiveFlag_INITS

`LL_RTC_IsActiveFlag_SHP`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_SHP (RTC_TypeDef * RTCx)

Function description

Get Shift operation pending flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SHPF LL_RTC_IsActiveFlag_SHP

`LL_RTC_IsActiveFlag_WUTW`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_WUTW (RTC_TypeDef * RTCx)

Function description

Get Wakeup timer write flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR WUTWF LL_RTC_IsActiveFlag_WUTW

`LL_RTC_IsActiveFlag_ALRBW`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRBW (RTC_TypeDef * RTCx)

Function description

Get Alarm B write flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ALRBWF LL_RTC_IsActiveFlag_ALRBW

`LL_RTC_IsActiveFlag_ALRAW`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsActiveFlag_ALRAW (RTC_TypeDef * RTCx)

Function description

Get Alarm A write flag.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ALRAWF LL_RTC_IsActiveFlag_ALRAW

`LL_RTC_EnableIT_TS`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_TS (RTC_TypeDef * RTCx)

Function description

Enable Time-stamp interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR TSIE LL_RTC_EnableIT_TS

`LL_RTC_DisableIT_TS`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_TS (RTC_TypeDef * RTCx)

Function description

Disable Time-stamp interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR TSIE LL_RTC_DisableIT_TS

`LL_RTC_EnableIT_WUT`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_WUT (RTC_TypeDef * RTCx)

Function description

Enable Wakeup timer interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR WUTIE LL_RTC_EnableIT_WUT

`LL_RTC_DisableIT_WUT`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_WUT (RTC_TypeDef * RTCx)

Function description

Disable Wakeup timer interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR WUTIE LL_RTC_DisableIT_WUT

`LL_RTC_EnableIT_ALRB`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_ALRB (RTC_TypeDef * RTCx)

Function description

Enable Alarm B interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRBIE LL_RTC_EnableIT_ALRB

`LL_RTC_DisableIT_ALRB`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_ALRB (RTC_TypeDef * RTCx)

Function description

Disable Alarm B interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRBIE LL_RTC_DisableIT_ALRB

`LL_RTC_EnableIT_ALRA`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_ALRA (RTC_TypeDef * RTCx)

Function description

Enable Alarm A interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRAIE LL_RTC_EnableIT_ALRA

`LL_RTC_DisableIT_ALRA`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_ALRA (RTC_TypeDef * RTCx)

Function description

Disable Alarm A interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Notes

- Bit is write-protected. LL_RTC_DisableWriteProtection function should be called before.

Reference Manual to LL API cross reference:

- RTC_CR ALRAIE LL_RTC_DisableIT_ALRA

`LL_RTC_EnableIT_TAMP3`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_TAMP3 (RTC_TypeDef * RTCx)

Function description

Enable Tamper 3 interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP3IE LL_RTC_EnableIT_TAMP3

`LL_RTC_DisableIT_TAMP3`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_TAMP3 (RTC_TypeDef * RTCx)

Function description

Disable Tamper 3 interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP3IE LL_RTC_DisableIT_TAMP3

`LL_RTC_EnableIT_TAMP2`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_TAMP2 (RTC_TypeDef * RTCx)

Function description

Enable Tamper 2 interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP2IE LL_RTC_EnableIT_TAMP2

`LL_RTC_DisableIT_TAMP2`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_TAMP2 (RTC_TypeDef * RTCx)

Function description

Disable Tamper 2 interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP2IE LL_RTC_DisableIT_TAMP2

`LL_RTC_EnableIT_TAMP1`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_TAMP1 (RTC_TypeDef * RTCx)

Function description

Enable Tamper 1 interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1IE LL_RTC_EnableIT_TAMP1

`LL_RTC_DisableIT_TAMP1`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_TAMP1 (RTC_TypeDef * RTCx)

Function description

Disable Tamper 1 interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMP1IE LL_RTC_DisableIT_TAMP1

`LL_RTC_EnableIT_TAMP`

Function name

__STATIC_INLINE void LL_RTC_EnableIT_TAMP (RTC_TypeDef * RTCx)

Function description

Enable all Tamper Interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPIE LL_RTC_EnableIT_TAMP

`LL_RTC_DisableIT_TAMP`

Function name

__STATIC_INLINE void LL_RTC_DisableIT_TAMP (RTC_TypeDef * RTCx)

Function description

Disable all Tamper Interrupt.

Parameters

- **RTCx:** RTC Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- TAMPCR TAMPIE LL_RTC_DisableIT_TAMP

`LL_RTC_IsEnabledIT_TS`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TS (RTC_TypeDef * RTCx)

Function description

Check if Time-stamp interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR TSIE LL_RTC_IsEnabledIT_TS

`LL_RTC_IsEnabledIT_WUT`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_WUT (RTC_TypeDef * RTCx)

Function description

Check if Wakeup timer interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR WUTIE LL_RTC_IsEnabledIT_WUT

`LL_RTC_IsEnabledIT_ALRB`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_ALRB (RTC_TypeDef * RTCx)

Function description

Check if Alarm B interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR ALRBIE LL_RTC_IsEnabledIT_ALRB

`LL_RTC_IsEnabledIT_ALRA`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_ALRA (RTC_TypeDef * RTCx)

Function description

Check if Alarm A interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR ALRAIE LL_RTC_IsEnabledIT_ALRA

`LL_RTC_IsEnabledIT_TAMP3`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP3 (RTC_TypeDef * RTCx)

Function description

Check if Tamper 3 interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- TAMPCR TAMP3IE LL_RTC_IsEnabledIT_TAMP3

`LL_RTC_IsEnabledIT_TAMP2`

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP2 (RTC_TypeDef * RTCx)

Function description

Check if Tamper 2 interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- TAMPCR TAMP2IE LL_RTC_IsEnabledIT_TAMP2

LL_RTC_IsEnabledIT_TAMP1

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP1 (RTC_TypeDef * RTCx)

Function description

Check if Tamper 1 interrupt is enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- TAMPCR TAMP1IE LL_RTC_IsEnabledIT_TAMP1

LL_RTC_IsEnabledIT_TAMP

Function name

__STATIC_INLINE uint32_t LL_RTC_IsEnabledIT_TAMP (RTC_TypeDef * RTCx)

Function description

Check if all the TAMPER interrupts are enabled or not.

Parameters

- **RTCx:** RTC Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- TAMPCR TAMPIE LL_RTC_IsEnabledIT_TAMP

LL_RTC_DeInit

Function name

ErrorStatus LL_RTC_DeInit (RTC_TypeDef * RTCx)

Function description

De-Initializes the RTC registers to their default reset values.

Parameters

- **RTCx:** RTC Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC registers are de-initialized
  - ERROR: RTC registers are not de-initialized

Notes

- This function does not reset the RTC Clock source and RTC Backup Data registers.

LL_RTC_Init

Function name

ErrorStatus LL_RTC_Init (RTC_TypeDef * RTCx, LL_RTC_InitTypeDef * RTC_InitStruct)

Function description

Initializes the RTC registers according to the specified parameters in RTC_InitStruct.

Parameters

- **RTCx:** RTC Instance
- **RTC_InitStruct:** pointer to a LL_RTC_InitTypeDef structure that contains the configuration information for the RTC peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC registers are initialized
  - ERROR: RTC registers are not initialized

Notes

- The RTC Prescaler register is write protected and can be written in initialization mode only.

LL_RTC_StructInit

Function name

void LL_RTC_StructInit (LL_RTC_InitTypeDef * RTC_InitStruct)

Function description

Set each LL_RTC_InitTypeDef field to default value.

Parameters

- **RTC_InitStruct:** pointer to a LL_RTC_InitTypeDef structure which will be initialized.

Return values

- **None:**

LL_RTC_TIME_Init

Function name

ErrorStatus LL_RTC_TIME_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_TimeTypeDef * RTC_TimeStruct)

Function description

Set the RTC current time.

Parameters

- **RTCx:** RTC Instance
- **RTC_Format:** This parameter can be one of the following values:
  - LL_RTC_FORMAT_BIN
  - LL_RTC_FORMAT_BCD
- **RTC_TimeStruct:** pointer to a RTC_TimeTypeDef structure that contains the time configuration information for the RTC.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC Time register is configured
  - ERROR: RTC Time register is not configured

`LL_RTC_TIME_StructInit`

Function name

void LL_RTC_TIME_StructInit (LL_RTC_TimeTypeDef * RTC_TimeStruct)

Function description

Set each LL_RTC_TimeTypeDef field to default value (Time = 00h:00min:00sec).

Parameters

- **RTC_TimeStruct:** pointer to a LL_RTC_TimeTypeDef structure which will be initialized.

Return values

- **None:**

`LL_RTC_DATE_Init`

Function name

ErrorStatus LL_RTC_DATE_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_DateTypeDef * RTC_DateStruct)

Function description

Set the RTC current date.

Parameters

- **RTCx:** RTC Instance
- **RTC_Format:** This parameter can be one of the following values:
  - LL_RTC_FORMAT_BIN
  - LL_RTC_FORMAT_BCD
- **RTC_DateStruct:** pointer to a RTC_DateTypeDef structure that contains the date configuration information for the RTC.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC Day register is configured
  - ERROR: RTC Day register is not configured

`LL_RTC_DATE_StructInit`

Function name

void LL_RTC_DATE_StructInit (LL_RTC_DateTypeDef * RTC_DateStruct)

Function description

Set each LL_RTC_DateTypeDef field to default value (date = Monday, January 01 xx00)

Parameters

- **RTC_DateStruct:** pointer to a LL_RTC_DateTypeDef structure which will be initialized.

Return values

- **None:**

`LL_RTC_ALMA_Init`

Function name

ErrorStatus LL_RTC_ALMA_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_AlarmTypeDef * RTC_AlarmStruct)

Function description

Set the RTC Alarm A.

Parameters

- **RTCx:** RTC Instance
- **RTC_Format:** This parameter can be one of the following values:
  - LL_RTC_FORMAT_BIN
  - LL_RTC_FORMAT_BCD
- **RTC_AlarmStruct:** pointer to a LL_RTC_AlarmTypeDef structure that contains the alarm configuration parameters.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ALARMA registers are configured
  - ERROR: ALARMA registers are not configured

Notes

- The Alarm register can only be written when the corresponding Alarm is disabled (Use LL_RTC_ALMA_Disable function).

`LL_RTC_ALMB_Init`

Function name

ErrorStatus LL_RTC_ALMB_Init (RTC_TypeDef * RTCx, uint32_t RTC_Format, LL_RTC_AlarmTypeDef * RTC_AlarmStruct)

Function description

Set the RTC Alarm B.

Parameters

- **RTCx:** RTC Instance
- **RTC_Format:** This parameter can be one of the following values:
  - LL_RTC_FORMAT_BIN
  - LL_RTC_FORMAT_BCD
- **RTC_AlarmStruct:** pointer to a LL_RTC_AlarmTypeDef structure that contains the alarm configuration parameters.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: ALARMB registers are configured
  - ERROR: ALARMB registers are not configured

Notes

- The Alarm register can only be written when the corresponding Alarm is disabled (LL_RTC_ALMB_Disable function).

LL_RTC_ALMA_StructInit

Function name

void LL_RTC_ALMA_StructInit (LL_RTC_AlarmTypeDef * RTC_AlarmStruct)

Function description

Set each LL_RTC_AlarmTypeDef of ALARMA field to default value (Time = 00h:00mn:00sec / Day = 1st day of the month/Mask = all fields are masked).

Parameters

- **RTC_AlarmStruct:** pointer to a LL_RTC_AlarmTypeDef structure which will be initialized.

Return values

- **None:**

LL_RTC_ALMB_StructInit

Function name

void LL_RTC_ALMB_StructInit (LL_RTC_AlarmTypeDef * RTC_AlarmStruct)

Function description

Set each LL_RTC_AlarmTypeDef of ALARMA field to default value (Time = 00h:00mn:00sec / Day = 1st day of the month/Mask = all fields are masked).

Parameters

- **RTC_AlarmStruct:** pointer to a LL_RTC_AlarmTypeDef structure which will be initialized.

Return values

- **None:**

LL_RTC_EnterInitMode

Function name

ErrorStatus LL_RTC_EnterInitMode (RTC_TypeDef * RTCx)

Function description

Enters the RTC Initialization mode.

Parameters

- **RTCx:** RTC Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC is in Init mode
  - ERROR: RTC is not in Init mode

Notes

- The RTC Initialization mode is write protected, use the LL_RTC_DisableWriteProtection before calling this function.

LL_RTC_ExitInitMode

Function name

ErrorStatus LL_RTC_ExitInitMode (RTC_TypeDef * RTCx)

Function description

Exit the RTC Initialization mode.

Parameters

- **RTCx:** RTC Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC exited from in Init mode
  - ERROR: Not applicable

Notes

- When the initialization sequence is complete, the calendar restarts counting after 4 RTCCLK cycles.
- The RTC Initialization mode is write protected, use the LL_RTC_DisableWriteProtection before calling this function.

`LL_RTC_WaitForSynchro`

Function name

ErrorStatus LL_RTC_WaitForSynchro (RTC_TypeDef * RTCx)

Function description

Waits until the RTC Time and Day registers (RTC_TR and RTC_DR) are synchronized with RTC APB clock.

Parameters

- **RTCx:** RTC Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: RTC registers are synchronised
  - ERROR: RTC registers are not synchronised

Notes

- The RTC Resynchronization mode is write protected, use the LL_RTC_DisableWriteProtection before calling this function.
- To read the calendar through the shadow registers after Calendar initialization, calendar update or after wakeup from low power modes the software must first clear the RSF flag. The software must then wait until it is set again before reading the calendar, which means that the calendar registers have been correctly copied into the RTC_TR and RTC_DR shadow registers.

101.3 RTC Firmware driver defines

The following section lists the various define and macros of the module.

101.3.1 RTC

RTC

ALARM OUTPUT

LL_RTC_ALARMOUT_DISABLE

Output disabled

LL_RTC_ALARMOUT_ALMA

Alarm A output enabled

LL_RTC_ALARMOUT_ALMB

Alarm B output enabled

LL_RTC_ALARMOUT_WAKEUP

Wakeup output enabled

ALARM OUTPUT TYPE

LL_RTC_ALARM_OUTPUTTYPE_OPENDRAIN

RTC_ALARM is open-drain output

LL_RTC_ALARM_OUTPUTTYPE_PUSHPULL

RTC_ALARM, when mapped on PC13, is push-pull output

ALARMA MASK

LL_RTC_ALMA_MASK_NONE

No masks applied on Alarm A

LL_RTC_ALMA_MASK_DATEWEEKDAY

Date/day do not care in Alarm A comparison

LL_RTC_ALMA_MASK_HOURS

Hours do not care in Alarm A comparison

LL_RTC_ALMA_MASK_MINUTES

Minutes do not care in Alarm A comparison

LL_RTC_ALMA_MASK_SECONDS

Seconds do not care in Alarm A comparison

LL_RTC_ALMA_MASK_ALL

Masks all

ALARMA TIME FORMAT

LL_RTC_ALMA_TIME_FORMAT_AM

AM or 24-hour format

LL_RTC_ALMA_TIME_FORMAT_PM

PM

RTC Alarm A Date WeekDay

LL_RTC_ALMA_DATEWEEKDAYSEL_DATE

Alarm A Date is selected

LL_RTC_ALMA_DATEWEEKDAYSEL_WEEKDAY

Alarm A WeekDay is selected

ALARMB MASK

LL_RTC_ALMB_MASK_NONE

No masks applied on Alarm B

LL_RTC_ALMB_MASK_DATEWEEKDAY

Date/day do not care in Alarm B comparison

LL_RTC_ALMB_MASK_HOURS

Hours do not care in Alarm B comparison

LL_RTC_ALMB_MASK_MINUTES

Minutes do not care in Alarm B comparison

LL_RTC_ALMB_MASK_SECONDS

Seconds do not care in Alarm B comparison

LL_RTC_ALMB_MASK_ALL

Masks all

ALARMB TIME FORMAT

LL_RTC_ALMB_TIME_FORMAT_AM

AM or 24-hour format

LL_RTC_ALMB_TIME_FORMAT_PM

PM

RTC Alarm B Date WeekDay

LL_RTC_ALMB_DATEWEEKDAYSEL_DATE

Alarm B Date is selected

LL_RTC_ALMB_DATEWEEKDAYSEL_WEEKDAY

Alarm B WeekDay is selected

BACKUP

LL_RTC_BKP_DR0

LL_RTC_BKP_DR1

LL_RTC_BKP_DR2

LL_RTC_BKP_DR3

LL_RTC_BKP_DR4

LL_RTC_BKP_DR5

LL_RTC_BKP_DR6

LL_RTC_BKP_DR7

LL_RTC_BKP_DR8

LL_RTC_BKP_DR9

LL_RTC_BKP_DR10

LL_RTC_BKP_DR11

LL_RTC_BKP_DR12

LL_RTC_BKP_DR13

LL_RTC_BKP_DR14

LL_RTC_BKP_DR15

LL_RTC_BKP_DR16

LL_RTC_BKP_DR17

LL_RTC_BKP_DR18

LL_RTC_BKP_DR19

LL_RTC_BKP_DR20

LL_RTC_BKP_DR21

LL_RTC_BKP_DR22

LL_RTC_BKP_DR23

LL_RTC_BKP_DR24

LL_RTC_BKP_DR25

LL_RTC_BKP_DR26

LL_RTC_BKP_DR27

LL_RTC_BKP_DR28

LL_RTC_BKP_DR29

LL_RTC_BKP_DR30

LL_RTC_BKP_DR31

Calibration pulse insertion

LL_RTC_CALIB_INSERTPULSE_NONE

No RTCCLK pulses are added

LL_RTC_CALIB_INSERTPULSE_SET

One RTCCLK pulse is effectively inserted every 2exp11 pulses (frequency increased by 488.5 ppm)

Calibration output

LL_RTC_CALIB_OUTPUT_NONE

Calibration output disabled

LL_RTC_CALIB_OUTPUT_1HZ

Calibration output is 1 Hz

LL_RTC_CALIB_OUTPUT_512HZ

Calibration output is 512 Hz

Calibration period

LL_RTC_CALIB_PERIOD_32SEC

Use a 32-second calibration cycle period

LL_RTC_CALIB_PERIOD_16SEC

Use a 16-second calibration cycle period

LL_RTC_CALIB_PERIOD_8SEC

Use a 8-second calibration cycle period

FORMAT

LL_RTC_FORMAT_BIN

Binary data format

LL_RTC_FORMAT_BCD

BCD data format

Get Flags Defines

LL_RTC_ISR_ITSF

LL_RTC_ISR_RECALPF

LL_RTC_ISR_TAMP3F

LL_RTC_ISR_TAMP2F

LL_RTC_ISR_TAMP1F

LL_RTC_ISR_TSOVF

LL_RTC_ISR_TSF

LL_RTC_ISR_WUTF

LL_RTC_ISR_ALRBF

LL_RTC_ISR_ALRAF

LL_RTC_ISR_INITF

LL_RTC_ISR_RSF

LL_RTC_ISR_INITS

LL_RTC_ISR_SHPF

LL_RTC_ISR_WUTWF

LL_RTC_ISR_ALRBWF

LL_RTC_ISR_ALRAWF

HOUR FORMAT

LL_RTC_HOURFORMAT_24HOUR

24 hour/day format

LL_RTC_HOURFORMAT_AMPM

AM/PM hour format

IT Defines

LL_RTC_CR_TSIE

LL_RTC_CR_WUTIE

LL_RTC_CR_ALRBIE

LL_RTC_CR_ALRAIE

LL_RTC_TAMPCR_TAMP3IE

LL_RTC_TAMPCR_TAMP2IE

LL_RTC_TAMPCR_TAMP1IE

LL_RTC_TAMPCR_TAMPIE

MONTH

LL_RTC_MONTH_JANUARY

January

LL_RTC_MONTH_FEBRUARY

February

LL_RTC_MONTH_MARCH

March

LL_RTC_MONTH_APRIL

April

LL_RTC_MONTH_MAY

May

LL_RTC_MONTH_JUNE

June

LL_RTC_MONTH_JULY

July

LL_RTC_MONTH_AUGUST

August

LL_RTC_MONTH_SEPTEMBER

September

LL_RTC_MONTH_OCTOBER

October

LL_RTC_MONTH_NOVEMBER

November

LL_RTC_MONTH_DECEMBER

December

OUTPUT POLARITY PIN

LL_RTC_OUTPUTPOLARITY_PIN_HIGH

Pin is high when ALRAF/ALRBF/WUTF is asserted (depending on OSEL)

LL_RTC_OUTPUTPOLARITY_PIN_LOW

Pin is low when ALRAF/ALRBF/WUTF is asserted (depending on OSEL)

SHIFT SECOND

LL_RTC_SHIFT_SECOND_DELAY

LL_RTC_SHIFT_SECOND_ADVANCE

TAMPER

LL_RTC_TAMPER_1

RTC_TAMP1 input detection

LL_RTC_TAMPER_2

RTC_TAMP2 input detection

LL_RTC_TAMPER_3

RTC_TAMP3 input detection

TAMPER ACTIVE LEVEL

LL_RTC_TAMPER_ACTIVELEVEL_TAMP1

RTC_TAMP1 input falling edge (if TAMPFLT = 00) or staying high (if TAMPFLT != 00) triggers a tamper detection event

LL_RTC_TAMPER_ACTIVELEVEL_TAMP2

RTC_TAMP2 input falling edge (if TAMPFLT = 00) or staying high (if TAMPFLT != 00) triggers a tamper detection event

LL_RTC_TAMPER_ACTIVELEVEL_TAMP3

RTC_TAMP3 input falling edge (if TAMPFLT = 00) or staying high (if TAMPFLT != 00) triggers a tamper detection event

TAMPER DURATION

LL_RTC_TAMPER_DURATION_1RTCCLK

Tamper pins are pre-charged before sampling during 1 RTCCLK cycle

LL_RTC_TAMPER_DURATION_2RTCCLK

Tamper pins are pre-charged before sampling during 2 RTCCLK cycles

LL_RTC_TAMPER_DURATION_4RTCCLK

Tamper pins are pre-charged before sampling during 4 RTCCLK cycles

LL_RTC_TAMPER_DURATION_8RTCCLK

Tamper pins are pre-charged before sampling during 8 RTCCLK cycles

TAMPER FILTER

LL_RTC_TAMPER_FILTER_DISABLE

Tamper filter is disabled

LL_RTC_TAMPER_FILTER_2SAMPLE

Tamper is activated after 2 consecutive samples at the active level

LL_RTC_TAMPER_FILTER_4SAMPLE

Tamper is activated after 4 consecutive samples at the active level

LL_RTC_TAMPER_FILTER_8SAMPLE

Tamper is activated after 8 consecutive samples at the active level.

TAMPER MASK

LL_RTC_TAMPER_MASK_TAMPER1

Tamper 1 event generates a trigger event. TAMP1F is masked and internally cleared by hardware.The backup registers are not erased

LL_RTC_TAMPER_MASK_TAMPER2

Tamper 2 event generates a trigger event. TAMP2F is masked and internally cleared by hardware. The backup registers are not erased.

LL_RTC_TAMPER_MASK_TAMPER3

Tamper 3 event generates a trigger event. TAMP3F is masked and internally cleared by hardware. The backup registers are not erased

TAMPER NO ERASE

LL_RTC_TAMPER_NOERASE_TAMPER1

Tamper 1 event does not erase the backup registers.

LL_RTC_TAMPER_NOERASE_TAMPER2

Tamper 2 event does not erase the backup registers.

LL_RTC_TAMPER_NOERASE_TAMPER3

Tamper 3 event does not erase the backup registers.

TAMPER SAMPLING FREQUENCY DIVIDER

LL_RTC_TAMPER_SAMPLFREQDIV_32768

Each of the tamper inputs are sampled with a frequency = RTCCLK / 32768

LL_RTC_TAMPER_SAMPLFREQDIV_16384

Each of the tamper inputs are sampled with a frequency = RTCCLK / 16384

LL_RTC_TAMPER_SAMPLFREQDIV_8192

Each of the tamper inputs are sampled with a frequency = RTCCLK / 8192

LL_RTC_TAMPER_SAMPLFREQDIV_4096

Each of the tamper inputs are sampled with a frequency = RTCCLK / 4096

LL_RTC_TAMPER_SAMPLFREQDIV_2048

Each of the tamper inputs are sampled with a frequency = RTCCLK / 2048

LL_RTC_TAMPER_SAMPLFREQDIV_1024

Each of the tamper inputs are sampled with a frequency = RTCCLK / 1024

LL_RTC_TAMPER_SAMPLFREQDIV_512

Each of the tamper inputs are sampled with a frequency = RTCCLK / 512

LL_RTC_TAMPER_SAMPLFREQDIV_256

Each of the tamper inputs are sampled with a frequency = RTCCLK / 256

TIMESTAMP EDGE

LL_RTC_TIMESTAMP_EDGE_RISING

RTC_TS input rising edge generates a time-stamp event

LL_RTC_TIMESTAMP_EDGE_FALLING

RTC_TS input falling edge generates a time-stamp even

TIME FORMAT

LL_RTC_TIME_FORMAT_AM_OR_24

AM or 24-hour format

LL_RTC_TIME_FORMAT_PM

PM

TIMESTAMP TIME FORMAT

LL_RTC_TS_TIME_FORMAT_AM

AM or 24-hour format

LL_RTC_TS_TIME_FORMAT_PM

PM

WAKEUP CLOCK DIV

LL_RTC_WAKEUPCLOCK_DIV_16

RTC/16 clock is selected

LL_RTC_WAKEUPCLOCK_DIV_8

RTC/8 clock is selected

LL_RTC_WAKEUPCLOCK_DIV_4

RTC/4 clock is selected

LL_RTC_WAKEUPCLOCK_DIV_2

RTC/2 clock is selected

LL_RTC_WAKEUPCLOCK_CKSPRE

ck_spre (usually 1 Hz) clock is selected

LL_RTC_WAKEUPCLOCK_CKSPRE_WUT

ck_spre (usually 1 Hz) clock is selected and 2exp16 is added to the WUT counter value

WEEK DAY

LL_RTC_WEEKDAY_MONDAY

Monday

LL_RTC_WEEKDAY_TUESDAY

Tuesday

LL_RTC_WEEKDAY_WEDNESDAY

Wednesday

LL_RTC_WEEKDAY_THURSDAY

Thrusday

LL_RTC_WEEKDAY_FRIDAY

Friday

LL_RTC_WEEKDAY_SATURDAY

Saturday

LL_RTC_WEEKDAY_SUNDAY

Sunday

Convert helper Macros

__LL_RTC_CONVERT_BIN2BCD

Description:

- Helper macro to convert a value from 2 digit decimal format to BCD format.

Parameters:

- __VALUE__: Byte to be converted

Return value:

- Converted: byte

__LL_RTC_CONVERT_BCD2BIN

Description:

- Helper macro to convert a value from BCD format to 2 digit decimal format.

Parameters:

- __VALUE__: BCD value to be converted

Return value:

- Converted: byte

Date helper Macros

__LL_RTC_GET_WEEKDAY

Description:

- Helper macro to retrieve weekday.

Parameters:

- __RTC_DATE__: Date returned by

Return value:

- Returned: value can be one of the following values:
  - LL_RTC_WEEKDAY_MONDAY
  - LL_RTC_WEEKDAY_TUESDAY
  - LL_RTC_WEEKDAY_WEDNESDAY
  - LL_RTC_WEEKDAY_THURSDAY
  - LL_RTC_WEEKDAY_FRIDAY
  - LL_RTC_WEEKDAY_SATURDAY
  - LL_RTC_WEEKDAY_SUNDAY

__LL_RTC_GET_YEAR

Description:

- Helper macro to retrieve Year in BCD format.

Parameters:

- __RTC_DATE__: Value returned by

Return value:

- Year: in BCD format (0x00 . . . 0x99)

__LL_RTC_GET_MONTH

Description:

- Helper macro to retrieve Month in BCD format.

Parameters:

- __RTC_DATE__: Value returned by

Return value:

- Returned: value can be one of the following values:
  - LL_RTC_MONTH_JANUARY
  - LL_RTC_MONTH_FEBRUARY
  - LL_RTC_MONTH_MARCH
  - LL_RTC_MONTH_APRIL
  - LL_RTC_MONTH_MAY
  - LL_RTC_MONTH_JUNE
  - LL_RTC_MONTH_JULY
  - LL_RTC_MONTH_AUGUST
  - LL_RTC_MONTH_SEPTEMBER
  - LL_RTC_MONTH_OCTOBER
  - LL_RTC_MONTH_NOVEMBER
  - LL_RTC_MONTH_DECEMBER

__LL_RTC_GET_DAY

Description:

- Helper macro to retrieve Day in BCD format.

Parameters:

- __RTC_DATE__: Value returned by

Return value:

- Day: in BCD format (0x01 . . . 0x31)

Time helper Macros

__LL_RTC_GET_HOUR

Description:

- Helper macro to retrieve hour in BCD format.

Parameters:

- __RTC_TIME__: RTC time returned by

Return value:

- Hours: in BCD format (0x01. . .0x12 or between Min_Data=0x00 and Max_Data=0x23)

__LL_RTC_GET_MINUTE

Description:

- Helper macro to retrieve minute in BCD format.

Parameters:

- __RTC_TIME__: RTC time returned by

Return value:

- Minutes: in BCD format (0x00. . .0x59)

__LL_RTC_GET_SECOND

Description:

- Helper macro to retrieve second in BCD format.

Parameters:

- __RTC_TIME__: RTC time returned by

Return value:

- Seconds: in format (0x00. . .0x59)

Common Write and read registers Macros

LL_RTC_WriteReg

Description:

- Write a value in RTC register.

Parameters:

- __INSTANCE__: RTC Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_RTC_ReadReg

Description:

- Read a value in RTC register.

Parameters:

- __INSTANCE__: RTC Instance
- __REG__: Register to be read

Return value:

- Register: value

102 LL SPI Generic Driver

102.1 SPI Firmware driver registers structures

102.1.1 LL_SPI_InitTypeDef

LL_SPI_InitTypeDef is defined in the stm32l4xx_ll_spi.h

Data Fields

- ***uint32_t TransferDirection***
- ***uint32_t Mode***
- ***uint32_t DataWidth***
- ***uint32_t ClockPolarity***
- ***uint32_t ClockPhase***
- ***uint32_t NSS***
- ***uint32_t BaudRate***
- ***uint32_t BitOrder***
- ***uint32_t CRCCalculation***
- ***uint32_t CRCPoly***

Field Documentation

- ***uint32_t LL_SPI_InitTypeDef::TransferDirection***

  Specifies the SPI unidirectional or bidirectional data mode. This parameter can be a value of ***SPI_LL_EC_TRANSFER_MODE***.This feature can be modified afterwards using unitary function **LL_SPI_SetTransferDirection()**.
- ***uint32_t LL_SPI_InitTypeDef::Mode***

  Specifies the SPI mode (Master/Slave). This parameter can be a value of ***SPI_LL_EC_MODE***.This feature can be modified afterwards using unitary function **LL_SPI_SetMode()**.
- ***uint32_t LL_SPI_InitTypeDef::DataWidth***

  Specifies the SPI data width. This parameter can be a value of ***SPI_LL_EC_DATAWIDTH***.This feature can be modified afterwards using unitary function **LL_SPI_SetDataWidth()**.
- ***uint32_t LL_SPI_InitTypeDef::ClockPolarity***

  Specifies the serial clock steady state. This parameter can be a value of ***SPI_LL_EC_POLARITY***.This feature can be modified afterwards using unitary function **LL_SPI_SetClockPolarity()**.
- ***uint32_t LL_SPI_InitTypeDef::ClockPhase***

  Specifies the clock active edge for the bit capture. This parameter can be a value of ***SPI_LL_EC_PHASE***.This feature can be modified afterwards using unitary function **LL_SPI_SetClockPhase()**.
- ***uint32_t LL_SPI_InitTypeDef::NSS***

  Specifies whether the NSS signal is managed by hardware (NSS pin) or by software using the SSI bit. This parameter can be a value of ***SPI_LL_EC_NSS_MODE***.This feature can be modified afterwards using unitary function **LL_SPI_SetNSSMode()**.
- ***uint32_t LL_SPI_InitTypeDef::BaudRate***

  Specifies the BaudRate prescaler value which will be used to configure the transmit and receive SCK clock. This parameter can be a value of ***SPI_LL_EC_BAUDRATEPRESCALER***.

  Note:

  – The communication clock is derived from the master clock. The slave clock does not need to be set.

  This feature can be modified afterwards using unitary function **LL_SPI_SetBaudRatePrescaler()**.
- ***uint32_t LL_SPI_InitTypeDef::BitOrder***

  Specifies whether data transfers start from MSB or LSB bit. This parameter can be a value of ***SPI_LL_EC_BIT_ORDER***.This feature can be modified afterwards using unitary function **LL_SPI_SetTransferBitOrder()**.

- ***uint32_t LL_SPI_InitTypeDef::CRCCalculation***
  Specifies if the CRC calculation is enabled or not. This parameter can be a value of ***SPI_LL_EC_CRC_CALCULATION***.This feature can be modified afterwards using unitary functions **LL_SPI_EnableCRC()** and **LL_SPI_DisableCRC()**.
- ***uint32_t LL_SPI_InitTypeDef::CRCPoly***
  Specifies the polynomial used for the CRC calculation. This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFFFF.This feature can be modified afterwards using unitary function **LL_SPI_SetCRCPolynomial()**.

102.2 SPI Firmware driver API description

The following section lists the various functions of the SPI library.

102.2.1 Detailed description of functions

`LL_SPI_Enable`

Function name

__STATIC_INLINE void LL_SPI_Enable (SPI_TypeDef * SPIx)

Function description

Enable SPI peripheral.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 SPE LL_SPI_Enable

`LL_SPI_Disable`

Function name

__STATIC_INLINE void LL_SPI_Disable (SPI_TypeDef * SPIx)

Function description

Disable SPI peripheral.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- When disabling the SPI, follow the procedure described in the Reference Manual.

Reference Manual to LL API cross reference:

- CR1 SPE LL_SPI_Disable

`LL_SPI_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabled (SPI_TypeDef * SPIx)

Function description

Check if SPI peripheral is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 SPE LL_SPI_IsEnabled

LL_SPI_SetMode

Function name

__STATIC_INLINE void LL_SPI_SetMode (SPI_TypeDef * SPIx, uint32_t Mode)

Function description

Set SPI operation mode to Master or Slave.

Parameters

- **SPIx:** SPI Instance
- **Mode:** This parameter can be one of the following values:
  - LL_SPI_MODE_MASTER
  - LL_SPI_MODE_SLAVE

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing.

Reference Manual to LL API cross reference:

- CR1 MSTR LL_SPI_SetMode
- CR1 SSI LL_SPI_SetMode

LL_SPI_GetMode

Function name

__STATIC_INLINE uint32_t LL_SPI_GetMode (SPI_TypeDef * SPIx)

Function description

Get SPI operation mode (Master or Slave)

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_MODE_MASTER
  - LL_SPI_MODE_SLAVE

Reference Manual to LL API cross reference:

- CR1 MSTR LL_SPI_GetMode
- CR1 SSI LL_SPI_GetMode

`LL_SPI_SetStandard`

Function name

__STATIC_INLINE void LL_SPI_SetStandard (SPI_TypeDef * SPIx, uint32_t Standard)

Function description

Set serial protocol used.

Parameters

- **SPIx:** SPI Instance
- **Standard:** This parameter can be one of the following values:
  - LL_SPI_PROTOCOL_MOTOROLA
  - LL_SPI_PROTOCOL_TI

Return values

- **None:**

Notes

- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.

Reference Manual to LL API cross reference:

- CR2 FRF LL_SPI_SetStandard

`LL_SPI_GetStandard`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetStandard (SPI_TypeDef * SPIx)

Function description

Get serial protocol used.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_PROTOCOL_MOTOROLA
  - LL_SPI_PROTOCOL_TI

Reference Manual to LL API cross reference:

- CR2 FRF LL_SPI_GetStandard

`LL_SPI_SetClockPhase`

Function name

__STATIC_INLINE void LL_SPI_SetClockPhase (SPI_TypeDef * SPIx, uint32_t ClockPhase)

Function description

Set clock phase.

Parameters

- **SPIx:** SPI Instance
- **ClockPhase:** This parameter can be one of the following values:
  - LL_SPI_PHASE_1EDGE
  - LL_SPI_PHASE_2EDGE

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR1 CPHA LL_SPI_SetClockPhase

`LL_SPI_GetClockPhase`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetClockPhase (SPI_TypeDef * SPIx)

Function description

Get clock phase.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_PHASE_1EDGE
  - LL_SPI_PHASE_2EDGE

Reference Manual to LL API cross reference:

- CR1 CPHA LL_SPI_GetClockPhase

`LL_SPI_SetClockPolarity`

Function name

__STATIC_INLINE void LL_SPI_SetClockPolarity (SPI_TypeDef * SPIx, uint32_t ClockPolarity)

Function description

Set clock polarity.

Parameters

- **SPIx:** SPI Instance
- **ClockPolarity:** This parameter can be one of the following values:
  - LL_SPI_POLARITY_LOW
  - LL_SPI_POLARITY_HIGH

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR1 CPOL LL_SPI_SetClockPolarity

`LL_SPI_GetClockPolarity`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetClockPolarity (SPI_TypeDef * SPIx)

Function description

Get clock polarity.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_POLARITY_LOW
  - LL_SPI_POLARITY_HIGH

Reference Manual to LL API cross reference:

- CR1 CPOL LL_SPI_GetClockPolarity

LL_SPI_SetBaudRatePrescaler

Function name

__STATIC_INLINE void LL_SPI_SetBaudRatePrescaler (SPI_TypeDef * SPIx, uint32_t BaudRate)

Function description

Set baud rate prescaler.

Parameters

- **SPIx:** SPI Instance
- **BaudRate:** This parameter can be one of the following values:
  - LL_SPI_BAUDRATEPRESCALER_DIV2
  - LL_SPI_BAUDRATEPRESCALER_DIV4
  - LL_SPI_BAUDRATEPRESCALER_DIV8
  - LL_SPI_BAUDRATEPRESCALER_DIV16
  - LL_SPI_BAUDRATEPRESCALER_DIV32
  - LL_SPI_BAUDRATEPRESCALER_DIV64
  - LL_SPI_BAUDRATEPRESCALER_DIV128
  - LL_SPI_BAUDRATEPRESCALER_DIV256

Return values

- **None:**

Notes

- These bits should not be changed when communication is ongoing. SPI BaudRate = fPCLK/Prescaler.

Reference Manual to LL API cross reference:

- CR1 BR LL_SPI_SetBaudRatePrescaler

LL_SPI_GetBaudRatePrescaler

Function name

__STATIC_INLINE uint32_t LL_SPI_GetBaudRatePrescaler (SPI_TypeDef * SPIx)

Function description

Get baud rate prescaler.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_BAUDRATEPRESCALER_DIV2
  - LL_SPI_BAUDRATEPRESCALER_DIV4
  - LL_SPI_BAUDRATEPRESCALER_DIV8
  - LL_SPI_BAUDRATEPRESCALER_DIV16
  - LL_SPI_BAUDRATEPRESCALER_DIV32
  - LL_SPI_BAUDRATEPRESCALER_DIV64
  - LL_SPI_BAUDRATEPRESCALER_DIV128
  - LL_SPI_BAUDRATEPRESCALER_DIV256

Reference Manual to LL API cross reference:

- CR1 BR LL_SPI_GetBaudRatePrescaler

`LL_SPI_SetTransferBitOrder`

Function name

__STATIC_INLINE void LL_SPI_SetTransferBitOrder (SPI_TypeDef * SPIx, uint32_t BitOrder)

Function description

Set transfer bit order.

Parameters

- **SPIx:** SPI Instance
- **BitOrder:** This parameter can be one of the following values:
  - LL_SPI_LSB_FIRST
  - LL_SPI_MSB_FIRST

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR1 LSBFIRST LL_SPI_SetTransferBitOrder

`LL_SPI_GetTransferBitOrder`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetTransferBitOrder (SPI_TypeDef * SPIx)

Function description

Get transfer bit order.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_LSB_FIRST
  - LL_SPI_MSB_FIRST

Reference Manual to LL API cross reference:

- CR1 LSBFIRST LL_SPI_GetTransferBitOrder

`LL_SPI_SetTransferDirection`

Function name

__STATIC_INLINE void LL_SPI_SetTransferDirection (SPI_TypeDef * SPIx, uint32_t TransferDirection)

Function description

Set transfer direction mode.

Parameters

- **SPIx:** SPI Instance
- **TransferDirection:** This parameter can be one of the following values:
  - LL_SPI_FULL_DUPLEX
  - LL_SPI_SIMPLEX_RX
  - LL_SPI_HALF_DUPLEX_RX
  - LL_SPI_HALF_DUPLEX_TX

Return values

- **None:**

Notes

- For Half-Duplex mode, Rx Direction is set by default. In master mode, the MOSI pin is used and in slave mode, the MISO pin is used for Half-Duplex.

Reference Manual to LL API cross reference:

- CR1 RXONLY LL_SPI_SetTransferDirection
- CR1 BIDIMODE LL_SPI_SetTransferDirection
- CR1 BIDIOE LL_SPI_SetTransferDirection

`LL_SPI_GetTransferDirection`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetTransferDirection (SPI_TypeDef * SPIx)

Function description

Get transfer direction mode.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_FULL_DUPLEX
  - LL_SPI_SIMPLEX_RX
  - LL_SPI_HALF_DUPLEX_RX
  - LL_SPI_HALF_DUPLEX_TX

Reference Manual to LL API cross reference:

- CR1 RXONLY LL_SPI_GetTransferDirection
- CR1 BIDIMODE LL_SPI_GetTransferDirection
- CR1 BIDIOE LL_SPI_GetTransferDirection

`LL_SPI_SetDataWidth`

Function name

__STATIC_INLINE void LL_SPI_SetDataWidth (SPI_TypeDef * SPIx, uint32_t DataWidth)

Function description

Set frame data width.

Parameters

- **SPIx:** SPI Instance
- **DataWidth:** This parameter can be one of the following values:
  - LL_SPI_DATAWIDTH_4BIT
  - LL_SPI_DATAWIDTH_5BIT
  - LL_SPI_DATAWIDTH_6BIT
  - LL_SPI_DATAWIDTH_7BIT
  - LL_SPI_DATAWIDTH_8BIT
  - LL_SPI_DATAWIDTH_9BIT
  - LL_SPI_DATAWIDTH_10BIT
  - LL_SPI_DATAWIDTH_11BIT
  - LL_SPI_DATAWIDTH_12BIT
  - LL_SPI_DATAWIDTH_13BIT
  - LL_SPI_DATAWIDTH_14BIT
  - LL_SPI_DATAWIDTH_15BIT
  - LL_SPI_DATAWIDTH_16BIT

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 DS LL_SPI_SetDataWidth

`LL_SPI_GetDataWidth`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetDataWidth (SPI_TypeDef * SPIx)

Function description

Get frame data width.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_DATAWIDTH_4BIT
  - LL_SPI_DATAWIDTH_5BIT
  - LL_SPI_DATAWIDTH_6BIT
  - LL_SPI_DATAWIDTH_7BIT
  - LL_SPI_DATAWIDTH_8BIT
  - LL_SPI_DATAWIDTH_9BIT
  - LL_SPI_DATAWIDTH_10BIT
  - LL_SPI_DATAWIDTH_11BIT
  - LL_SPI_DATAWIDTH_12BIT
  - LL_SPI_DATAWIDTH_13BIT
  - LL_SPI_DATAWIDTH_14BIT
  - LL_SPI_DATAWIDTH_15BIT
  - LL_SPI_DATAWIDTH_16BIT

Reference Manual to LL API cross reference:

- CR2 DS LL_SPI_GetDataWidth

`LL_SPI_SetRxFIFOThreshold`

Function name

__STATIC_INLINE void LL_SPI_SetRxFIFOThreshold (SPI_TypeDef * SPIx, uint32_t Threshold)

Function description

Set threshold of RXFIFO that triggers an RXNE event.

Parameters

- **SPIx:** SPI Instance
- **Threshold:** This parameter can be one of the following values:
  - LL_SPI_RX_FIFO_TH_HALF
  - LL_SPI_RX_FIFO_TH_QUARTER

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 FRXTH LL_SPI_SetRxFIFOThreshold

`LL_SPI_GetRxFIFOThreshold`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetRxFIFOThreshold (SPI_TypeDef * SPIx)

Function description

Get threshold of RXFIFO that triggers an RXNE event.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_RX_FIFO_TH_HALF
  - LL_SPI_RX_FIFO_TH_QUARTER

Reference Manual to LL API cross reference:

- CR2 FRXTH LL_SPI_GetRxFIFOThreshold

`LL_SPI_EnableCRC`

Function name

__STATIC_INLINE void LL_SPI_EnableCRC (SPI_TypeDef * SPIx)

Function description

Enable CRC.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.

Reference Manual to LL API cross reference:

- CR1 CRCEN LL_SPI_EnableCRC

`LL_SPI_DisableCRC`

Function name

__STATIC_INLINE void LL_SPI_DisableCRC (SPI_TypeDef * SPIx)

Function description

Disable CRC.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.

Reference Manual to LL API cross reference:

- CR1 CRCEN LL_SPI_DisableCRC

`LL_SPI_IsEnabledCRC`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledCRC (SPI_TypeDef * SPIx)

Function description

Check if CRC is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Notes

- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.

Reference Manual to LL API cross reference:

- CR1 CRCEN LL_SPI_IsEnabledCRC

`LL_SPI_SetCRCWidth`

Function name

__STATIC_INLINE void LL_SPI_SetCRCWidth (SPI_TypeDef * SPIx, uint32_t CRCLength)

Function description

Set CRC Length.

Parameters

- **SPIx:** SPI Instance
- **CRCLength:** This parameter can be one of the following values:
  - LL_SPI_CRC_8BIT
  - LL_SPI_CRC_16BIT

Return values

- **None:**

Notes

- This bit should be written only when SPI is disabled (SPE = 0) for correct operation.

Reference Manual to LL API cross reference:

- CR1 CRCL LL_SPI_SetCRCWidth

`LL_SPI_GetCRCWidth`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetCRCWidth (SPI_TypeDef * SPIx)

Function description

Get CRC Length.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_CRC_8BIT
  - LL_SPI_CRC_16BIT

Reference Manual to LL API cross reference:

- CR1 CRCL LL_SPI_GetCRCWidth

`LL_SPI_SetCRCNext`

Function name

__STATIC_INLINE void LL_SPI_SetCRCNext (SPI_TypeDef * SPIx)

Function description

Set CRCNext to transfer CRC on the line.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit has to be written as soon as the last data is written in the SPIx_DR register.

Reference Manual to LL API cross reference:

- CR1 CRCNEXT LL_SPI_SetCRCNext

`LL_SPI_SetCRCPolynomial`

Function name

__STATIC_INLINE void LL_SPI_SetCRCPolynomial (SPI_TypeDef * SPIx, uint32_t CRCPoly)

Function description

Set polynomial for CRC calculation.

Parameters

- **SPIx:** SPI Instance
- **CRCPoly:** This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- CRCPR CRCPOLY LL_SPI_SetCRCPolynomial

`LL_SPI_GetCRCPolynomial`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetCRCPolynomial (SPI_TypeDef * SPIx)

Function description

Get polynomial for CRC calculation.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value is a number between Min_Data = 0x00 and Max_Data = 0xFFFF

Reference Manual to LL API cross reference:

- CRCPR CRCPOLY LL_SPI_GetCRCPolynomial

`LL_SPI_GetRxCRC`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetRxCRC (SPI_TypeDef * SPIx)

Function description

Get Rx CRC.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value is a number between Min_Data = 0x00 and Max_Data = 0xFFFF

Reference Manual to LL API cross reference:

- RXCRCR RXCRC LL_SPI_GetRxCRC

`LL_SPI_GetTxCRC`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetTxCRC (SPI_TypeDef * SPIx)

Function description

Get Tx CRC.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value is a number between Min_Data = 0x00 and Max_Data = 0xFFFF

Reference Manual to LL API cross reference:

- TXCRCR TXCRC LL_SPI_GetTxCRC

`LL_SPI_SetNSSMode`

Function name

__STATIC_INLINE void LL_SPI_SetNSSMode (SPI_TypeDef * SPIx, uint32_t NSS)

Function description

Set NSS mode.

Parameters

- **SPIx:** SPI Instance
- **NSS:** This parameter can be one of the following values:
  - LL_SPI_NSS_SOFT
  - LL_SPI_NSS_HARD_INPUT
  - LL_SPI_NSS_HARD_OUTPUT

Return values

- **None:**

Notes

- LL_SPI_NSS_SOFT Mode is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR1 SSM LL_SPI_SetNSSMode
-
- CR2 SSOE LL_SPI_SetNSSMode

`LL_SPI_GetNSSMode`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetNSSMode (SPI_TypeDef * SPIx)

Function description

Get NSS mode.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_NSS_SOFT
  - LL_SPI_NSS_HARD_INPUT
  - LL_SPI_NSS_HARD_OUTPUT

Reference Manual to LL API cross reference:

- CR1 SSM LL_SPI_GetNSSMode
-
- CR2 SSOE LL_SPI_GetNSSMode

`LL_SPI_EnableNSSPulseMgt`

Function name

__STATIC_INLINE void LL_SPI_EnableNSSPulseMgt (SPI_TypeDef * SPIx)

Function description

Enable NSS pulse management.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR2 NSSP LL_SPI_EnableNSSPulseMgt

`LL_SPI_DisableNSSPulseMgt`

Function name

__STATIC_INLINE void LL_SPI_DisableNSSPulseMgt (SPI_TypeDef * SPIx)

Function description

Disable NSS pulse management.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR2 NSSP LL_SPI_DisableNSSPulseMgt

`LL_SPI_IsEnabledNSSPulse`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledNSSPulse (SPI_TypeDef * SPIx)

Function description

Check if NSS pulse is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Notes

- This bit should not be changed when communication is ongoing. This bit is not used in SPI TI mode.

Reference Manual to LL API cross reference:

- CR2 NSSP LL_SPI_IsEnabledNSSPulse

`LL_SPI_IsActiveFlag_RXNE`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_RXNE (SPI_TypeDef * SPIx)

Function description

Check if Rx buffer is not empty.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR RXNE LL_SPI_IsActiveFlag_RXNE

`LL_SPI_IsActiveFlag_TXE`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_TXE (SPI_TypeDef * SPIx)

Function description

Check if Tx buffer is empty.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR TXE LL_SPI_IsActiveFlag_TXE

`LL_SPI_IsActiveFlag_CRCERR`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_CRCERR (SPI_TypeDef * SPIx)

Function description

Get CRC error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CRCERR LL_SPI_IsActiveFlag_CRCERR

`LL_SPI_IsActiveFlag_MODF`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_MODF (SPI_TypeDef * SPIx)

Function description

Get mode fault error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR MODF LL_SPI_IsActiveFlag_MODF

`LL_SPI_IsActiveFlag_OVR`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_OVR (SPI_TypeDef * SPIx)

Function description

Get overrun error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR OVR LL_SPI_IsActiveFlag_OVR

`LL_SPI_IsActiveFlag_BSY`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_BSY (SPI_TypeDef * SPIx)

Function description

Get busy flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Notes

- The BSY flag is cleared under any one of the following conditions: -When the SPI is correctly disabled - When a fault is detected in Master mode (MODF bit set to 1) -In Master mode, when it finishes a data transmission and no new data is ready to be sent -In Slave mode, when the BSY flag is set to '0' for at least one SPI clock cycle between each data transfer.

Reference Manual to LL API cross reference:

- SR BSY LL_SPI_IsActiveFlag_BSY

`LL_SPI_IsActiveFlag_FRE`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsActiveFlag_FRE (SPI_TypeDef * SPIx)

Function description

Get frame format error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR FRE LL_SPI_IsActiveFlag_FRE

`LL_SPI_GetRxFIFOLevel`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetRxFIFOLevel (SPI_TypeDef * SPIx)

Function description

Get FIFO reception Level.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_RX_FIFO_EMPTY
  - LL_SPI_RX_FIFO_QUARTER_FULL
  - LL_SPI_RX_FIFO_HALF_FULL
  - LL_SPI_RX_FIFO_FULL

Reference Manual to LL API cross reference:

- SR FRLVL LL_SPI_GetRxFIFOLevel

`LL_SPI_GetTxFIFOLevel`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetTxFIFOLevel (SPI_TypeDef * SPIx)

Function description

Get FIFO Transmission Level.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_TX_FIFO_EMPTY
  - LL_SPI_TX_FIFO_QUARTER_FULL
  - LL_SPI_TX_FIFO_HALF_FULL
  - LL_SPI_TX_FIFO_FULL

Reference Manual to LL API cross reference:

- SR FTLVL LL_SPI_GetTxFIFOLevel

`LL_SPI_ClearFlag_CRCERR`

Function name

__STATIC_INLINE void LL_SPI_ClearFlag_CRCERR (SPI_TypeDef * SPIx)

Function description

Clear CRC error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CRCERR LL_SPI_ClearFlag_CRCERR

`LL_SPI_ClearFlag_MODF`

Function name

__STATIC_INLINE void LL_SPI_ClearFlag_MODF (SPI_TypeDef * SPIx)

Function description

Clear mode fault error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- Clearing this flag is done by a read access to the SPIx_SR register followed by a write access to the SPIx_CR1 register

Reference Manual to LL API cross reference:

- SR MODF LL_SPI_ClearFlag_MODF

`LL_SPI_ClearFlag_OVR`

Function name

__STATIC_INLINE void LL_SPI_ClearFlag_OVR (SPI_TypeDef * SPIx)

Function description

Clear overrun error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- Clearing this flag is done by a read access to the SPIx_DR register followed by a read access to the SPIx_SR register

Reference Manual to LL API cross reference:

- SR OVR LL_SPI_ClearFlag_OVR

`LL_SPI_ClearFlag_FRE`

Function name

__STATIC_INLINE void LL_SPI_ClearFlag_FRE (SPI_TypeDef * SPIx)

Function description

Clear frame format error flag.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- Clearing this flag is done by reading SPIx_SR register

Reference Manual to LL API cross reference:

- SR FRE LL_SPI_ClearFlag_FRE

`LL_SPI_EnableIT_ERR`

Function name

__STATIC_INLINE void LL_SPI_EnableIT_ERR (SPI_TypeDef * SPIx)

Function description

Enable error interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit controls the generation of an interrupt when an error condition occurs (CRCERR, OVR, MODF in SPI mode, FRE at TI mode).

Reference Manual to LL API cross reference:

- CR2 ERRIE LL_SPI_EnableIT_ERR

`LL_SPI_EnableIT_RXNE`

Function name

__STATIC_INLINE void LL_SPI_EnableIT_RXNE (SPI_TypeDef * SPIx)

Function description

Enable Rx buffer not empty interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXNEIE LL_SPI_EnableIT_RXNE

`LL_SPI_EnableIT_TXE`

Function name

__STATIC_INLINE void LL_SPI_EnableIT_TXE (SPI_TypeDef * SPIx)

Function description

Enable Tx buffer empty interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_SPI_EnableIT_TXE

`LL_SPI_DisableIT_ERR`

Function name

__STATIC_INLINE void LL_SPI_DisableIT_ERR (SPI_TypeDef * SPIx)

Function description

Disable error interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Notes

- This bit controls the generation of an interrupt when an error condition occurs (CRCERR, OVR, MODF in SPI mode, FRE at TI mode).

Reference Manual to LL API cross reference:

- CR2 ERRIE LL_SPI_DisableIT_ERR

`LL_SPI_DisableIT_RXNE`

Function name

__STATIC_INLINE void LL_SPI_DisableIT_RXNE (SPI_TypeDef * SPIx)

Function description

Disable Rx buffer not empty interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXNEIE LL_SPI_DisableIT_RXNE

`LL_SPI_DisableIT_TXE`

Function name

__STATIC_INLINE void LL_SPI_DisableIT_TXE (SPI_TypeDef * SPIx)

Function description

Disable Tx buffer empty interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_SPI_DisableIT_TXE

`LL_SPI_IsEnabledIT_ERR`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledIT_ERR (SPI_TypeDef * SPIx)

Function description

Check if error interrupt is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 ERRIE LL_SPI_IsEnabledIT_ERR

`LL_SPI_IsEnabledIT_RXNE`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledIT_RXNE (SPI_TypeDef * SPIx)

Function description

Check if Rx buffer not empty interrupt is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RXNEIE LL_SPI_IsEnabledIT_RXNE

`LL_SPI_IsEnabledIT_TXE`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledIT_TXE (SPI_TypeDef * SPIx)

Function description

Check if Tx buffer empty interrupt.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 TXEIE LL_SPI_IsEnabledIT_TXE

`LL_SPI_EnableDMAReq_RX`

Function name

__STATIC_INLINE void LL_SPI_EnableDMAReq_RX (SPI_TypeDef * SPIx)

Function description

Enable DMA Rx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_SPI_EnableDMAReq_RX

`LL_SPI_DisableDMAReq_RX`

Function name

__STATIC_INLINE void LL_SPI_DisableDMAReq_RX (SPI_TypeDef * SPIx)

Function description

Disable DMA Rx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_SPI_DisableDMAReq_RX

`LL_SPI_IsEnabledDMAReq_RX`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledDMAReq_RX (SPI_TypeDef * SPIx)

Function description

Check if DMA Rx is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RXDMAEN LL_SPI_IsEnabledDMAReq_RX

`LL_SPI_EnableDMAReq_TX`

Function name

__STATIC_INLINE void LL_SPI_EnableDMAReq_TX (SPI_TypeDef * SPIx)

Function description

Enable DMA Tx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_SPI_EnableDMAReq_TX

`LL_SPI_DisableDMAReq_TX`

Function name

__STATIC_INLINE void LL_SPI_DisableDMAReq_TX (SPI_TypeDef * SPIx)

Function description

Disable DMA Tx.

Parameters

- **SPIx:** SPI Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_SPI_DisableDMAReq_TX

`LL_SPI_IsEnabledDMAReq_TX`

Function name

__STATIC_INLINE uint32_t LL_SPI_IsEnabledDMAReq_TX (SPI_TypeDef * SPIx)

Function description

Check if DMA Tx is enabled.

Parameters

- **SPIx:** SPI Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 TXDMAEN LL_SPI_IsEnabledDMAReq_TX

`LL_SPI_SetDMAParity_RX`

Function name

__STATIC_INLINE void LL_SPI_SetDMAParity_RX (SPI_TypeDef * SPIx, uint32_t Parity)

Function description

Set parity of Last DMA reception.

Parameters

- **SPIx:** SPI Instance
- **Parity:** This parameter can be one of the following values:
  - LL_SPI_DMA_PARITY_ODD
  - LL_SPI_DMA_PARITY_EVEN

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 LDMARX LL_SPI_SetDMAParity_RX

`LL_SPI_GetDMAParity_RX`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetDMAParity_RX (SPI_TypeDef * SPIx)

Function description

Get parity configuration for Last DMA reception.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_DMA_PARITY_ODD
  - LL_SPI_DMA_PARITY_EVEN

Reference Manual to LL API cross reference:

- CR2 LDMARX LL_SPI_GetDMAParity_RX

`LL_SPI_SetDMAParity_TX`

Function name

__STATIC_INLINE void LL_SPI_SetDMAParity_TX (SPI_TypeDef * SPIx, uint32_t Parity)

Function description

Set parity of Last DMA transmission.

Parameters

- **SPIx:** SPI Instance
- **Parity:** This parameter can be one of the following values:
  - LL_SPI_DMA_PARITY_ODD
  - LL_SPI_DMA_PARITY_EVEN

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 LDMATX LL_SPI_SetDMAParity_TX

`LL_SPI_GetDMAParity_TX`

Function name

__STATIC_INLINE uint32_t LL_SPI_GetDMAParity_TX (SPI_TypeDef * SPIx)

Function description

Get parity configuration for Last DMA transmission.

Parameters

- **SPIx:** SPI Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_SPI_DMA_PARITY_ODD
  - LL_SPI_DMA_PARITY_EVEN

Reference Manual to LL API cross reference:

- CR2 LDMATX LL_SPI_GetDMAParity_TX

`LL_SPI_DMA_GetRegAddr`

Function name

__STATIC_INLINE uint32_t LL_SPI_DMA_GetRegAddr (SPI_TypeDef * SPIx)

Function description

Get the data register address used for DMA transfer.

Parameters

- **SPIx:** SPI Instance

Return values

- **Address:** of data register

Reference Manual to LL API cross reference:

- DR DR LL_SPI_DMA_GetRegAddr

`LL_SPI_ReceiveData8`

Function name

__STATIC_INLINE uint8_t LL_SPI_ReceiveData8 (SPI_TypeDef * SPIx)

Function description

Read 8-Bits in the data register.

Parameters

- **SPIx:** SPI Instance

Return values

- **RxData:** Value between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- DR DR LL_SPI_ReceiveData8

`LL_SPI_ReceiveData16`

Function name

__STATIC_INLINE uint16_t LL_SPI_ReceiveData16 (SPI_TypeDef * SPIx)

Function description

Read 16-Bits in the data register.

Parameters

- **SPIx:** SPI Instance

Return values

- **RxData:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Reference Manual to LL API cross reference:

- DR DR LL_SPI_ReceiveData16

`LL_SPI_TransmitData8`

Function name

__STATIC_INLINE void LL_SPI_TransmitData8 (SPI_TypeDef * SPIx, uint8_t TxData)

Function description

Write 8-Bits in the data register.

Parameters

- **SPIx:** SPI Instance
- **TxData:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DR DR LL_SPI_TransmitData8

`LL_SPI_TransmitData16`

Function name

__STATIC_INLINE void LL_SPI_TransmitData16 (SPI_TypeDef * SPIx, uint16_t TxData)

Function description

Write 16-Bits in the data register.

Parameters

- **SPIx:** SPI Instance
- **TxData:** Value between Min_Data=0x00 and Max_Data=0xFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- DR DR LL_SPI_TransmitData16

`LL_SPI_DeInit`

Function name

ErrorStatus LL_SPI_DeInit (SPI_TypeDef * SPIx)

Function description

De-initialize the SPI registers to their default reset values.

Parameters

- **SPIx:** SPI Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: SPI registers are de-initialized
  - ERROR: SPI registers are not de-initialized

`LL_SPI_Init`

Function name

ErrorStatus LL_SPI_Init (SPI_TypeDef * SPIx, LL_SPI_InitTypeDef * SPI_InitStruct)

Function description

Initialize the SPI registers according to the specified parameters in SPI_InitStruct.

Parameters

- **SPIx:** SPI Instance
- **SPI_InitStruct:** pointer to a LL_SPI_InitTypeDef structure

Return values

- **An:** ErrorStatus enumeration value. (Return always SUCCESS)

Notes

- As some bits in SPI configuration registers can only be written when the SPI is disabled (SPI_CR1_SPE bit =0), SPI peripheral should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.

`LL_SPI_StructInit`

Function name

void LL_SPI_StructInit (LL_SPI_InitTypeDef * SPI_InitStruct)

Function description

Set each LL_SPI_InitTypeDef field to default value.

Parameters

- **SPI_InitStruct:** pointer to a LL_SPI_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

102.3 SPI Firmware driver defines

The following section lists the various define and macros of the module.

102.3.1 SPI

SPI

Baud Rate Prescaler

LL_SPI_BAUDRATEPRESCALER_DIV2

BaudRate control equal to fPCLK/2

LL_SPI_BAUDRATEPRESCALER_DIV4

BaudRate control equal to fPCLK/4

LL_SPI_BAUDRATEPRESCALER_DIV8

BaudRate control equal to fPCLK/8

LL_SPI_BAUDRATEPRESCALER_DIV16

BaudRate control equal to fPCLK/16

LL_SPI_BAUDRATEPRESCALER_DIV32

BaudRate control equal to fPCLK/32

LL_SPI_BAUDRATEPRESCALER_DIV64

BaudRate control equal to fPCLK/64

LL_SPI_BAUDRATEPRESCALER_DIV128

BaudRate control equal to fPCLK/128

LL_SPI_BAUDRATEPRESCALER_DIV256

BaudRate control equal to fPCLK/256

Transmission Bit Order

LL_SPI_LSB_FIRST

Data is transmitted/received with the LSB first

LL_SPI_MSB_FIRST

Data is transmitted/received with the MSB first

CRC Calculation

LL_SPI_CRCCALCULATION_DISABLE

CRC calculation disabled

LL_SPI_CRCCALCULATION_ENABLE

CRC calculation enabled

CRC Length

LL_SPI_CRC_8BIT

8-bit CRC length

LL_SPI_CRC_16BIT

16-bit CRC length

Datawidth

LL_SPI_DATAWIDTH_4BIT

Data length for SPI transfer: 4 bits

LL_SPI_DATAWIDTH_5BIT

Data length for SPI transfer: 5 bits

LL_SPI_DATAWIDTH_6BIT

Data length for SPI transfer: 6 bits

LL_SPI_DATAWIDTH_7BIT

Data length for SPI transfer: 7 bits

LL_SPI_DATAWIDTH_8BIT

Data length for SPI transfer: 8 bits

LL_SPI_DATAWIDTH_9BIT

Data length for SPI transfer: 9 bits

LL_SPI_DATAWIDTH_10BIT

Data length for SPI transfer: 10 bits

LL_SPI_DATAWIDTH_11BIT

Data length for SPI transfer: 11 bits

LL_SPI_DATAWIDTH_12BIT

Data length for SPI transfer: 12 bits

LL_SPI_DATAWIDTH_13BIT

Data length for SPI transfer: 13 bits

LL_SPI_DATAWIDTH_14BIT

Data length for SPI transfer: 14 bits

LL_SPI_DATAWIDTH_15BIT

Data length for SPI transfer: 15 bits

LL_SPI_DATAWIDTH_16BIT

Data length for SPI transfer: 16 bits

DMA Parity

LL_SPI_DMA_PARITY_EVEN

Select DMA parity Even

LL_SPI_DMA_PARITY_ODD

Select DMA parity Odd

Get Flags Defines

LL_SPI_SR_RXNE

Rx buffer not empty flag

LL_SPI_SR_TXE

Tx buffer empty flag

LL_SPI_SR_BSY

Busy flag

LL_SPI_SR_CRCERR

CRC error flag

LL_SPI_SR_MODF

Mode fault flag

LL_SPI_SR_OVR

Overrun flag

LL_SPI_SR_FRE

TI mode frame format error flag

IT Defines

LL_SPI_CR2_RXNEIE

Rx buffer not empty interrupt enable

LL_SPI_CR2_TXEIE

Tx buffer empty interrupt enable

LL_SPI_CR2_ERRIE

Error interrupt enable

Operation Mode

LL_SPI_MODE_MASTER

Master configuration

LL_SPI_MODE_SLAVE

Slave configuration

Slave Select Pin Mode

LL_SPI_NSS_SOFT

NSS managed internally. NSS pin not used and free

LL_SPI_NSS_HARD_INPUT

NSS pin used in Input. Only used in Master mode

LL_SPI_NSS_HARD_OUTPUT

NSS pin used in Output. Only used in Slave mode as chip select

Clock Phase

LL_SPI_PHASE_1EDGE

First clock transition is the first data capture edge

LL_SPI_PHASE_2EDGE

Second clock transition is the first data capture edge

Clock Polarity

LL_SPI_POLARITY_LOW

Clock to 0 when idle

LL_SPI_POLARITY_HIGH

Clock to 1 when idle

Serial Protocol

LL_SPI_PROTOCOL_MOTOROLA

Motorola mode. Used as default value

LL_SPI_PROTOCOL_TI

TI mode

RX FIFO Level

LL_SPI_RX_FIFO_EMPTY

FIFO reception empty

LL_SPI_RX_FIFO_QUARTER_FULL

FIFO reception 1/4

LL_SPI_RX_FIFO_HALF_FULL

FIFO reception 1/2

LL_SPI_RX_FIFO_FULL

FIFO reception full

RX FIFO Threshold

LL_SPI_RX_FIFO_TH_HALF

RXNE event is generated if FIFO level is greater than or equel to 1/2 (16-bit)

LL_SPI_RX_FIFO_TH_QUARTER

RXNE event is generated if FIFO level is greater than or equel to 1/4 (8-bit)

Transfer Mode

LL_SPI_FULL_DUPLEX

Full-Duplex mode. Rx and Tx transfer on 2 lines

LL_SPI_SIMPLEX_RX

Simplex Rx mode. Rx transfer only on 1 line

LL_SPI_HALF_DUPLEX_RX

Half-Duplex Rx mode. Rx transfer on 1 line

LL_SPI_HALF_DUPLEX_TX

Half-Duplex Tx mode. Tx transfer on 1 line

TX FIFO Level

LL_SPI_TX_FIFO_EMPTY

FIFO transmission empty

LL_SPI_TX_FIFO_QUARTER_FULL

FIFO transmission 1/4

LL_SPI_TX_FIFO_HALF_FULL

FIFO transmission 1/2

LL_SPI_TX_FIFO_FULL

FIFO transmission full

Common Write and read registers Macros

LL_SPI_WriteReg

Description:

- Write a value in SPI register.

Parameters:

- __INSTANCE__: SPI Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_SPI_ReadReg

Description:

- Read a value in SPI register.

Parameters:

- __INSTANCE__: SPI Instance
- __REG__: Register to be read

Return value:

- Register: value

103 LL SYSTEM Generic Driver

103.1 SYSTEM Firmware driver API description

The following section lists the various functions of the SYSTEM library.

103.1.1 Detailed description of functions

`LL_SYSCFG_SetRemapMemory`

Function name

__STATIC_INLINE void LL_SYSCFG_SetRemapMemory (uint32_t Memory)

Function description

Set memory mapping at address 0x00000000.

Parameters

- **Memory:** This parameter can be one of the following values:
  - LL_SYSCFG_REMAP_FLASH
  - LL_SYSCFG_REMAP_SYSTEMFLASH
  - LL_SYSCFG_REMAP_SRAM
  - LL_SYSCFG_REMAP_FMC (*)
  - LL_SYSCFG_REMAP_QUADSPI

  (*) value not defined in all devices

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_MEMRMP MEM_MODE LL_SYSCFG_SetRemapMemory

`LL_SYSCFG_GetRemapMemory`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_GetRemapMemory (void)

Function description

Get memory mapping at address 0x00000000.

Return values

- **Returned:** value can be one of the following values:
  - LL_SYSCFG_REMAP_FLASH
  - LL_SYSCFG_REMAP_SYSTEMFLASH
  - LL_SYSCFG_REMAP_SRAM
  - LL_SYSCFG_REMAP_FMC (*)
  - LL_SYSCFG_REMAP_QUADSPI

  (*) value not defined in all devices

Reference Manual to LL API cross reference:

- SYSCFG_MEMRMP MEM_MODE LL_SYSCFG_GetRemapMemory

`LL_SYSCFG_SetFlashBankMode`

Function name

__STATIC_INLINE void LL_SYSCFG_SetFlashBankMode (uint32_t Bank)

Function description

Select Flash bank mode (Bank flashed at 0x08000000)

Parameters

- **Bank:** This parameter can be one of the following values:
  - LL_SYSCFG_BANKMODE_BANK1
  - LL_SYSCFG_BANKMODE_BANK2

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_MEMRMP FB_MODE LL_SYSCFG_SetFlashBankMode

`LL_SYSCFG_GetFlashBankMode`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_GetFlashBankMode (void)

Function description

Get Flash bank mode (Bank flashed at 0x08000000)

Return values

- **Returned:** value can be one of the following values:
  - LL_SYSCFG_BANKMODE_BANK1
  - LL_SYSCFG_BANKMODE_BANK2

Reference Manual to LL API cross reference:

- SYSCFG_MEMRMP FB_MODE LL_SYSCFG_GetFlashBankMode

`LL_SYSCFG_EnableFirewall`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableFirewall (void)

Function description

Firewall protection enabled.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FWDIS LL_SYSCFG_EnableFirewall

`LL_SYSCFG_IsEnabledFirewall`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledFirewall (void)

Function description

Check if Firewall protection is enabled or not.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FWDIS LL_SYSCFG_IsEnabledFirewall

`LL_SYSCFG_EnableAnalogBooster`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableAnalogBooster (void)

Function description

Enable I/O analog switch voltage booster.

Return values

- **None:**

Notes

- When voltage booster is enabled, I/O analog switches are supplied by a dedicated voltage booster, from VDD power domain. This is the recommended configuration with low VDDA voltage operation.
- The I/O analog switch voltage booster is relevant for peripherals using I/O in analog input: ADC, COMP, OPAMP. However, COMP and OPAMP inputs have a high impedance and voltage booster do not impact performance significantly. Therefore, the voltage booster is mainly intended for usage with ADC.

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 BOOSTEN LL_SYSCFG_EnableAnalogBooster

`LL_SYSCFG_DisableAnalogBooster`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableAnalogBooster (void)

Function description

Disable I/O analog switch voltage booster.

Return values

- **None:**

Notes

- When voltage booster is enabled, I/O analog switches are supplied by a dedicated voltage booster, from VDD power domain. This is the recommended configuration with low VDDA voltage operation.
- The I/O analog switch voltage booster is relevant for peripherals using I/O in analog input: ADC, COMP, OPAMP. However, COMP and OPAMP inputs have a high impedance and voltage booster do not impact performance significantly. Therefore, the voltage booster is mainly intended for usage with ADC.

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 BOOSTEN LL_SYSCFG_DisableAnalogBooster

`LL_SYSCFG_EnableFastModePlus`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableFastModePlus (uint32_t ConfigFastModePlus)

Function description

Enable the I2C fast mode plus driving capability.

Parameters

- **ConfigFastModePlus:** This parameter can be a combination of the following values:
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB6
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB7
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB8 (*)
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB9 (*)
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C1
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C2 (*)
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C3
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C4 (*)

  (*) value not defined in all devices

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 I2C_PBx_FMP LL_SYSCFG_EnableFastModePlus
- SYSCFG_CFGR1 I2Cx_FMP LL_SYSCFG_EnableFastModePlus

`LL_SYSCFG_DisableFastModePlus`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableFastModePlus (uint32_t ConfigFastModePlus)

Function description

Disable the I2C fast mode plus driving capability.

Parameters

- **ConfigFastModePlus:** This parameter can be a combination of the following values:
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB6
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB7
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB8 (*)
  - LL_SYSCFG_I2C_FASTMODEPLUS_PB9 (*)
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C1
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C2 (*)
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C3
  - LL_SYSCFG_I2C_FASTMODEPLUS_I2C4 (*)

  (*) value not defined in all devices

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 I2C_PBx_FMP LL_SYSCFG_DisableFastModePlus
- SYSCFG_CFGR1 I2Cx_FMP LL_SYSCFG_DisableFastModePlus

`LL_SYSCFG_EnableIT_FPU_IOC`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableIT_FPU_IOC (void)

Function description

Enable Floating Point Unit Invalid operation Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_0 LL_SYSCFG_EnableIT_FPU_IOC

`LL_SYSCFG_EnableIT_FPU_DZC`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableIT_FPU_DZC (void)

Function description

Enable Floating Point Unit Divide-by-zero Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_1 LL_SYSCFG_EnableIT_FPU_DZC

`LL_SYSCFG_EnableIT_FPU_UFC`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableIT_FPU_UFC (void)

Function description

Enable Floating Point Unit Underflow Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_2 LL_SYSCFG_EnableIT_FPU_UFC

`LL_SYSCFG_EnableIT_FPU_OFC`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableIT_FPU_OFC (void)

Function description

Enable Floating Point Unit Overflow Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_3 LL_SYSCFG_EnableIT_FPU_OFC

`LL_SYSCFG_EnableIT_FPU_IDC`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableIT_FPU_IDC (void)

Function description

Enable Floating Point Unit Input denormal Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_4 LL_SYSCFG_EnableIT_FPU_IDC

`LL_SYSCFG_EnableIT_FPU_IXC`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableIT_FPU_IXC (void)

Function description

Enable Floating Point Unit Inexact Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_5 LL_SYSCFG_EnableIT_FPU_IXC

`LL_SYSCFG_DisableIT_FPU_IOC`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableIT_FPU_IOC (void)

Function description

Disable Floating Point Unit Invalid operation Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_0 LL_SYSCFG_DisableIT_FPU_IOC

`LL_SYSCFG_DisableIT_FPU_DZC`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableIT_FPU_DZC (void)

Function description

Disable Floating Point Unit Divide-by-zero Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_1 LL_SYSCFG_DisableIT_FPU_DZC

`LL_SYSCFG_DisableIT_FPU_UFC`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableIT_FPU_UFC (void)

Function description

Disable Floating Point Unit Underflow Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_2 LL_SYSCFG_DisableIT_FPU_UFC

`LL_SYSCFG_DisableIT_FPU_OFC`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableIT_FPU_OFC (void)

Function description

Disable Floating Point Unit Overflow Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_3 LL_SYSCFG_DisableIT_FPU_OFC

`LL_SYSCFG_DisableIT_FPU_IDC`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableIT_FPU_IDC (void)

Function description

Disable Floating Point Unit Input denormal Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_4 LL_SYSCFG_DisableIT_FPU_IDC

`LL_SYSCFG_DisableIT_FPU_IXC`

Function name

__STATIC_INLINE void LL_SYSCFG_DisableIT_FPU_IXC (void)

Function description

Disable Floating Point Unit Inexact Interrupt.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_5 LL_SYSCFG_DisableIT_FPU_IXC

`LL_SYSCFG_IsEnabledIT_FPU_IOC`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledIT_FPU_IOC (void)

Function description

Check if Floating Point Unit Invalid operation Interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_0 LL_SYSCFG_IsEnabledIT_FPU_IOC

`LL_SYSCFG_IsEnabledIT_FPU_DZC`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledIT_FPU_DZC (void)

Function description

Check if Floating Point Unit Divide-by-zero Interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_1 LL_SYSCFG_IsEnabledIT_FPU_DZC

`LL_SYSCFG_IsEnabledIT_FPU_UFC`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledIT_FPU_UFC (void)

Function description

Check if Floating Point Unit Underflow Interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_2 LL_SYSCFG_IsEnabledIT_FPU_UFC

`LL_SYSCFG_IsEnabledIT_FPU_OFC`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledIT_FPU_OFC (void)

Function description

Check if Floating Point Unit Overflow Interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_3 LL_SYSCFG_IsEnabledIT_FPU_OFC

`LL_SYSCFG_IsEnabledIT_FPU_IDC`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledIT_FPU_IDC (void)

Function description

Check if Floating Point Unit Input denormal Interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_4 LL_SYSCFG_IsEnabledIT_FPU_IDC

LL_SYSCFG_IsEnabledIT_FPU_IXC

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsEnabledIT_FPU_IXC (void)

Function description

Check if Floating Point Unit Inexact Interrupt source is enabled or disabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR1 FPU_IE_5 LL_SYSCFG_IsEnabledIT_FPU_IXC

LL_SYSCFG_SetEXTISource

Function name

__STATIC_INLINE void LL_SYSCFG_SetEXTISource (uint32_t Port, uint32_t Line)

Function description

Configure source input for the EXTI external interrupt.

Parameters

- **Port:** This parameter can be one of the following values:
  - LL_SYSCFG_EXTI_PORTA
  - LL_SYSCFG_EXTI_PORTB
  - LL_SYSCFG_EXTI_PORTC
  - LL_SYSCFG_EXTI_PORTD
  - LL_SYSCFG_EXTI_PORTE
  - LL_SYSCFG_EXTI_PORTF (*)
  - LL_SYSCFG_EXTI_PORTG (*)
  - LL_SYSCFG_EXTI_PORTH
  - LL_SYSCFG_EXTI_PORTI (*)

  (*) value not defined in all devices
- **Line:** This parameter can be one of the following values:
  - LL_SYSCFG_EXTI_LINE0
  - LL_SYSCFG_EXTI_LINE1
  - LL_SYSCFG_EXTI_LINE2
  - LL_SYSCFG_EXTI_LINE3
  - LL_SYSCFG_EXTI_LINE4
  - LL_SYSCFG_EXTI_LINE5
  - LL_SYSCFG_EXTI_LINE6
  - LL_SYSCFG_EXTI_LINE7
  - LL_SYSCFG_EXTI_LINE8
  - LL_SYSCFG_EXTI_LINE9
  - LL_SYSCFG_EXTI_LINE10
  - LL_SYSCFG_EXTI_LINE11
  - LL_SYSCFG_EXTI_LINE12
  - LL_SYSCFG_EXTI_LINE13
  - LL_SYSCFG_EXTI_LINE14
  - LL_SYSCFG_EXTI_LINE15

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_EXTICR1 EXTIx LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTIx LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTIx LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTIx LL_SYSCFG_SetEXTISource

`LL_SYSCFG_GetEXTISource`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_GetEXTISource (uint32_t Line)

Function description

Get the configured defined for specific EXTI Line.

Parameters

- **Line:** This parameter can be one of the following values:
  - LL_SYSCFG_EXTI_LINE0
  - LL_SYSCFG_EXTI_LINE1
  - LL_SYSCFG_EXTI_LINE2
  - LL_SYSCFG_EXTI_LINE3
  - LL_SYSCFG_EXTI_LINE4
  - LL_SYSCFG_EXTI_LINE5
  - LL_SYSCFG_EXTI_LINE6
  - LL_SYSCFG_EXTI_LINE7
  - LL_SYSCFG_EXTI_LINE8
  - LL_SYSCFG_EXTI_LINE9
  - LL_SYSCFG_EXTI_LINE10
  - LL_SYSCFG_EXTI_LINE11
  - LL_SYSCFG_EXTI_LINE12
  - LL_SYSCFG_EXTI_LINE13
  - LL_SYSCFG_EXTI_LINE14
  - LL_SYSCFG_EXTI_LINE15

Return values

- **Returned:** value can be one of the following values:
  - LL_SYSCFG_EXTI_PORTA
  - LL_SYSCFG_EXTI_PORTB
  - LL_SYSCFG_EXTI_PORTC
  - LL_SYSCFG_EXTI_PORTD
  - LL_SYSCFG_EXTI_PORTE
  - LL_SYSCFG_EXTI_PORTF (*)
  - LL_SYSCFG_EXTI_PORTG (*)
  - LL_SYSCFG_EXTI_PORTH
  - LL_SYSCFG_EXTI_PORTI (*)

  (*) value not defined in all devices

Reference Manual to LL API cross reference:

- SYSCFG_EXTICR1 EXTIx LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTIx LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTIx LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTIx LL_SYSCFG_GetEXTISource

LL_SYSCFG_EnableSRAM2Erase

Function name

__STATIC_INLINE void LL_SYSCFG_EnableSRAM2Erase (void)

Function description

Enable SRAM2 Erase (starts a hardware SRAM2 erase operation.

Return values

- **None:**

Notes

- This bit is write-protected: setting this bit is possible only after the correct key sequence is written in the SYSCFG_SKR register as described in the Reference Manual.

Reference Manual to LL API cross reference:

- SYSCFG_SCSR SRAM2ER LL_SYSCFG_EnableSRAM2Erase

`LL_SYSCFG_IsSRAM2EraseOngoing`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsSRAM2EraseOngoing (void)

Function description

Check if SRAM2 erase operation is on going.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_SCSR SRAM2BSY LL_SYSCFG_IsSRAM2EraseOngoing

`LL_SYSCFG_SetTIMBreakInputs`

Function name

__STATIC_INLINE void LL_SYSCFG_SetTIMBreakInputs (uint32_t Break)

Function description

Set connections to TIM1/8/15/16/17 Break inputs.

Parameters

- **Break:** This parameter can be a combination of the following values:
  - LL_SYSCFG_TIMBREAK_ECC
  - LL_SYSCFG_TIMBREAK_PVD
  - LL_SYSCFG_TIMBREAK_SRAM2_PARITY
  - LL_SYSCFG_TIMBREAK_LOCKUP

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR2 CLL LL_SYSCFG_SetTIMBreakInputs
- SYSCFG_CFGR2 SPL LL_SYSCFG_SetTIMBreakInputs
- SYSCFG_CFGR2 PVDL LL_SYSCFG_SetTIMBreakInputs
- SYSCFG_CFGR2 ECCL LL_SYSCFG_SetTIMBreakInputs

`LL_SYSCFG_GetTIMBreakInputs`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_GetTIMBreakInputs (void)

Function description

Get connections to TIM1/8/15/16/17 Break inputs.

Return values

- **Returned:** value can be can be a combination of the following values:
  - LL_SYSCFG_TIMBREAK_ECC
  - LL_SYSCFG_TIMBREAK_PVD
  - LL_SYSCFG_TIMBREAK_SRAM2_PARITY
  - LL_SYSCFG_TIMBREAK_LOCKUP

Reference Manual to LL API cross reference:

- SYSCFG_CFGR2 CLL LL_SYSCFG_GetTIMBreakInputs
- SYSCFG_CFGR2 SPL LL_SYSCFG_GetTIMBreakInputs
- SYSCFG_CFGR2 PVDL LL_SYSCFG_GetTIMBreakInputs
- SYSCFG_CFGR2 ECCL LL_SYSCFG_GetTIMBreakInputs

`LL_SYSCFG_IsActiveFlag_SP`

Function name

__STATIC_INLINE uint32_t LL_SYSCFG_IsActiveFlag_SP (void)

Function description

Check if SRAM2 parity error detected.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SYSCFG_CFGR2 SPF LL_SYSCFG_IsActiveFlag_SP

`LL_SYSCFG_ClearFlag_SP`

Function name

__STATIC_INLINE void LL_SYSCFG_ClearFlag_SP (void)

Function description

Clear SRAM2 parity error flag.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_CFGR2 SPF LL_SYSCFG_ClearFlag_SP

`LL_SYSCFG_EnableSRAM2PageWRP_0_31`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableSRAM2PageWRP_0_31 (uint32_t SRAM2WRP)

Function description

`LL_SYSCFG_EnableSRAM2PageWRP_32_63`

Function name

__STATIC_INLINE void LL_SYSCFG_EnableSRAM2PageWRP_32_63 (uint32_t SRAM2WRP)

Function description

Enable SRAM2 page write protection for Pages in range 32 to 63.

Parameters

- **SRAM2WRP:** This parameter can be a combination of the following values:
  - LL_SYSCFG_SRAM2WRP_PAGE32 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE33 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE34 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE35 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE36 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE37 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE38 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE39 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE40 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE41 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE42 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE43 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE44 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE45 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE46 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE47 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE48 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE49 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE50 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE51 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE52 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE53 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE54 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE55 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE56 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE57 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE58 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE59 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE60 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE61 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE62 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE63 (*)

  (*) value not defined in all devices

Return values

- **None:**

Notes

- Write protection is cleared only by a system reset

Reference Manual to LL API cross reference:

- SYSCFG_SWPR2 PxWP LL_SYSCFG_EnableSRAM2PageWRP_32_63

LL_SYSCFG_LockSRAM2WRP

Function name

__STATIC_INLINE void LL_SYSCFG_LockSRAM2WRP (void)

Function description

SRAM2 page write protection lock prior to erase.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_SKR KEY LL_SYSCFG_LockSRAM2WRP

`LL_SYSCFG_UnlockSRAM2WRP`

Function name

__STATIC_INLINE void LL_SYSCFG_UnlockSRAM2WRP (void)

Function description

SRAM2 page write protection unlock prior to erase.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_SKR KEY LL_SYSCFG_UnlockSRAM2WRP

`LL_DBGMCU_GetDeviceID`

Function name

__STATIC_INLINE uint32_t LL_DBGMCU_GetDeviceID (void)

Function description

Return the device identifier.

Return values

- **Values:** between Min_Data=0x00 and Max_Data=0xFFFF (ex: device ID is 0x6415)

Reference Manual to LL API cross reference:

- DBGMCU_IDCODE DEV_ID LL_DBGMCU_GetDeviceID

`LL_DBGMCU_GetRevisionID`

Function name

__STATIC_INLINE uint32_t LL_DBGMCU_GetRevisionID (void)

Function description

Return the device revision identifier.

Return values

- **Values:** between Min_Data=0x00 and Max_Data=0xFFFF

Notes

- This field indicates the revision of the device.

Reference Manual to LL API cross reference:

- DBGMCU_IDCODE REV_ID LL_DBGMCU_GetRevisionID

LL_DBGMCU_EnableDBGSleepMode

Function name

__STATIC_INLINE void LL_DBGMCU_EnableDBGSleepMode (void)

Function description

Enable the Debug Module during SLEEP mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR DBG_SLEEP LL_DBGMCU_EnableDBGSleepMode

LL_DBGMCU_DisableDBGSleepMode

Function name

__STATIC_INLINE void LL_DBGMCU_DisableDBGSleepMode (void)

Function description

Disable the Debug Module during SLEEP mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR DBG_SLEEP LL_DBGMCU_DisableDBGSleepMode

LL_DBGMCU_EnableDBGStopMode

Function name

__STATIC_INLINE void LL_DBGMCU_EnableDBGStopMode (void)

Function description

Enable the Debug Module during STOP mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR DBG_STOP LL_DBGMCU_EnableDBGStopMode

LL_DBGMCU_DisableDBGStopMode

Function name

__STATIC_INLINE void LL_DBGMCU_DisableDBGStopMode (void)

Function description

Disable the Debug Module during STOP mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR DBG_STOP LL_DBGMCU_DisableDBGStopMode

LL_DBGMCU_EnableDBGStandbyMode

Function name

__STATIC_INLINE void LL_DBGMCU_EnableDBGStandbyMode (void)

Function description

Enable the Debug Module during STANDBY mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR DBG_STANDBY LL_DBGMCU_EnableDBGStandbyMode

LL_DBGMCU_DisableDBGStandbyMode

Function name

__STATIC_INLINE void LL_DBGMCU_DisableDBGStandbyMode (void)

Function description

Disable the Debug Module during STANDBY mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR DBG_STANDBY LL_DBGMCU_DisableDBGStandbyMode

LL_DBGMCU_SetTracePinAssignment

Function name

__STATIC_INLINE void LL_DBGMCU_SetTracePinAssignment (uint32_t PinAssignment)

Function description

Set Trace pin assignment control.

Parameters

- **PinAssignment:** This parameter can be one of the following values:
  - LL_DBGMCU_TRACE_NONE
  - LL_DBGMCU_TRACE_ASYNCH
  - LL_DBGMCU_TRACE_SYNCH_SIZE1
  - LL_DBGMCU_TRACE_SYNCH_SIZE2
  - LL_DBGMCU_TRACE_SYNCH_SIZE4

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_CR TRACE_IOEN LL_DBGMCU_SetTracePinAssignment
- DBGMCU_CR TRACE_MODE LL_DBGMCU_SetTracePinAssignment

LL_DBGMCU_GetTracePinAssignment

Function name

__STATIC_INLINE uint32_t LL_DBGMCU_GetTracePinAssignment (void)

Function description

Get Trace pin assignment control.

Return values

- **Returned:** value can be one of the following values:
  - LL_DBGMCU_TRACE_NONE
  - LL_DBGMCU_TRACE_ASYNCH
  - LL_DBGMCU_TRACE_SYNCH_SIZE1
  - LL_DBGMCU_TRACE_SYNCH_SIZE2
  - LL_DBGMCU_TRACE_SYNCH_SIZE4

Reference Manual to LL API cross reference:

- DBGMCU_CR TRACE_IOEN LL_DBGMCU_GetTracePinAssignment
- DBGMCU_CR TRACE_MODE LL_DBGMCU_GetTracePinAssignment

`LL_DBGMCU_APB1_GRP1_FreezePeriph`

Function name

__STATIC_INLINE void LL_DBGMCU_APB1_GRP1_FreezePeriph (uint32_t Periphs)

Function description

Freeze APB1 peripherals (group1 peripherals)

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_DBGMCU_APB1_GRP1_TIM2_STOP
  - LL_DBGMCU_APB1_GRP1_TIM3_STOP (*)
  - LL_DBGMCU_APB1_GRP1_TIM4_STOP (*)
  - LL_DBGMCU_APB1_GRP1_TIM5_STOP (*)
  - LL_DBGMCU_APB1_GRP1_TIM6_STOP
  - LL_DBGMCU_APB1_GRP1_TIM7_STOP (*)
  - LL_DBGMCU_APB1_GRP1_RTC_STOP
  - LL_DBGMCU_APB1_GRP1_WWDG_STOP
  - LL_DBGMCU_APB1_GRP1_IWDG_STOP
  - LL_DBGMCU_APB1_GRP1_I2C1_STOP
  - LL_DBGMCU_APB1_GRP1_I2C2_STOP (*)
  - LL_DBGMCU_APB1_GRP1_I2C3_STOP
  - LL_DBGMCU_APB1_GRP1_CAN_STOP
  - LL_DBGMCU_APB1_GRP1_CAN2_STOP (*)
  - LL_DBGMCU_APB1_GRP1_LPTIM1_STOP

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_APB1FZR1 DBG_xxxx_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph

`LL_DBGMCU_APB1_GRP2_FreezePeriph`

Function name

__STATIC_INLINE void LL_DBGMCU_APB1_GRP2_FreezePeriph (uint32_t Periphs)

Function description

Freeze APB1 peripherals (group2 peripherals)

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_DBGMCU_APB1_GRP2_I2C4_STOP (*)
  - LL_DBGMCU_APB1_GRP2_LPTIM2_STOP

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_APB1FZR2 DBG_xxxx_STOP LL_DBGMCU_APB1_GRP2_FreezePeriph

LL_DBGMCU_APB1_GRP1_UnFreezePeriph

Function name

__STATIC_INLINE void LL_DBGMCU_APB1_GRP1_UnFreezePeriph (uint32_t Periphs)

Function description

Unfreeze APB1 peripherals (group1 peripherals)

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_DBGMCU_APB1_GRP1_TIM2_STOP
  - LL_DBGMCU_APB1_GRP1_TIM3_STOP (*)
  - LL_DBGMCU_APB1_GRP1_TIM4_STOP (*)
  - LL_DBGMCU_APB1_GRP1_TIM5_STOP (*)
  - LL_DBGMCU_APB1_GRP1_TIM6_STOP
  - LL_DBGMCU_APB1_GRP1_TIM7_STOP (*)
  - LL_DBGMCU_APB1_GRP1_RTC_STOP
  - LL_DBGMCU_APB1_GRP1_WWDG_STOP
  - LL_DBGMCU_APB1_GRP1_IWDG_STOP
  - LL_DBGMCU_APB1_GRP1_I2C1_STOP
  - LL_DBGMCU_APB1_GRP1_I2C2_STOP (*)
  - LL_DBGMCU_APB1_GRP1_I2C3_STOP
  - LL_DBGMCU_APB1_GRP1_CAN_STOP
  - LL_DBGMCU_APB1_GRP1_CAN2_STOP (*)
  - LL_DBGMCU_APB1_GRP1_LPTIM1_STOP

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_APB1FZR1 DBG_xxxx_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph

LL_DBGMCU_APB1_GRP2_UnFreezePeriph

Function name

__STATIC_INLINE void LL_DBGMCU_APB1_GRP2_UnFreezePeriph (uint32_t Periphs)

Function description

Unfreeze APB1 peripherals (group2 peripherals)

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_DBGMCU_APB1_GRP2_I2C4_STOP (*)
  - LL_DBGMCU_APB1_GRP2_LPTIM2_STOP

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_APB1FZR2 DBG_xxxx_STOP LL_DBGMCU_APB1_GRP2_UnFreezePeriph

LL_DBGMCU_APB2_GRP1_FreezePeriph

Function name

__STATIC_INLINE void LL_DBGMCU_APB2_GRP1_FreezePeriph (uint32_t Periphs)

Function description

Freeze APB2 peripherals.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_DBGMCU_APB2_GRP1_TIM1_STOP
  - LL_DBGMCU_APB2_GRP1_TIM8_STOP (*)
  - LL_DBGMCU_APB2_GRP1_TIM15_STOP
  - LL_DBGMCU_APB2_GRP1_TIM16_STOP
  - LL_DBGMCU_APB2_GRP1_TIM17_STOP (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_APB2FZ DBG_TIMx_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph

LL_DBGMCU_APB2_GRP1_UnFreezePeriph

Function name

__STATIC_INLINE void LL_DBGMCU_APB2_GRP1_UnFreezePeriph (uint32_t Periphs)

Function description

Unfreeze APB2 peripherals.

Parameters

- **Periphs:** This parameter can be a combination of the following values:
  - LL_DBGMCU_APB2_GRP1_TIM1_STOP
  - LL_DBGMCU_APB2_GRP1_TIM8_STOP (*)
  - LL_DBGMCU_APB2_GRP1_TIM15_STOP
  - LL_DBGMCU_APB2_GRP1_TIM16_STOP
  - LL_DBGMCU_APB2_GRP1_TIM17_STOP (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- DBGMCU_APB2FZ DBG_TIMx_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph

`LL_VREFBUF_Enable`

Function name

__STATIC_INLINE void LL_VREFBUF_Enable (void)

Function description

Enable Internal voltage reference.

Return values

- **None:**

Reference Manual to LL API cross reference:

- VREFBUF_CSR ENVR LL_VREFBUF_Enable

`LL_VREFBUF_Disable`

Function name

__STATIC_INLINE void LL_VREFBUF_Disable (void)

Function description

Disable Internal voltage reference.

Return values

- **None:**

Reference Manual to LL API cross reference:

- VREFBUF_CSR ENVR LL_VREFBUF_Disable

`LL_VREFBUF_EnableHIZ`

Function name

__STATIC_INLINE void LL_VREFBUF_EnableHIZ (void)

Function description

Enable high impedance (VREF+pin is high impedance)

Return values

- **None:**

Reference Manual to LL API cross reference:

- VREFBUF_CSR HIZ LL_VREFBUF_EnableHIZ

`LL_VREFBUF_DisableHIZ`

Function name

__STATIC_INLINE void LL_VREFBUF_DisableHIZ (void)

Function description

Disable high impedance (VREF+pin is internally connected to the voltage reference buffer output)

Return values

- **None:**

Reference Manual to LL API cross reference:

- VREFBUF_CSR HIZ LL_VREFBUF_DisableHIZ

`LL_VREFBUF_SetVoltageScaling`

Function name

__STATIC_INLINE void LL_VREFBUF_SetVoltageScaling (uint32_t Scale)

Function description

Set the Voltage reference scale.

Parameters

- **Scale:** This parameter can be one of the following values:
  - LL_VREFBUF_VOLTAGE_SCALE0
  - LL_VREFBUF_VOLTAGE_SCALE1

Return values

- **None:**

Reference Manual to LL API cross reference:

- VREFBUF_CSR VRS LL_VREFBUF_SetVoltageScaling

`LL_VREFBUF_GetVoltageScaling`

Function name

__STATIC_INLINE uint32_t LL_VREFBUF_GetVoltageScaling (void)

Function description

Get the Voltage reference scale.

Return values

- **Returned:** value can be one of the following values:
  - LL_VREFBUF_VOLTAGE_SCALE0
  - LL_VREFBUF_VOLTAGE_SCALE1

Reference Manual to LL API cross reference:

- VREFBUF_CSR VRS LL_VREFBUF_GetVoltageScaling

`LL_VREFBUF_IsVREFReady`

Function name

__STATIC_INLINE uint32_t LL_VREFBUF_IsVREFReady (void)

Function description

Check if Voltage reference buffer is ready.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- VREFBUF_CSR VRR LL_VREFBUF_IsVREFReady

LL_VREFBUF_GetTrimming

Function name

__STATIC_INLINE uint32_t LL_VREFBUF_GetTrimming (void)

Function description

Get the trimming code for VREFBUF calibration.

Return values

- **Between:** 0 and 0x3F

Reference Manual to LL API cross reference:

- VREFBUF_CCR TRIM LL_VREFBUF_GetTrimming

LL_VREFBUF_SetTrimming

Function name

__STATIC_INLINE void LL_VREFBUF_SetTrimming (uint32_t Value)

Function description

Set the trimming code for VREFBUF calibration (Tune the internal reference buffer voltage)

Parameters

- **Value:** Between 0 and 0x3F

Return values

- **None:**

Reference Manual to LL API cross reference:

- VREFBUF_CCR TRIM LL_VREFBUF_SetTrimming

LL_FLASH_SetLatency

Function name

__STATIC_INLINE void LL_FLASH_SetLatency (uint32_t Latency)

Function description

Set FLASH Latency.

Parameters

- **Latency:** This parameter can be one of the following values:
  - LL_FLASH_LATENCY_0
  - LL_FLASH_LATENCY_1
  - LL_FLASH_LATENCY_2
  - LL_FLASH_LATENCY_3
  - LL_FLASH_LATENCY_4
  - LL_FLASH_LATENCY_5 (*)
  - LL_FLASH_LATENCY_6 (*)
  - LL_FLASH_LATENCY_7 (*)
  - LL_FLASH_LATENCY_8 (*)
  - LL_FLASH_LATENCY_9 (*)
  - LL_FLASH_LATENCY_10 (*)
  - LL_FLASH_LATENCY_11 (*)
  - LL_FLASH_LATENCY_12 (*)
  - LL_FLASH_LATENCY_13 (*)
  - LL_FLASH_LATENCY_14 (*)
  - LL_FLASH_LATENCY_15 (*)

  (*) value not defined in all devices.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR LATENCY LL_FLASH_SetLatency

`LL_FLASH_GetLatency`

Function name

__STATIC_INLINE uint32_t LL_FLASH_GetLatency (void)

Function description

Get FLASH Latency.

Return values

- **Returned:** value can be one of the following values:
  - LL_FLASH_LATENCY_0
  - LL_FLASH_LATENCY_1
  - LL_FLASH_LATENCY_2
  - LL_FLASH_LATENCY_3
  - LL_FLASH_LATENCY_4
  - LL_FLASH_LATENCY_5 (*)
  - LL_FLASH_LATENCY_6 (*)
  - LL_FLASH_LATENCY_7 (*)
  - LL_FLASH_LATENCY_8 (*)
  - LL_FLASH_LATENCY_9 (*)
  - LL_FLASH_LATENCY_10 (*)
  - LL_FLASH_LATENCY_11 (*)
  - LL_FLASH_LATENCY_12 (*)
  - LL_FLASH_LATENCY_13 (*)
  - LL_FLASH_LATENCY_14 (*)
  - LL_FLASH_LATENCY_15 (*)

  (*) value not defined in all devices.

Reference Manual to LL API cross reference:

- FLASH_ACR LATENCY LL_FLASH_GetLatency

`LL_FLASH_EnablePrefetch`

Function name

__STATIC_INLINE void LL_FLASH_EnablePrefetch (void)

Function description

Enable Prefetch.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR PRFTEN LL_FLASH_EnablePrefetch

`LL_FLASH_DisablePrefetch`

Function name

__STATIC_INLINE void LL_FLASH_DisablePrefetch (void)

Function description

Disable Prefetch.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR PRFTEN LL_FLASH_DisablePrefetch

LL_FLASH_IsPrefetchEnabled

Function name

__STATIC_INLINE uint32_t LL_FLASH_IsPrefetchEnabled (void)

Function description

Check if Prefetch buffer is enabled.

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- FLASH_ACR PRFTEN LL_FLASH_IsPrefetchEnabled

LL_FLASH_EnableInstCache

Function name

__STATIC_INLINE void LL_FLASH_EnableInstCache (void)

Function description

Enable Instruction cache.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR ICEN LL_FLASH_EnableInstCache

LL_FLASH_DisableInstCache

Function name

__STATIC_INLINE void LL_FLASH_DisableInstCache (void)

Function description

Disable Instruction cache.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR ICEN LL_FLASH_DisableInstCache

LL_FLASH_EnableDataCache

Function name

__STATIC_INLINE void LL_FLASH_EnableDataCache (void)

Function description

Enable Data cache.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR DCEN LL_FLASH_EnableDataCache

LL_FLASH_DisableDataCache

Function name

__STATIC_INLINE void LL_FLASH_DisableDataCache (void)

Function description

Disable Data cache.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR DCEN LL_FLASH_DisableDataCache

LL_FLASH_EnableInstCacheReset

Function name

__STATIC_INLINE void LL_FLASH_EnableInstCacheReset (void)

Function description

Enable Instruction cache reset.

Return values

- **None:**

Notes

- bit can be written only when the instruction cache is disabled

Reference Manual to LL API cross reference:

- FLASH_ACR ICRST LL_FLASH_EnableInstCacheReset

LL_FLASH_DisableInstCacheReset

Function name

__STATIC_INLINE void LL_FLASH_DisableInstCacheReset (void)

Function description

Disable Instruction cache reset.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR ICRST LL_FLASH_DisableInstCacheReset

LL_FLASH_EnableDataCacheReset

Function name

__STATIC_INLINE void LL_FLASH_EnableDataCacheReset (void)

Function description

Enable Data cache reset.

Return values

- **None:**

Notes

- bit can be written only when the data cache is disabled

Reference Manual to LL API cross reference:

- FLASH_ACR DCRST LL_FLASH_EnableDataCacheReset

`LL_FLASH_DisableDataCacheReset`

Function name

__STATIC_INLINE void LL_FLASH_DisableDataCacheReset (void)

Function description

Disable Data cache reset.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR DCRST LL_FLASH_DisableDataCacheReset

`LL_FLASH_EnableRunPowerDown`

Function name

__STATIC_INLINE void LL_FLASH_EnableRunPowerDown (void)

Function description

Enable Flash Power-down mode during run mode or Low-power run mode.

Return values

- **None:**

Notes

- Flash memory can be put in power-down mode only when the code is executed from RAM
- Flash must not be accessed when power down is enabled
- Flash must not be put in power-down while a program or an erase operation is on-going

Reference Manual to LL API cross reference:

- FLASH_ACR RUN_PD LL_FLASH_EnableRunPowerDown
- FLASH_PDKEYR PDKEY1 LL_FLASH_EnableRunPowerDown
- FLASH_PDKEYR PDKEY2 LL_FLASH_EnableRunPowerDown

`LL_FLASH_DisableRunPowerDown`

Function name

__STATIC_INLINE void LL_FLASH_DisableRunPowerDown (void)

Function description

Disable Flash Power-down mode during run mode or Low-power run mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR RUN_PD LL_FLASH_DisableRunPowerDown
- FLASH_PDKEYR PDKEY1 LL_FLASH_DisableRunPowerDown
- FLASH_PDKEYR PDKEY2 LL_FLASH_DisableRunPowerDown

`LL_FLASH_EnableSleepPowerDown`

Function name

__STATIC_INLINE void LL_FLASH_EnableSleepPowerDown (void)

Function description

Enable Flash Power-down mode during Sleep or Low-power sleep mode.

Return values

- **None:**

Notes

- Flash must not be put in power-down while a program or an erase operation is on-going

Reference Manual to LL API cross reference:

- FLASH_ACR SLEEP_PD LL_FLASH_EnableSleepPowerDown

`LL_FLASH_DisableSleepPowerDown`

Function name

__STATIC_INLINE void LL_FLASH_DisableSleepPowerDown (void)

Function description

Disable Flash Power-down mode during Sleep or Low-power sleep mode.

Return values

- **None:**

Reference Manual to LL API cross reference:

- FLASH_ACR SLEEP_PD LL_FLASH_DisableSleepPowerDown

103.2 SYSTEM Firmware driver defines

The following section lists the various define and macros of the module.

103.2.1 SYSTEM

SYSTEM

DBGMCU APB1 GRP1 STOP IP

LL_DBGMCU_APB1_GRP1_TIM2_STOP

The counter clock of TIM2 is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_TIM3_STOP

The counter clock of TIM3 is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_TIM4_STOP

The counter clock of TIM4 is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_TIM5_STOP

The counter clock of TIM5 is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_TIM6_STOP

The counter clock of TIM6 is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_TIM7_STOP

The counter clock of TIM7 is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_RTC_STOP

The clock of the RTC counter is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_WWDG_STOP

The window watchdog counter clock is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_IWDG_STOP

The independent watchdog counter clock is stopped when the core is halted

LL_DBGMCU_APB1_GRP1_I2C1_STOP

The I2C1 SMBus timeout is frozen

LL_DBGMCU_APB1_GRP1_I2C2_STOP

The I2C2 SMBus timeout is frozen

LL_DBGMCU_APB1_GRP1_I2C3_STOP

The I2C3 SMBus timeout is frozen

LL_DBGMCU_APB1_GRP1_CAN_STOP

The bxCAN receive registers are frozen

LL_DBGMCU_APB1_GRP1_LPTIM1_STOP

The counter clock of LPTIM1 is stopped when the core is halted

DBGMCU APB1 GRP2 STOP IP

LL_DBGMCU_APB1_GRP2_I2C4_STOP

The I2C4 SMBus timeout is frozen

LL_DBGMCU_APB1_GRP2_LPTIM2_STOP

The counter clock of LPTIM2 is stopped when the core is halted

DBGMCU APB2 GRP1 STOP IP

LL_DBGMCU_APB2_GRP1_TIM1_STOP

The counter clock of TIM1 is stopped when the core is halted

LL_DBGMCU_APB2_GRP1_TIM8_STOP

The counter clock of TIM8 is stopped when the core is halted

LL_DBGMCU_APB2_GRP1_TIM15_STOP

The counter clock of TIM15 is stopped when the core is halted

LL_DBGMCU_APB2_GRP1_TIM16_STOP

The counter clock of TIM16 is stopped when the core is halted

LL_DBGMCU_APB2_GRP1_TIM17_STOP

The counter clock of TIM17 is stopped when the core is halted

SYSCFG BANK MODE

LL_SYSCFG_BANKMODE_BANK1

Flash Bank1 mapped at 0x08000000 (and aliased @0x00000000) and Flash Bank2 mapped at 0x08080000 (and aliased at 0x00080000)

LL_SYSCFG_BANKMODE_BANK2

Flash Bank2 mapped at 0x08000000 (and aliased @0x00000000) and Flash Bank1 mapped at 0x08080000 (and aliased at 0x00080000)

SYSCFG EXTI LINE

LL_SYSCFG_EXTI_LINE0

LL_SYSCFG_EXTI_LINE1

LL_SYSCFG_EXTI_LINE2

LL_SYSCFG_EXTI_LINE3

LL_SYSCFG_EXTI_LINE4

LL_SYSCFG_EXTI_LINE5

LL_SYSCFG_EXTI_LINE6

LL_SYSCFG_EXTI_LINE7

LL_SYSCFG_EXTI_LINE8

LL_SYSCFG_EXTI_LINE9

LL_SYSCFG_EXTI_LINE10

LL_SYSCFG_EXTI_LINE11

LL_SYSCFG_EXTI_LINE12

LL_SYSCFG_EXTI_LINE13

LL_SYSCFG_EXTI_LINE14

LL_SYSCFG_EXTI_LINE15

SYSCFG EXTI PORT

LL_SYSCFG_EXTI_PORTA
EXTI PORT A

LL_SYSCFG_EXTI_PORTB
EXTI PORT B

LL_SYSCFG_EXTI_PORTC
EXTI PORT C

LL_SYSCFG_EXTI_PORTD
EXTI PORT D

LL_SYSCFG_EXTI_PORTE
EXTI PORT E

LL_SYSCFG_EXTI_PORTF
EXTI PORT F

LL_SYSCFG_EXTI_PORTG
EXTI PORT G

LL_SYSCFG_EXTI_PORTH
EXTI PORT H

LL_SYSCFG_EXTI_PORTI

EXTI PORT I

SYSCFG I2C FASTMODEPLUS

LL_SYSCFG_I2C_FASTMODEPLUS_PB6

Enable Fast Mode Plus on PB6

LL_SYSCFG_I2C_FASTMODEPLUS_PB7

Enable Fast Mode Plus on PB7

LL_SYSCFG_I2C_FASTMODEPLUS_PB8

Enable Fast Mode Plus on PB8

LL_SYSCFG_I2C_FASTMODEPLUS_PB9

Enable Fast Mode Plus on PB9

LL_SYSCFG_I2C_FASTMODEPLUS_I2C1

Enable Fast Mode Plus on I2C1 pins

LL_SYSCFG_I2C_FASTMODEPLUS_I2C2

Enable Fast Mode Plus on I2C2 pins

LL_SYSCFG_I2C_FASTMODEPLUS_I2C3

Enable Fast Mode Plus on I2C3 pins

LL_SYSCFG_I2C_FASTMODEPLUS_I2C4

Enable Fast Mode Plus on I2C4 pins

FLASH LATENCY

LL_FLASH_LATENCY_0

FLASH Zero wait state

LL_FLASH_LATENCY_1

FLASH One wait state

LL_FLASH_LATENCY_2

FLASH Two wait states

LL_FLASH_LATENCY_3

FLASH Three wait states

LL_FLASH_LATENCY_4

FLASH Four wait states

LL_FLASH_LATENCY_5

FLASH five wait state

LL_FLASH_LATENCY_6

FLASH six wait state

LL_FLASH_LATENCY_7

FLASH seven wait states

LL_FLASH_LATENCY_8

FLASH eight wait states

LL_FLASH_LATENCY_9

FLASH nine wait states

LL_FLASH_LATENCY_10

FLASH ten wait states

LL_FLASH_LATENCY_11

FLASH eleven wait states

LL_FLASH_LATENCY_12

FLASH twelve wait states

LL_FLASH_LATENCY_13

FLASH thirteen wait states

LL_FLASH_LATENCY_14

FLASH fourteen wait states

LL_FLASH_LATENCY_15

FLASH fifteen wait states

SYSCFG REMAP

LL_SYSCFG_REMAP_FLASH

Main Flash memory mapped at 0x00000000

LL_SYSCFG_REMAP_SYSTEMFLASH

System Flash memory mapped at 0x00000000

LL_SYSCFG_REMAP_SRAM

SRAM1 mapped at 0x00000000

LL_SYSCFG_REMAP_FMC

FMC bank 1 (NOR/PSRAM 1 and 2) mapped at 0x00000000

LL_SYSCFG_REMAP_QUADSPI

QUADSPI memory mapped at 0x00000000

SYSCFG SRAM2 WRP

LL_SYSCFG_SRAM2WRP_PAGE0

SRAM2 Write protection page 0

LL_SYSCFG_SRAM2WRP_PAGE1

SRAM2 Write protection page 1

LL_SYSCFG_SRAM2WRP_PAGE2

SRAM2 Write protection page 2

LL_SYSCFG_SRAM2WRP_PAGE3

SRAM2 Write protection page 3

LL_SYSCFG_SRAM2WRP_PAGE4

SRAM2 Write protection page 4

LL_SYSCFG_SRAM2WRP_PAGE5

SRAM2 Write protection page 5

LL_SYSCFG_SRAM2WRP_PAGE6

SRAM2 Write protection page 6

LL_SYSCFG_SRAM2WRP_PAGE7

SRAM2 Write protection page 7

LL_SYSCFG_SRAM2WRP_PAGE8

SRAM2 Write protection page 8

LL_SYSCFG_SRAM2WRP_PAGE9

SRAM2 Write protection page 9

LL_SYSCFG_SRAM2WRP_PAGE10

SRAM2 Write protection page 10

LL_SYSCFG_SRAM2WRP_PAGE11

SRAM2 Write protection page 11

LL_SYSCFG_SRAM2WRP_PAGE12

SRAM2 Write protection page 12

LL_SYSCFG_SRAM2WRP_PAGE13

SRAM2 Write protection page 13

LL_SYSCFG_SRAM2WRP_PAGE14

SRAM2 Write protection page 14

LL_SYSCFG_SRAM2WRP_PAGE15

SRAM2 Write protection page 15

LL_SYSCFG_SRAM2WRP_PAGE16

SRAM2 Write protection page 16

LL_SYSCFG_SRAM2WRP_PAGE17

SRAM2 Write protection page 17

LL_SYSCFG_SRAM2WRP_PAGE18

SRAM2 Write protection page 18

LL_SYSCFG_SRAM2WRP_PAGE19

SRAM2 Write protection page 19

LL_SYSCFG_SRAM2WRP_PAGE20

SRAM2 Write protection page 20

LL_SYSCFG_SRAM2WRP_PAGE21

SRAM2 Write protection page 21

LL_SYSCFG_SRAM2WRP_PAGE22

SRAM2 Write protection page 22

LL_SYSCFG_SRAM2WRP_PAGE23

SRAM2 Write protection page 23

LL_SYSCFG_SRAM2WRP_PAGE24

SRAM2 Write protection page 24

LL_SYSCFG_SRAM2WRP_PAGE25

SRAM2 Write protection page 25

LL_SYSCFG_SRAM2WRP_PAGE26

SRAM2 Write protection page 26

LL_SYSCFG_SRAM2WRP_PAGE27

SRAM2 Write protection page 27

LL_SYSCFG_SRAM2WRP_PAGE28

SRAM2 Write protection page 28

LL_SYSCFG_SRAM2WRP_PAGE29

SRAM2 Write protection page 29

LL_SYSCFG_SRAM2WRP_PAGE30

SRAM2 Write protection page 30

LL_SYSCFG_SRAM2WRP_PAGE31

SRAM2 Write protection page 31

LL_SYSCFG_SRAM2WRP_PAGE32

SRAM2 Write protection page 32

LL_SYSCFG_SRAM2WRP_PAGE33

SRAM2 Write protection page 33

LL_SYSCFG_SRAM2WRP_PAGE34

SRAM2 Write protection page 34

LL_SYSCFG_SRAM2WRP_PAGE35

SRAM2 Write protection page 35

LL_SYSCFG_SRAM2WRP_PAGE36

SRAM2 Write protection page 36

LL_SYSCFG_SRAM2WRP_PAGE37

SRAM2 Write protection page 37

LL_SYSCFG_SRAM2WRP_PAGE38

SRAM2 Write protection page 38

LL_SYSCFG_SRAM2WRP_PAGE39

SRAM2 Write protection page 39

LL_SYSCFG_SRAM2WRP_PAGE40

SRAM2 Write protection page 40

LL_SYSCFG_SRAM2WRP_PAGE41

SRAM2 Write protection page 41

LL_SYSCFG_SRAM2WRP_PAGE42

SRAM2 Write protection page 42

LL_SYSCFG_SRAM2WRP_PAGE43

SRAM2 Write protection page 43

LL_SYSCFG_SRAM2WRP_PAGE44

SRAM2 Write protection page 44

LL_SYSCFG_SRAM2WRP_PAGE45

SRAM2 Write protection page 45

LL_SYSCFG_SRAM2WRP_PAGE46

SRAM2 Write protection page 46

LL_SYSCFG_SRAM2WRP_PAGE47

SRAM2 Write protection page 47

LL_SYSCFG_SRAM2WRP_PAGE48

SRAM2 Write protection page 48

LL_SYSCFG_SRAM2WRP_PAGE49

SRAM2 Write protection page 49

LL_SYSCFG_SRAM2WRP_PAGE50

SRAM2 Write protection page 50

LL_SYSCFG_SRAM2WRP_PAGE51

SRAM2 Write protection page 51

LL_SYSCFG_SRAM2WRP_PAGE52

SRAM2 Write protection page 52

LL_SYSCFG_SRAM2WRP_PAGE53

SRAM2 Write protection page 53

LL_SYSCFG_SRAM2WRP_PAGE54

SRAM2 Write protection page 54

LL_SYSCFG_SRAM2WRP_PAGE55

SRAM2 Write protection page 55

LL_SYSCFG_SRAM2WRP_PAGE56

SRAM2 Write protection page 56

LL_SYSCFG_SRAM2WRP_PAGE57

SRAM2 Write protection page 57

LL_SYSCFG_SRAM2WRP_PAGE58

SRAM2 Write protection page 58

LL_SYSCFG_SRAM2WRP_PAGE59

SRAM2 Write protection page 59

LL_SYSCFG_SRAM2WRP_PAGE60

SRAM2 Write protection page 60

LL_SYSCFG_SRAM2WRP_PAGE61

SRAM2 Write protection page 61

LL_SYSCFG_SRAM2WRP_PAGE62

SRAM2 Write protection page 62

LL_SYSCFG_SRAM2WRP_PAGE63

SRAM2 Write protection page 63

SYSCFG TIMER BREAK

LL_SYSCFG_TIMBREAK_ECC

Enables and locks the ECC error signal with Break Input of TIM1/8/15/16/17

LL_SYSCFG_TIMBREAK_PVD

Enables and locks the PVD connection with TIM1/8/15/16/17 Break Input and also the PVDE and PLS bits of the Power Control Interface

LL_SYSCFG_TIMBREAK_SRAM2_PARITY

Enables and locks the SRAM2_PARITY error signal with Break Input of TIM1/8/15/16/17

LL_SYSCFG_TIMBREAK_LOCKUP

Enables and locks the LOCKUP output of CortexM4 with Break Input of TIM1/15/16/17

DBGMCU TRACE Pin Assignment

LL_DBGMCU_TRACE_NONE

TRACE pins not assigned (default state)

LL_DBGMCU_TRACE_ASYNCH

TRACE pin assignment for Asynchronous Mode

LL_DBGMCU_TRACE_SYNCH_SIZE1

TRACE pin assignment for Synchronous Mode with a TRACEDATA size of 1

LL_DBGMCU_TRACE_SYNCH_SIZE2

TRACE pin assignment for Synchronous Mode with a TRACEDATA size of 2

LL_DBGMCU_TRACE_SYNCH_SIZE4

TRACE pin assignment for Synchronous Mode with a TRACEDATA size of 4

VREFBUF VOLTAGE

LL_VREFBUF_VOLTAGE_SCALE0

Voltage reference scale 0 (VREF_OUT1)

LL_VREFBUF_VOLTAGE_SCALE1

Voltage reference scale 1 (VREF_OUT2)

SYSCFG

LL_SYSCFG_EnableSRAM2PageWRP

Description:

- Enable SRAM2 page write protection for Pages in range 0 to 31.

Parameters:

- SRAM2WRP: This parameter can be a combination of the following values:
  - LL_SYSCFG_SRAM2WRP_PAGE0
  - LL_SYSCFG_SRAM2WRP_PAGE1
  - LL_SYSCFG_SRAM2WRP_PAGE2
  - LL_SYSCFG_SRAM2WRP_PAGE3
  - LL_SYSCFG_SRAM2WRP_PAGE4
  - LL_SYSCFG_SRAM2WRP_PAGE5
  - LL_SYSCFG_SRAM2WRP_PAGE6
  - LL_SYSCFG_SRAM2WRP_PAGE7
  - LL_SYSCFG_SRAM2WRP_PAGE8
  - LL_SYSCFG_SRAM2WRP_PAGE9
  - LL_SYSCFG_SRAM2WRP_PAGE10
  - LL_SYSCFG_SRAM2WRP_PAGE11
  - LL_SYSCFG_SRAM2WRP_PAGE12
  - LL_SYSCFG_SRAM2WRP_PAGE13
  - LL_SYSCFG_SRAM2WRP_PAGE14
  - LL_SYSCFG_SRAM2WRP_PAGE15
  - LL_SYSCFG_SRAM2WRP_PAGE16 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE17 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE18 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE19 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE20 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE21 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE22 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE23 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE24 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE25 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE26 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE27 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE28 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE29 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE30 (*)
  - LL_SYSCFG_SRAM2WRP_PAGE31 (*)

Return value:

- None

Notes:

- Write protection is cleared only by a system reset

104 LL TIM Generic Driver

104.1 TIM Firmware driver registers structures

104.1.1 LL_TIM_InitTypeDef

LL_TIM_InitTypeDef is defined in the stm32l4xx_ll_tim.h

Data Fields

- ***uint16_t Prescaler***
- ***uint32_t CounterMode***
- ***uint32_t Autoreload***
- ***uint32_t ClockDivision***
- ***uint8_t RepetitionCounter***

Field Documentation

- ***uint16_t LL_TIM_InitTypeDef::Prescaler***

  Specifies the prescaler value used to divide the TIM clock. This parameter can be a number between Min_Data=0x0000 and Max_Data=0xFFFF.This feature can be modified afterwards using unitary function **LL_TIM_SetPrescaler()**.
- ***uint32_t LL_TIM_InitTypeDef::CounterMode***

  Specifies the counter mode. This parameter can be a value of ***TIM_LL_EC_COUNTERMODE***.This feature can be modified afterwards using unitary function **LL_TIM_SetCounterMode()**.
- ***uint32_t LL_TIM_InitTypeDef::Autoreload***

  Specifies the auto reload value to be loaded into the active Auto-Reload Register at the next update event. This parameter must be a number between Min_Data=0x0000 and Max_Data=0xFFFF. Some timer instances may support 32 bits counters. In that case this parameter must be a number between 0x0000 and 0xFFFFFFFF.This feature can be modified afterwards using unitary function **LL_TIM_SetAutoReload()**.
- ***uint32_t LL_TIM_InitTypeDef::ClockDivision***

  Specifies the clock division. This parameter can be a value of ***TIM_LL_EC_CLOCKDIVISION***.This feature can be modified afterwards using unitary function **LL_TIM_SetClockDivision()**.
- ***uint8_t LL_TIM_InitTypeDef::RepetitionCounter***

  Specifies the repetition counter value. Each time the RCR downcounter reaches zero, an update event is generated and counting restarts from the RCR value (N). This means in PWM mode that (N+1) corresponds to:
  - the number of PWM periods in edge-aligned mode
  - the number of half PWM period in center-aligned mode This parameter must be a number between 0x00 and 0xFF.

  This feature can be modified afterwards using unitary function **LL_TIM_SetRepetitionCounter()**.

104.1.2 LL_TIM_OC_InitTypeDef

LL_TIM_OC_InitTypeDef is defined in the stm32l4xx_ll_tim.h

Data Fields

- ***uint32_t OCMode***
- ***uint32_t OCState***
- ***uint32_t OCNState***
- ***uint32_t CompareValue***
- ***uint32_t OCPolarity***
- ***uint32_t OCNPolarity***
- ***uint32_t OCIdleState***
- ***uint32_t OCNIdleState***

Field Documentation

- ***uint32_t LL_TIM_OC_InitTypeDef::OCMode***

  Specifies the output mode. This parameter can be a value of ***TIM_LL_EC_OCMODE***.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetMode()**.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCState***

  Specifies the TIM Output Compare state. This parameter can be a value of ***TIM_LL_EC_OCSTATE***.This feature can be modified afterwards using unitary functions **LL_TIM_CC_EnableChannel()** or **LL_TIM_CC_DisableChannel()**.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCNState***

  Specifies the TIM complementary Output Compare state. This parameter can be a value of ***TIM_LL_EC_OCSTATE***.This feature can be modified afterwards using unitary functions **LL_TIM_CC_EnableChannel()** or **LL_TIM_CC_DisableChannel()**.
- ***uint32_t LL_TIM_OC_InitTypeDef::CompareValue***

  Specifies the Compare value to be loaded into the Capture Compare Register. This parameter can be a number between Min_Data=0x0000 and Max_Data=0xFFFF.This feature can be modified afterwards using unitary function LL_TIM_OC_SetCompareCHx (x=1..6).
- ***uint32_t LL_TIM_OC_InitTypeDef::OCPolarity***

  Specifies the output polarity. This parameter can be a value of ***TIM_LL_EC_OCPOLARITY***.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetPolarity()**.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCNPolarity***

  Specifies the complementary output polarity. This parameter can be a value of ***TIM_LL_EC_OCPOLARITY***.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetPolarity()**.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCIdleState***

  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of ***TIM_LL_EC_OCIDLESTATE***.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetIdleState()**.
- ***uint32_t LL_TIM_OC_InitTypeDef::OCNIdleState***

  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of ***TIM_LL_EC_OCIDLESTATE***.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetIdleState()**.

104.1.3 LL_TIM_IC_InitTypeDef

LL_TIM_IC_InitTypeDef is defined in the stm32l4xx_ll_tim.h

Data Fields

- ***uint32_t ICPolarity***
- ***uint32_t ICActiveInput***
- ***uint32_t ICPrescaler***
- ***uint32_t ICFilter***

Field Documentation

- ***uint32_t LL_TIM_IC_InitTypeDef::ICPolarity***

  Specifies the active edge of the input signal. This parameter can be a value of ***TIM_LL_EC_IC_POLARITY***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPolarity()**.
- ***uint32_t LL_TIM_IC_InitTypeDef::ICActiveInput***

  Specifies the input. This parameter can be a value of ***TIM_LL_EC_ACTIVEINPUT***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetActiveInput()**.
- ***uint32_t LL_TIM_IC_InitTypeDef::ICPrescaler***

  Specifies the Input Capture Prescaler. This parameter can be a value of ***TIM_LL_EC_ICPSC***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPrescaler()**.
- ***uint32_t LL_TIM_IC_InitTypeDef::ICFilter***

  Specifies the input capture filter. This parameter can be a value of ***TIM_LL_EC_IC_FILTER***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetFilter()**.

104.1.4 LL_TIM_ENCODER_InitTypeDef

LL_TIM_ENCODER_InitTypeDef is defined in the stm32l4xx_ll_tim.h

Data Fields

- ***uint32_t EncoderMode***
- ***uint32_t IC1Polarity***
- ***uint32_t IC1ActiveInput***
- ***uint32_t IC1Prescaler***
- ***uint32_t IC1Filter***
- ***uint32_t IC2Polarity***
- ***uint32_t IC2ActiveInput***
- ***uint32_t IC2Prescaler***
- ***uint32_t IC2Filter***

Field Documentation

- ***uint32_t LL_TIM_ENCODER_InitTypeDef::EncoderMode***

  Specifies the encoder resolution (x2 or x4). This parameter can be a value of *TIM_LL_EC_ENCODERMODE*.This feature can be modified afterwards using unitary function **LL_TIM_SetEncoderMode()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC1Polarity***

  Specifies the active edge of TI1 input. This parameter can be a value of *TIM_LL_EC_IC_POLARITY*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPolarity()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC1ActiveInput***

  Specifies the TI1 input source This parameter can be a value of *TIM_LL_EC_ACTIVEINPUT*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetActiveInput()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC1Prescaler***

  Specifies the TI1 input prescaler value. This parameter can be a value of *TIM_LL_EC_ICPSC*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPrescaler()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC1Filter***

  Specifies the TI1 input filter. This parameter can be a value of *TIM_LL_EC_IC_FILTER*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetFilter()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC2Polarity***

  Specifies the active edge of TI2 input. This parameter can be a value of *TIM_LL_EC_IC_POLARITY*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPolarity()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC2ActiveInput***

  Specifies the TI2 input source This parameter can be a value of *TIM_LL_EC_ACTIVEINPUT*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetActiveInput()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC2Prescaler***

  Specifies the TI2 input prescaler value. This parameter can be a value of *TIM_LL_EC_ICPSC*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPrescaler()**.
- ***uint32_t LL_TIM_ENCODER_InitTypeDef::IC2Filter***

  Specifies the TI2 input filter. This parameter can be a value of *TIM_LL_EC_IC_FILTER*.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetFilter()**.

104.1.5 LL_TIM_HALLSENSOR_InitTypeDef

LL_TIM_HALLSENSOR_InitTypeDef is defined in the stm32l4xx_ll_tim.h

Data Fields

- ***uint32_t IC1Polarity***
- ***uint32_t IC1Prescaler***
- ***uint32_t IC1Filter***
- ***uint32_t CommutationDelay***

Field Documentation

- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::IC1Polarity***

  Specifies the active edge of TI1 input. This parameter can be a value of ***TIM_LL_EC_IC_POLARITY***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPolarity()**.
- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::IC1Prescaler***

  Specifies the TI1 input prescaler value. Prescaler must be set to get a maximum counter period longer than the time interval between 2 consecutive changes on the Hall inputs. This parameter can be a value of ***TIM_LL_EC_ICPSC***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetPrescaler()**.
- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::IC1Filter***

  Specifies the TI1 input filter. This parameter can be a value of ***TIM_LL_EC_IC_FILTER***.This feature can be modified afterwards using unitary function **LL_TIM_IC_SetFilter()**.
- ***uint32_t LL_TIM_HALLSENSOR_InitTypeDef::CommutationDelay***

  Specifies the compare value to be loaded into the Capture Compare Register. A positive pulse (TRGO event) is generated with a programmable delay every time a change occurs on the Hall inputs. This parameter can be a number between Min_Data = 0x0000 and Max_Data = 0xFFFF.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetCompareCH2()**.

104.1.6 LL_TIM_BDTR_InitTypeDef

LL_TIM_BDTR_InitTypeDef is defined in the stm32l4xx_ll_tim.h

Data Fields

- ***uint32_t OSSRState***
- ***uint32_t OSSIState***
- ***uint32_t LockLevel***
- ***uint8_t DeadTime***
- ***uint16_t BreakState***
- ***uint32_t BreakPolarity***
- ***uint32_t BreakFilter***
- ***uint32_t Break2State***
- ***uint32_t Break2Polarity***
- ***uint32_t Break2Filter***
- ***uint32_t AutomaticOutput***

Field Documentation

- ***uint32_t LL_TIM_BDTR_InitTypeDef::OSSRState***

  Specifies the Off-State selection used in Run mode. This parameter can be a value of ***TIM_LL_EC_OSSR***This feature can be modified afterwards using unitary function **LL_TIM_SetOffStates()**

  Note:

  – This bit-field cannot be modified as long as LOCK level 2 has been programmed.
- ***uint32_t LL_TIM_BDTR_InitTypeDef::OSSIState***

  Specifies the Off-State used in Idle state. This parameter can be a value of ***TIM_LL_EC_OSSI***This feature can be modified afterwards using unitary function **LL_TIM_SetOffStates()**

  Note:

  – This bit-field cannot be modified as long as LOCK level 2 has been programmed.
- ***uint32_t LL_TIM_BDTR_InitTypeDef::LockLevel***

  Specifies the LOCK level parameters. This parameter can be a value of ***TIM_LL_EC_LOCKLEVEL***

  Note:

  – The LOCK bits can be written only once after the reset. Once the TIMx_BDTR register has been written, their content is frozen until the next reset.

- ***uint8_t LL_TIM_BDTR_InitTypeDef::DeadTime***

  Specifies the delay time between the switching-off and the switching-on of the outputs. This parameter can be a number between Min_Data = 0x00 and Max_Data = 0xFF.This feature can be modified afterwards using unitary function **LL_TIM_OC_SetDeadTime()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1, 2 or 3 has been programmed.

- ***uint16_t LL_TIM_BDTR_InitTypeDef::BreakState***

  Specifies whether the TIM Break input is enabled or not. This parameter can be a value of *TIM_LL_EC_BREAK_ENABLE*This feature can be modified afterwards using unitary functions **LL_TIM_EnableBRK()** or **LL_TIM_DisableBRK()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

- ***uint32_t LL_TIM_BDTR_InitTypeDef::BreakPolarity***

  Specifies the TIM Break Input pin polarity. This parameter can be a value of *TIM_LL_EC_BREAK_POLARITY*This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

- ***uint32_t LL_TIM_BDTR_InitTypeDef::BreakFilter***

  Specifies the TIM Break Filter. This parameter can be a value of *TIM_LL_EC_BREAK_FILTER*This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

- ***uint32_t LL_TIM_BDTR_InitTypeDef::Break2State***

  Specifies whether the TIM Break2 input is enabled or not. This parameter can be a value of *TIM_LL_EC_BREAK2_ENABLE*This feature can be modified afterwards using unitary functions **LL_TIM_EnableBRK2()** or **LL_TIM_DisableBRK2()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

- ***uint32_t LL_TIM_BDTR_InitTypeDef::Break2Polarity***

  Specifies the TIM Break2 Input pin polarity. This parameter can be a value of *TIM_LL_EC_BREAK2_POLARITY*This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK2()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

- ***uint32_t LL_TIM_BDTR_InitTypeDef::Break2Filter***

  Specifies the TIM Break2 Filter. This parameter can be a value of *TIM_LL_EC_BREAK2_FILTER*This feature can be modified afterwards using unitary function **LL_TIM_ConfigBRK2()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

- ***uint32_t LL_TIM_BDTR_InitTypeDef::AutomaticOutput***

  Specifies whether the TIM Automatic Output feature is enabled or not. This parameter can be a value of *TIM_LL_EC_AUTOMATICOUTPUT_ENABLE*This feature can be modified afterwards using unitary functions **LL_TIM_EnableAutomaticOutput()** or **LL_TIM_DisableAutomaticOutput()**

  Note:

  – This bit-field can not be modified as long as LOCK level 1 has been programmed.

104.2 TIM Firmware driver API description

The following section lists the various functions of the TIM library.

104.2.1 Detailed description of functions

`LL_TIM_EnableCounter`

Function name

__STATIC_INLINE void LL_TIM_EnableCounter (TIM_TypeDef * TIMx)

Function description

Enable timer counter.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CEN LL_TIM_EnableCounter

`LL_TIM_DisableCounter`

Function name

__STATIC_INLINE void LL_TIM_DisableCounter (TIM_TypeDef * TIMx)

Function description

Disable timer counter.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CEN LL_TIM_DisableCounter

`LL_TIM_IsEnabledCounter`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledCounter (TIM_TypeDef * TIMx)

Function description

Indicates whether the timer counter is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 CEN LL_TIM_IsEnabledCounter

`LL_TIM_EnableUpdateEvent`

Function name

__STATIC_INLINE void LL_TIM_EnableUpdateEvent (TIM_TypeDef * TIMx)

Function description

Enable update event generation.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 UDIS LL_TIM_EnableUpdateEvent

`LL_TIM_DisableUpdateEvent`

Function name

__STATIC_INLINE void LL_TIM_DisableUpdateEvent (TIM_TypeDef * TIMx)

Function description

Disable update event generation.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 UDIS LL_TIM_DisableUpdateEvent

`LL_TIM_IsEnabledUpdateEvent`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledUpdateEvent (TIM_TypeDef * TIMx)

Function description

Indicates whether update event generation is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **Inverted:** state of bit (0 or 1).

Reference Manual to LL API cross reference:

- CR1 UDIS LL_TIM_IsEnabledUpdateEvent

`LL_TIM_SetUpdateSource`

Function name

__STATIC_INLINE void LL_TIM_SetUpdateSource (TIM_TypeDef * TIMx, uint32_t UpdateSource)

Function description

Set update event source.

Parameters

- **TIMx:** Timer instance
- **UpdateSource:** This parameter can be one of the following values:
  - LL_TIM_UPDATESOURCE_REGULAR
  - LL_TIM_UPDATESOURCE_COUNTER

Return values

- **None:**

Notes

- Update event source set to LL_TIM_UPDATESOURCE_REGULAR: any of the following events generate an update interrupt or DMA request if enabled: Counter overflow/underflowSetting the UG bitUpdate generation through the slave mode controller
- Update event source set to LL_TIM_UPDATESOURCE_COUNTER: only counter overflow/underflow generates an update interrupt or DMA request if enabled.

Reference Manual to LL API cross reference:

- CR1 URS LL_TIM_SetUpdateSource

LL_TIM_GetUpdateSource

Function name

__STATIC_INLINE uint32_t LL_TIM_GetUpdateSource (TIM_TypeDef * TIMx)

Function description

Get actual event update source.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_UPDATESOURCE_REGULAR
  - LL_TIM_UPDATESOURCE_COUNTER

Reference Manual to LL API cross reference:

- CR1 URS LL_TIM_GetUpdateSource

LL_TIM_SetOnePulseMode

Function name

__STATIC_INLINE void LL_TIM_SetOnePulseMode (TIM_TypeDef * TIMx, uint32_t OnePulseMode)

Function description

Set one pulse mode (one shot v.s.

Parameters

- **TIMx:** Timer instance
- **OnePulseMode:** This parameter can be one of the following values:
  - LL_TIM_ONEPULSEMODE_SINGLE
  - LL_TIM_ONEPULSEMODE_REPETITIVE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 OPM LL_TIM_SetOnePulseMode

`LL_TIM_GetOnePulseMode`

Function name

__STATIC_INLINE uint32_t LL_TIM_GetOnePulseMode (TIM_TypeDef * TIMx)

Function description

Get actual one pulse mode.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_ONEPULSEMODE_SINGLE
  - LL_TIM_ONEPULSEMODE_REPETITIVE

Reference Manual to LL API cross reference:

- CR1 OPM LL_TIM_GetOnePulseMode

`LL_TIM_SetCounterMode`

Function name

__STATIC_INLINE void LL_TIM_SetCounterMode (TIM_TypeDef * TIMx, uint32_t CounterMode)

Function description

Set the timer counter counting mode.

Parameters

- **TIMx:** Timer instance
- **CounterMode:** This parameter can be one of the following values:
  - LL_TIM_COUNTERMODE_UP
  - LL_TIM_COUNTERMODE_DOWN
  - LL_TIM_COUNTERMODE_CENTER_UP
  - LL_TIM_COUNTERMODE_CENTER_DOWN
  - LL_TIM_COUNTERMODE_CENTER_UP_DOWN

Return values

- **None:**

Notes

- Macro IS_TIM_COUNTER_MODE_SELECT_INSTANCE(TIMx) can be used to check whether or not the counter mode selection feature is supported by a timer instance.
- Switching from Center Aligned counter mode to Edge counter mode (or reverse) requires a timer reset to avoid unexpected direction due to DIR bit readonly in center aligned mode.

Reference Manual to LL API cross reference:

- CR1 DIR LL_TIM_SetCounterMode
- CR1 CMS LL_TIM_SetCounterMode

LL_TIM_GetCounterMode

Function name

__STATIC_INLINE uint32_t LL_TIM_GetCounterMode (TIM_TypeDef * TIMx)

Function description

Get actual counter mode.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_COUNTERMODE_UP
  - LL_TIM_COUNTERMODE_DOWN
  - LL_TIM_COUNTERMODE_CENTER_UP
  - LL_TIM_COUNTERMODE_CENTER_DOWN
  - LL_TIM_COUNTERMODE_CENTER_UP_DOWN

Notes

- Macro IS_TIM_COUNTER_MODE_SELECT_INSTANCE(TIMx) can be used to check whether or not the counter mode selection feature is supported by a timer instance.

Reference Manual to LL API cross reference:

- CR1 DIR LL_TIM_GetCounterMode
- CR1 CMS LL_TIM_GetCounterMode

LL_TIM_EnableARRPreload

Function name

__STATIC_INLINE void LL_TIM_EnableARRPreload (TIM_TypeDef * TIMx)

Function description

Enable auto-reload (ARR) preload.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 ARPE LL_TIM_EnableARRPreload

LL_TIM_DisableARRPreload

Function name

__STATIC_INLINE void LL_TIM_DisableARRPreload (TIM_TypeDef * TIMx)

Function description

Disable auto-reload (ARR) preload.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 ARPE LL_TIM_DisableARRPreload

`LL_TIM_IsEnabledARRPreload`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledARRPreload (TIM_TypeDef * TIMx)

Function description

Indicates whether auto-reload (ARR) preload is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 ARPE LL_TIM_IsEnabledARRPreload

`LL_TIM_SetClockDivision`

Function name

__STATIC_INLINE void LL_TIM_SetClockDivision (TIM_TypeDef * TIMx, uint32_t ClockDivision)

Function description

Set the division ratio between the timer clock and the sampling clock used by the dead-time generators (when supported) and the digital filters.

Parameters

- **TIMx:** Timer instance
- **ClockDivision:** This parameter can be one of the following values:
  - LL_TIM_CLOCKDIVISION_DIV1
  - LL_TIM_CLOCKDIVISION_DIV2
  - LL_TIM_CLOCKDIVISION_DIV4

Return values

- **None:**

Notes

- Macro IS_TIM_CLOCK_DIVISION_INSTANCE(TIMx) can be used to check whether or not the clock division feature is supported by the timer instance.

Reference Manual to LL API cross reference:

- CR1 CKD LL_TIM_SetClockDivision

`LL_TIM_GetClockDivision`

Function name

__STATIC_INLINE uint32_t LL_TIM_GetClockDivision (TIM_TypeDef * TIMx)

Function description

Get the actual division ratio between the timer clock and the sampling clock used by the dead-time generators (when supported) and the digital filters.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_CLOCKDIVISION_DIV1
  - LL_TIM_CLOCKDIVISION_DIV2
  - LL_TIM_CLOCKDIVISION_DIV4

Notes

- Macro IS_TIM_CLOCK_DIVISION_INSTANCE(TIMx) can be used to check whether or not the clock division feature is supported by the timer instance.

Reference Manual to LL API cross reference:

- CR1 CKD LL_TIM_GetClockDivision

LL_TIM_SetCounter

Function name

__STATIC_INLINE void LL_TIM_SetCounter (TIM_TypeDef * TIMx, uint32_t Counter)

Function description

Set the counter value.

Parameters

- **TIMx:** Timer instance
- **Counter:** Counter value (between Min_Data=0 and Max_Data=0xFFFF or 0xFFFFFFFF)

Return values

- **None:**

Notes

- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.

Reference Manual to LL API cross reference:

- CNT CNT LL_TIM_SetCounter

LL_TIM_GetCounter

Function name

__STATIC_INLINE uint32_t LL_TIM_GetCounter (TIM_TypeDef * TIMx)

Function description

Get the counter value.

Parameters

- **TIMx:** Timer instance

Return values

- **Counter:** value (between Min_Data=0 and Max_Data=0xFFFF or 0xFFFFFFFF)

Notes

- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.

Reference Manual to LL API cross reference:

- CNT CNT LL_TIM_GetCounter

`LL_TIM_GetDirection`

Function name

__STATIC_INLINE uint32_t LL_TIM_GetDirection (TIM_TypeDef * TIMx)

Function description

Get the current direction of the counter.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_COUNTERDIRECTION_UP
  - LL_TIM_COUNTERDIRECTION_DOWN

Reference Manual to LL API cross reference:

- CR1 DIR LL_TIM_GetDirection

`LL_TIM_SetPrescaler`

Function name

__STATIC_INLINE void LL_TIM_SetPrescaler (TIM_TypeDef * TIMx, uint32_t Prescaler)

Function description

Set the prescaler value.

Parameters

- **TIMx:** Timer instance
- **Prescaler:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- The counter clock frequency CK_CNT is equal to fCK_PSC / (PSC[15:0] + 1).
- The prescaler can be changed on the fly as this control register is buffered. The new prescaler ratio is taken into account at the next update event.
- Helper macro __LL_TIM_CALC_PSC can be used to calculate the Prescaler parameter

Reference Manual to LL API cross reference:

- PSC PSC LL_TIM_SetPrescaler

`LL_TIM_GetPrescaler`

Function name

__STATIC_INLINE uint32_t LL_TIM_GetPrescaler (TIM_TypeDef * TIMx)

Function description

Get the prescaler value.

Parameters

- **TIMx:** Timer instance

Return values

- **Prescaler:** value between Min_Data=0 and Max_Data=65535

Reference Manual to LL API cross reference:

- PSC PSC LL_TIM_GetPrescaler

LL_TIM_SetAutoReload

Function name

__STATIC_INLINE void LL_TIM_SetAutoReload (TIM_TypeDef * TIMx, uint32_t AutoReload)

Function description

Set the auto-reload value.

Parameters

- **TIMx:** Timer instance
- **AutoReload:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- The counter is blocked while the auto-reload value is null.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Helper macro __LL_TIM_CALC_ARR can be used to calculate the AutoReload parameter

Reference Manual to LL API cross reference:

- ARR ARR LL_TIM_SetAutoReload

LL_TIM_GetAutoReload

Function name

__STATIC_INLINE uint32_t LL_TIM_GetAutoReload (TIM_TypeDef * TIMx)

Function description

Get the auto-reload value.

Parameters

- **TIMx:** Timer instance

Return values

- **Auto-reload:** value

Notes

- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.

Reference Manual to LL API cross reference:

- ARR ARR LL_TIM_GetAutoReload

LL_TIM_SetRepetitionCounter

Function name

__STATIC_INLINE void LL_TIM_SetRepetitionCounter (TIM_TypeDef * TIMx, uint32_t RepetitionCounter)

Function description

Set the repetition counter value.

Parameters

- **TIMx:** Timer instance
- **RepetitionCounter:** between Min_Data=0 and Max_Data=255

Return values

- **None:**

Notes

- For advanced timer instances RepetitionCounter can be up to 65535.
- Macro IS_TIM_REPETITION_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a repetition counter.

Reference Manual to LL API cross reference:

- RCR REP LL_TIM_SetRepetitionCounter

LL_TIM_GetRepetitionCounter

Function name

__STATIC_INLINE uint32_t LL_TIM_GetRepetitionCounter (TIM_TypeDef * TIMx)

Function description

Get the repetition counter value.

Parameters

- **TIMx:** Timer instance

Return values

- **Repetition:** counter value

Notes

- Macro IS_TIM_REPETITION_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a repetition counter.

Reference Manual to LL API cross reference:

- RCR REP LL_TIM_GetRepetitionCounter

LL_TIM_EnableUIFRemap

Function name

__STATIC_INLINE void LL_TIM_EnableUIFRemap (TIM_TypeDef * TIMx)

Function description

Force a continuous copy of the update interrupt flag (UIF) into the timer counter register (bit 31).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- This allows both the counter value and a potential roll-over condition signalled by the UIFCPY flag to be read in an atomic way.

Reference Manual to LL API cross reference:

- CR1 UIFREMAP LL_TIM_EnableUIFRemap

`LL_TIM_DisableUIFRemap`

Function name

__STATIC_INLINE void LL_TIM_DisableUIFRemap (TIM_TypeDef * TIMx)

Function description

Disable update interrupt flag (UIF) remapping.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 UIFREMAP LL_TIM_DisableUIFRemap

`LL_TIM_CC_EnablePreload`

Function name

__STATIC_INLINE void LL_TIM_CC_EnablePreload (TIM_TypeDef * TIMx)

Function description

Enable the capture/compare control bits (CCxE, CCxNE and OCxM) preload.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- CCxE, CCxNE and OCxM bits are preloaded, after having been written, they are updated only when a commutation event (COM) occurs.
- Only on channels that have a complementary output.
- Macro IS_TIM_COMMUTATION_EVENT_INSTANCE(TIMx) can be used to check whether or not a timer instance is able to generate a commutation event.

Reference Manual to LL API cross reference:

- CR2 CCPC LL_TIM_CC_EnablePreload

`LL_TIM_CC_DisablePreload`

Function name

__STATIC_INLINE void LL_TIM_CC_DisablePreload (TIM_TypeDef * TIMx)

Function description

Disable the capture/compare control bits (CCxE, CCxNE and OCxM) preload.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_COMMUTATION_EVENT_INSTANCE(TIMx) can be used to check whether or not a timer instance is able to generate a commutation event.

Reference Manual to LL API cross reference:

- CR2 CCPC LL_TIM_CC_DisablePreload

LL_TIM_CC_SetUpdate

Function name

__STATIC_INLINE void LL_TIM_CC_SetUpdate (TIM_TypeDef * TIMx, uint32_t CCUpdateSource)

Function description

Set the updated source of the capture/compare control bits (CCxE, CCxNE and OCxM).

Parameters

- **TIMx:** Timer instance
- **CCUpdateSource:** This parameter can be one of the following values:
  - LL_TIM_CCUPDATESOURCE_COMG_ONLY
  - LL_TIM_CCUPDATESOURCE_COMG_AND_TRGI

Return values

- **None:**

Notes

- Macro IS_TIM_COMMUTATION_EVENT_INSTANCE(TIMx) can be used to check whether or not a timer instance is able to generate a commutation event.

Reference Manual to LL API cross reference:

- CR2 CCUS LL_TIM_CC_SetUpdate

LL_TIM_CC_SetDMAReqTrigger

Function name

__STATIC_INLINE void LL_TIM_CC_SetDMAReqTrigger (TIM_TypeDef * TIMx, uint32_t DMAReqTrigger)

Function description

Set the trigger of the capture/compare DMA request.

Parameters

- **TIMx:** Timer instance
- **DMAReqTrigger:** This parameter can be one of the following values:
  - LL_TIM_CCDMAREQUEST_CC
  - LL_TIM_CCDMAREQUEST_UPDATE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 CCDS LL_TIM_CC_SetDMAReqTrigger

`LL_TIM_CC_GetDMAReqTrigger`

Function name

__STATIC_INLINE uint32_t LL_TIM_CC_GetDMAReqTrigger (TIM_TypeDef * TIMx)

Function description

Get actual trigger of the capture/compare DMA request.

Parameters

- **TIMx:** Timer instance

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_CCDMAREQUEST_CC
  - LL_TIM_CCDMAREQUEST_UPDATE

Reference Manual to LL API cross reference:

- CR2 CCDS LL_TIM_CC_GetDMAReqTrigger

`LL_TIM_CC_SetLockLevel`

Function name

__STATIC_INLINE void LL_TIM_CC_SetLockLevel (TIM_TypeDef * TIMx, uint32_t LockLevel)

Function description

Set the lock level to freeze the configuration of several capture/compare parameters.

Parameters

- **TIMx:** Timer instance
- **LockLevel:** This parameter can be one of the following values:
  - LL_TIM_LOCKLEVEL_OFF
  - LL_TIM_LOCKLEVEL_1
  - LL_TIM_LOCKLEVEL_2
  - LL_TIM_LOCKLEVEL_3

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not the lock mechanism is supported by a timer instance.

Reference Manual to LL API cross reference:

- BDTR LOCK LL_TIM_CC_SetLockLevel

`LL_TIM_CC_EnableChannel`

Function name

__STATIC_INLINE void LL_TIM_CC_EnableChannel (TIM_TypeDef * TIMx, uint32_t Channels)

Function description

Enable capture/compare channels.

Parameters

- **TIMx:** Timer instance
- **Channels:** This parameter can be a combination of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCER CC1E LL_TIM_CC_EnableChannel
- CCER CC1NE LL_TIM_CC_EnableChannel
- CCER CC2E LL_TIM_CC_EnableChannel
- CCER CC2NE LL_TIM_CC_EnableChannel
- CCER CC3E LL_TIM_CC_EnableChannel
- CCER CC3NE LL_TIM_CC_EnableChannel
- CCER CC4E LL_TIM_CC_EnableChannel
- CCER CC5E LL_TIM_CC_EnableChannel
- CCER CC6E LL_TIM_CC_EnableChannel

`LL_TIM_CC_DisableChannel`

Function name

__STATIC_INLINE void LL_TIM_CC_DisableChannel (TIM_TypeDef * TIMx, uint32_t Channels)

Function description

Disable capture/compare channels.

Parameters

- **TIMx:** Timer instance
- **Channels:** This parameter can be a combination of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCER CC1E LL_TIM_CC_DisableChannel
- CCER CC1NE LL_TIM_CC_DisableChannel
- CCER CC2E LL_TIM_CC_DisableChannel
- CCER CC2NE LL_TIM_CC_DisableChannel
- CCER CC3E LL_TIM_CC_DisableChannel
- CCER CC3NE LL_TIM_CC_DisableChannel
- CCER CC4E LL_TIM_CC_DisableChannel
- CCER CC5E LL_TIM_CC_DisableChannel
- CCER CC6E LL_TIM_CC_DisableChannel

`LL_TIM_CC_IsEnabledChannel`

Function name

__STATIC_INLINE uint32_t LL_TIM_CC_IsEnabledChannel (TIM_TypeDef * TIMx, uint32_t Channels)

Function description

Indicate whether channel(s) is(are) enabled.

Parameters

- **TIMx:** Timer instance
- **Channels:** This parameter can be a combination of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCER CC1E LL_TIM_CC_IsEnabledChannel
- CCER CC1NE LL_TIM_CC_IsEnabledChannel
- CCER CC2E LL_TIM_CC_IsEnabledChannel
- CCER CC2NE LL_TIM_CC_IsEnabledChannel
- CCER CC3E LL_TIM_CC_IsEnabledChannel
- CCER CC3NE LL_TIM_CC_IsEnabledChannel
- CCER CC4E LL_TIM_CC_IsEnabledChannel
- CCER CC5E LL_TIM_CC_IsEnabledChannel
- CCER CC6E LL_TIM_CC_IsEnabledChannel

`LL_TIM_OC_ConfigOutput`

Function name

__STATIC_INLINE void LL_TIM_OC_ConfigOutput (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Configuration)

Function description

Configure an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6
- **Configuration:** This parameter must be a combination of all the following values:
  - LL_TIM_OCPOLARITY_HIGH or LL_TIM_OCPOLARITY_LOW
  - LL_TIM_OCIDLESTATE_LOW or LL_TIM_OCIDLESTATE_HIGH

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 CC1S LL_TIM_OC_ConfigOutput
- CCMR1 CC2S LL_TIM_OC_ConfigOutput
- CCMR2 CC3S LL_TIM_OC_ConfigOutput
- CCMR2 CC4S LL_TIM_OC_ConfigOutput
- CCMR3 CC5S LL_TIM_OC_ConfigOutput
- CCMR3 CC6S LL_TIM_OC_ConfigOutput
- CCER CC1P LL_TIM_OC_ConfigOutput
- CCER CC2P LL_TIM_OC_ConfigOutput
- CCER CC3P LL_TIM_OC_ConfigOutput
- CCER CC4P LL_TIM_OC_ConfigOutput
- CCER CC5P LL_TIM_OC_ConfigOutput
- CCER CC6P LL_TIM_OC_ConfigOutput
- CR2 OIS1 LL_TIM_OC_ConfigOutput
- CR2 OIS2 LL_TIM_OC_ConfigOutput
- CR2 OIS3 LL_TIM_OC_ConfigOutput
- CR2 OIS4 LL_TIM_OC_ConfigOutput
- CR2 OIS5 LL_TIM_OC_ConfigOutput
- CR2 OIS6 LL_TIM_OC_ConfigOutput

LL_TIM_OC_SetMode

Function name

__STATIC_INLINE void LL_TIM_OC_SetMode (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Mode)

Function description

Define the behavior of the output reference signal OCxREF from which OCx and OCxN (when relevant) are derived.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6
- **Mode:** This parameter can be one of the following values:
  - LL_TIM_OCMODE_FROZEN
  - LL_TIM_OCMODE_ACTIVE
  - LL_TIM_OCMODE_INACTIVE
  - LL_TIM_OCMODE_TOGGLE
  - LL_TIM_OCMODE_FORCED_INACTIVE
  - LL_TIM_OCMODE_FORCED_ACTIVE
  - LL_TIM_OCMODE_PWM1
  - LL_TIM_OCMODE_PWM2
  - LL_TIM_OCMODE_RETRIG_OPM1
  - LL_TIM_OCMODE_RETRIG_OPM2
  - LL_TIM_OCMODE_COMBINED_PWM1
  - LL_TIM_OCMODE_COMBINED_PWM2
  - LL_TIM_OCMODE_ASSYMETRIC_PWM1
  - LL_TIM_OCMODE_ASSYMETRIC_PWM2

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 OC1M LL_TIM_OC_SetMode
- CCMR1 OC2M LL_TIM_OC_SetMode
- CCMR2 OC3M LL_TIM_OC_SetMode
- CCMR2 OC4M LL_TIM_OC_SetMode
- CCMR3 OC5M LL_TIM_OC_SetMode
- CCMR3 OC6M LL_TIM_OC_SetMode

`LL_TIM_OC_GetMode`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetMode (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the output compare mode of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_OCMODE_FROZEN
  - LL_TIM_OCMODE_ACTIVE
  - LL_TIM_OCMODE_INACTIVE
  - LL_TIM_OCMODE_TOGGLE
  - LL_TIM_OCMODE_FORCED_INACTIVE
  - LL_TIM_OCMODE_FORCED_ACTIVE
  - LL_TIM_OCMODE_PWM1
  - LL_TIM_OCMODE_PWM2
  - LL_TIM_OCMODE_RETRIG_OPM1
  - LL_TIM_OCMODE_RETRIG_OPM2
  - LL_TIM_OCMODE_COMBINED_PWM1
  - LL_TIM_OCMODE_COMBINED_PWM2
  - LL_TIM_OCMODE_ASSYMETRIC_PWM1
  - LL_TIM_OCMODE_ASSYMETRIC_PWM2

Reference Manual to LL API cross reference:

- CCMR1 OC1M LL_TIM_OC_GetMode
- CCMR1 OC2M LL_TIM_OC_GetMode
- CCMR2 OC3M LL_TIM_OC_GetMode
- CCMR2 OC4M LL_TIM_OC_GetMode
- CCMR3 OC5M LL_TIM_OC_GetMode
- CCMR3 OC6M LL_TIM_OC_GetMode

LL_TIM_OC_SetPolarity

Function name

__STATIC_INLINE void LL_TIM_OC_SetPolarity (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Polarity)

Function description

Set the polarity of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6
- **Polarity:** This parameter can be one of the following values:
  - LL_TIM_OCPOLARITY_HIGH
  - LL_TIM_OCPOLARITY_LOW

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCER CC1P LL_TIM_OC_SetPolarity
- CCER CC1NP LL_TIM_OC_SetPolarity
- CCER CC2P LL_TIM_OC_SetPolarity
- CCER CC2NP LL_TIM_OC_SetPolarity
- CCER CC3P LL_TIM_OC_SetPolarity
- CCER CC3NP LL_TIM_OC_SetPolarity
- CCER CC4P LL_TIM_OC_SetPolarity
- CCER CC5P LL_TIM_OC_SetPolarity
- CCER CC6P LL_TIM_OC_SetPolarity

`LL_TIM_OC_GetPolarity`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetPolarity (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the polarity of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_OCPOLARITY_HIGH
  - LL_TIM_OCPOLARITY_LOW

Reference Manual to LL API cross reference:

- CCER CC1P LL_TIM_OC_GetPolarity
- CCER CC1NP LL_TIM_OC_GetPolarity
- CCER CC2P LL_TIM_OC_GetPolarity
- CCER CC2NP LL_TIM_OC_GetPolarity
- CCER CC3P LL_TIM_OC_GetPolarity
- CCER CC3NP LL_TIM_OC_GetPolarity
- CCER CC4P LL_TIM_OC_GetPolarity
- CCER CC5P LL_TIM_OC_GetPolarity
- CCER CC6P LL_TIM_OC_GetPolarity

LL_TIM_OC_SetIdleState

Function name

__STATIC_INLINE void LL_TIM_OC_SetIdleState (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t IdleState)

Function description

Set the IDLE state of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6
- **IdleState:** This parameter can be one of the following values:
  - LL_TIM_OCIDLESTATE_LOW
  - LL_TIM_OCIDLESTATE_HIGH

Return values

- **None:**

Notes

- This function is significant only for the timer instances supporting the break feature. Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- CR2 OIS1 LL_TIM_OC_SetIdleState
- CR2 OIS2N LL_TIM_OC_SetIdleState
- CR2 OIS2 LL_TIM_OC_SetIdleState
- CR2 OIS2N LL_TIM_OC_SetIdleState
- CR2 OIS3 LL_TIM_OC_SetIdleState
- CR2 OIS3N LL_TIM_OC_SetIdleState
- CR2 OIS4 LL_TIM_OC_SetIdleState
- CR2 OIS5 LL_TIM_OC_SetIdleState
- CR2 OIS6 LL_TIM_OC_SetIdleState

LL_TIM_OC_GetIdleState

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetIdleState (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the IDLE state of an output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH1N
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH2N
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH3N
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_OCIDLESTATE_LOW
  - LL_TIM_OCIDLESTATE_HIGH

Reference Manual to LL API cross reference:

- CR2 OIS1 LL_TIM_OC_GetIdleState
- CR2 OIS2N LL_TIM_OC_GetIdleState
- CR2 OIS2 LL_TIM_OC_GetIdleState
- CR2 OIS2N LL_TIM_OC_GetIdleState
- CR2 OIS3 LL_TIM_OC_GetIdleState
- CR2 OIS3N LL_TIM_OC_GetIdleState
- CR2 OIS4 LL_TIM_OC_GetIdleState
- CR2 OIS5 LL_TIM_OC_GetIdleState
- CR2 OIS6 LL_TIM_OC_GetIdleState

LL_TIM_OC_EnableFast

Function name

__STATIC_INLINE void LL_TIM_OC_EnableFast (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Enable fast mode for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Notes

- Acts only if the channel is configured in PWM1 or PWM2 mode.

Reference Manual to LL API cross reference:

- CCMR1 OC1FE LL_TIM_OC_EnableFast
- CCMR1 OC2FE LL_TIM_OC_EnableFast
- CCMR2 OC3FE LL_TIM_OC_EnableFast
- CCMR2 OC4FE LL_TIM_OC_EnableFast
- CCMR3 OC5FE LL_TIM_OC_EnableFast
- CCMR3 OC6FE LL_TIM_OC_EnableFast

LL_TIM_OC_DisableFast

Function name

__STATIC_INLINE void LL_TIM_OC_DisableFast (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Disable fast mode for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 OC1FE LL_TIM_OC_DisableFast
- CCMR1 OC2FE LL_TIM_OC_DisableFast
- CCMR2 OC3FE LL_TIM_OC_DisableFast
- CCMR2 OC4FE LL_TIM_OC_DisableFast
- CCMR3 OC5FE LL_TIM_OC_DisableFast
- CCMR3 OC6FE LL_TIM_OC_DisableFast

`LL_TIM_OC_IsEnabledFast`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_IsEnabledFast (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Indicates whether fast mode is enabled for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCMR1 OC1FE LL_TIM_OC_IsEnabledFast
- CCMR1 OC2FE LL_TIM_OC_IsEnabledFast
- CCMR2 OC3FE LL_TIM_OC_IsEnabledFast
- CCMR2 OC4FE LL_TIM_OC_IsEnabledFast
- CCMR3 OC5FE LL_TIM_OC_IsEnabledFast
- CCMR3 OC6FE LL_TIM_OC_IsEnabledFast

`LL_TIM_OC_EnablePreload`

Function name

__STATIC_INLINE void LL_TIM_OC_EnablePreload (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Enable compare register (TIMx_CCRx) preload for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 OC1PE LL_TIM_OC_EnablePreload
- CCMR1 OC2PE LL_TIM_OC_EnablePreload
- CCMR2 OC3PE LL_TIM_OC_EnablePreload
- CCMR2 OC4PE LL_TIM_OC_EnablePreload
- CCMR3 OC5PE LL_TIM_OC_EnablePreload
- CCMR3 OC6PE LL_TIM_OC_EnablePreload

LL_TIM_OC_DisablePreload

Function name

__STATIC_INLINE void LL_TIM_OC_DisablePreload (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Disable compare register (TIMx_CCRx) preload for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 OC1PE LL_TIM_OC_DisablePreload
- CCMR1 OC2PE LL_TIM_OC_DisablePreload
- CCMR2 OC3PE LL_TIM_OC_DisablePreload
- CCMR2 OC4PE LL_TIM_OC_DisablePreload
- CCMR3 OC5PE LL_TIM_OC_DisablePreload
- CCMR3 OC6PE LL_TIM_OC_DisablePreload

LL_TIM_OC_IsEnabledPreload

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_IsEnabledPreload (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Indicates whether compare register (TIMx_CCRx) preload is enabled for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CCMR1 OC1PE LL_TIM_OC_IsEnabledPreload
- CCMR1 OC2PE LL_TIM_OC_IsEnabledPreload
- CCMR2 OC3PE LL_TIM_OC_IsEnabledPreload
- CCMR2 OC4PE LL_TIM_OC_IsEnabledPreload
- CCMR3 OC5PE LL_TIM_OC_IsEnabledPreload
- CCMR3 OC6PE LL_TIM_OC_IsEnabledPreload

LL_TIM_OC_EnableClear

Function name

__STATIC_INLINE void LL_TIM_OC_EnableClear (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Enable clearing the output channel on an external event.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Notes

- This function can only be used in Output compare and PWM modes. It does not work in Forced mode.
- Macro IS_TIM_OCXREF_CLEAR_INSTANCE(TIMx) can be used to check whether or not a timer instance can clear the OCxREF signal on an external event.

Reference Manual to LL API cross reference:

- CCMR1 OC1CE LL_TIM_OC_EnableClear
- CCMR1 OC2CE LL_TIM_OC_EnableClear
- CCMR2 OC3CE LL_TIM_OC_EnableClear
- CCMR2 OC4CE LL_TIM_OC_EnableClear
- CCMR3 OC5CE LL_TIM_OC_EnableClear
- CCMR3 OC6CE LL_TIM_OC_EnableClear

LL_TIM_OC_DisableClear

Function name

__STATIC_INLINE void LL_TIM_OC_DisableClear (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Disable clearing the output channel on an external event.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **None:**

Notes

- Macro IS_TIM_OCXREF_CLEAR_INSTANCE(TIMx) can be used to check whether or not a timer instance can clear the OCxREF signal on an external event.

Reference Manual to LL API cross reference:

- CCMR1 OC1CE LL_TIM_OC_DisableClear
- CCMR1 OC2CE LL_TIM_OC_DisableClear
- CCMR2 OC3CE LL_TIM_OC_DisableClear
- CCMR2 OC4CE LL_TIM_OC_DisableClear
- CCMR3 OC5CE LL_TIM_OC_DisableClear
- CCMR3 OC6CE LL_TIM_OC_DisableClear

LL_TIM_OC_IsEnabledClear

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_IsEnabledClear (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Indicates clearing the output channel on an external event is enabled for the output channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6

Return values

- **State:** of bit (1 or 0).

Notes

- This function enables clearing the output channel on an external event.
- This function can only be used in Output compare and PWM modes. It does not work in Forced mode.
- Macro IS_TIM_OCXREF_CLEAR_INSTANCE(TIMx) can be used to check whether or not a timer instance can clear the OCxREF signal on an external event.

Reference Manual to LL API cross reference:

- CCMR1 OC1CE LL_TIM_OC_IsEnabledClear
- CCMR1 OC2CE LL_TIM_OC_IsEnabledClear
- CCMR2 OC3CE LL_TIM_OC_IsEnabledClear
- CCMR2 OC4CE LL_TIM_OC_IsEnabledClear
- CCMR3 OC5CE LL_TIM_OC_IsEnabledClear
- CCMR3 OC6CE LL_TIM_OC_IsEnabledClear

LL_TIM_OC_SetDeadTime

Function name

__STATIC_INLINE void LL_TIM_OC_SetDeadTime (TIM_TypeDef * TIMx, uint32_t DeadTime)

Function description

Set the dead-time delay (delay inserted between the rising edge of the OCxREF signal and the rising edge of the Ocx and OCxN signals).

Parameters

- **TIMx:** Timer instance
- **DeadTime:** between Min_Data=0 and Max_Data=255

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not dead-time insertion feature is supported by a timer instance.
- Helper macro __LL_TIM_CALC_DEADTIME can be used to calculate the DeadTime parameter

Reference Manual to LL API cross reference:

- BDTR DTG LL_TIM_OC_SetDeadTime

LL_TIM_OC_SetCompareCH1

Function name

__STATIC_INLINE void LL_TIM_OC_SetCompareCH1 (TIM_TypeDef * TIMx, uint32_t CompareValue)

Function description

Set compare value for output channel 1 (TIMx_CCR1).

Parameters

- **TIMx:** Timer instance
- **CompareValue:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC1_INSTANCE(TIMx) can be used to check whether or not output channel 1 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR1 CCR1 LL_TIM_OC_SetCompareCH1

LL_TIM_OC_SetCompareCH2

Function name

__STATIC_INLINE void LL_TIM_OC_SetCompareCH2 (TIM_TypeDef * TIMx, uint32_t CompareValue)

Function description

Set compare value for output channel 2 (TIMx_CCR2).

Parameters

- **TIMx:** Timer instance
- **CompareValue:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC2_INSTANCE(TIMx) can be used to check whether or not output channel 2 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR2 CCR2 LL_TIM_OC_SetCompareCH2

LL_TIM_OC_SetCompareCH3

Function name

__STATIC_INLINE void LL_TIM_OC_SetCompareCH3 (TIM_TypeDef * TIMx, uint32_t CompareValue)

Function description

Set compare value for output channel 3 (TIMx_CCR3).

Parameters

- **TIMx:** Timer instance
- **CompareValue:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC3_INSTANCE(TIMx) can be used to check whether or not output channel is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR3 CCR3 LL_TIM_OC_SetCompareCH3

LL_TIM_OC_SetCompareCH4

Function name

__STATIC_INLINE void LL_TIM_OC_SetCompareCH4 (TIM_TypeDef * TIMx, uint32_t CompareValue)

Function description

Set compare value for output channel 4 (TIMx_CCR4).

Parameters

- **TIMx:** Timer instance
- **CompareValue:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- In 32-bit timer implementations compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC4_INSTANCE(TIMx) can be used to check whether or not output channel 4 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR4 CCR4 LL_TIM_OC_SetCompareCH4

LL_TIM_OC_SetCompareCH5

Function name

__STATIC_INLINE void LL_TIM_OC_SetCompareCH5 (TIM_TypeDef * TIMx, uint32_t CompareValue)

Function description

Set compare value for output channel 5 (TIMx_CCR5).

Parameters

- **TIMx:** Timer instance
- **CompareValue:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- Macro IS_TIM_CC5_INSTANCE(TIMx) can be used to check whether or not output channel 5 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR5 CCR5 LL_TIM_OC_SetCompareCH5

`LL_TIM_OC_SetCompareCH6`

Function name

__STATIC_INLINE void LL_TIM_OC_SetCompareCH6 (TIM_TypeDef * TIMx, uint32_t CompareValue)

Function description

Set compare value for output channel 6 (TIMx_CCR6).

Parameters

- **TIMx:** Timer instance
- **CompareValue:** between Min_Data=0 and Max_Data=65535

Return values

- **None:**

Notes

- Macro IS_TIM_CC6_INSTANCE(TIMx) can be used to check whether or not output channel 6 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR6 CCR6 LL_TIM_OC_SetCompareCH6

`LL_TIM_OC_GetCompareCH1`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH1 (TIM_TypeDef * TIMx)

Function description

Get compare value (TIMx_CCR1) set for output channel 1.

Parameters

- **TIMx:** Timer instance

Return values

- **CompareValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC1_INSTANCE(TIMx) can be used to check whether or not output channel 1 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR1 CCR1 LL_TIM_OC_GetCompareCH1

`LL_TIM_OC_GetCompareCH2`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH2 (TIM_TypeDef * TIMx)

Function description

Get compare value (TIMx_CCR2) set for output channel 2.

Parameters

- **TIMx:** Timer instance

Return values

- **CompareValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC2_INSTANCE(TIMx) can be used to check whether or not output channel 2 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR2 CCR2 LL_TIM_OC_GetCompareCH2

`LL_TIM_OC_GetCompareCH3`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH3 (TIM_TypeDef * TIMx)

Function description

Get compare value (TIMx_CCR3) set for output channel 3.

Parameters

- **TIMx:** Timer instance

Return values

- **CompareValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC3_INSTANCE(TIMx) can be used to check whether or not output channel 3 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR3 CCR3 LL_TIM_OC_GetCompareCH3

`LL_TIM_OC_GetCompareCH4`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH4 (TIM_TypeDef * TIMx)

Function description

Get compare value (TIMx_CCR4) set for output channel 4.

Parameters

- **TIMx:** Timer instance

Return values

- **CompareValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned compare value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC4_INSTANCE(TIMx) can be used to check whether or not output channel 4 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR4 CCR4 LL_TIM_OC_GetCompareCH4

`LL_TIM_OC_GetCompareCH5`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH5 (TIM_TypeDef * TIMx)

Function description

Get compare value (TIMx_CCR5) set for output channel 5.

Parameters

- **TIMx:** Timer instance

Return values

- **CompareValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- Macro IS_TIM_CC5_INSTANCE(TIMx) can be used to check whether or not output channel 5 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR5 CCR5 LL_TIM_OC_GetCompareCH5

`LL_TIM_OC_GetCompareCH6`

Function name

__STATIC_INLINE uint32_t LL_TIM_OC_GetCompareCH6 (TIM_TypeDef * TIMx)

Function description

Get compare value (TIMx_CCR6) set for output channel 6.

Parameters

- **TIMx:** Timer instance

Return values

- **CompareValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- Macro IS_TIM_CC6_INSTANCE(TIMx) can be used to check whether or not output channel 6 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR6 CCR6 LL_TIM_OC_GetCompareCH6

`LL_TIM_SetCH5CombinedChannels`

Function name

__STATIC_INLINE void LL_TIM_SetCH5CombinedChannels (TIM_TypeDef * TIMx, uint32_t GroupCH5)

Function description

Select on which reference signal the OC5REF is combined to.

Parameters

- **TIMx:** Timer instance
- **GroupCH5:** This parameter can be a combination of the following values:
  - LL_TIM_GROUPCH5_NONE
  - LL_TIM_GROUPCH5_OC1REFC
  - LL_TIM_GROUPCH5_OC2REFC
  - LL_TIM_GROUPCH5_OC3REFC

Return values

- **None:**

Notes

- Macro IS_TIM_COMBINED3PHASEPWM_INSTANCE(TIMx) can be used to check whether or not a timer instance supports the combined 3-phase PWM mode.

Reference Manual to LL API cross reference:

- CCR5 GC5C3 LL_TIM_SetCH5CombinedChannels
- CCR5 GC5C2 LL_TIM_SetCH5CombinedChannels
- CCR5 GC5C1 LL_TIM_SetCH5CombinedChannels

`LL_TIM_IC_Config`

Function name

__STATIC_INLINE void LL_TIM_IC_Config (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t Configuration)

Function description

Configure input channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **Configuration:** This parameter must be a combination of all the following values:
  - LL_TIM_ACTIVEINPUT_DIRECTTI or LL_TIM_ACTIVEINPUT_INDIRECTTI or LL_TIM_ACTIVEINPUT_TRC
  - LL_TIM_ICPSC_DIV1 or ... or LL_TIM_ICPSC_DIV8
  - LL_TIM_IC_FILTER_FDIV1 or ... or LL_TIM_IC_FILTER_FDIV32_N8
  - LL_TIM_IC_POLARITY_RISING or LL_TIM_IC_POLARITY_FALLING or LL_TIM_IC_POLARITY_BOTHEDGE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 CC1S LL_TIM_IC_Config
- CCMR1 IC1PSC LL_TIM_IC_Config
- CCMR1 IC1F LL_TIM_IC_Config
- CCMR1 CC2S LL_TIM_IC_Config
- CCMR1 IC2PSC LL_TIM_IC_Config
- CCMR1 IC2F LL_TIM_IC_Config
- CCMR2 CC3S LL_TIM_IC_Config
- CCMR2 IC3PSC LL_TIM_IC_Config
- CCMR2 IC3F LL_TIM_IC_Config
- CCMR2 CC4S LL_TIM_IC_Config
- CCMR2 IC4PSC LL_TIM_IC_Config
- CCMR2 IC4F LL_TIM_IC_Config
- CCER CC1P LL_TIM_IC_Config
- CCER CC1NP LL_TIM_IC_Config
- CCER CC2P LL_TIM_IC_Config
- CCER CC2NP LL_TIM_IC_Config
- CCER CC3P LL_TIM_IC_Config
- CCER CC3NP LL_TIM_IC_Config
- CCER CC4P LL_TIM_IC_Config
- CCER CC4NP LL_TIM_IC_Config

`LL_TIM_IC_SetActiveInput`

Function name

__STATIC_INLINE void LL_TIM_IC_SetActiveInput (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICActiveInput)

Function description

Set the active input.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **ICActiveInput:** This parameter can be one of the following values:
  - LL_TIM_ACTIVEINPUT_DIRECTTI
  - LL_TIM_ACTIVEINPUT_INDIRECTTI
  - LL_TIM_ACTIVEINPUT_TRC

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 CC1S LL_TIM_IC_SetActiveInput
- CCMR1 CC2S LL_TIM_IC_SetActiveInput
- CCMR2 CC3S LL_TIM_IC_SetActiveInput
- CCMR2 CC4S LL_TIM_IC_SetActiveInput

LL_TIM_IC_GetActiveInput

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetActiveInput (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the current active input.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_ACTIVEINPUT_DIRECTTI
  - LL_TIM_ACTIVEINPUT_INDIRECTTI
  - LL_TIM_ACTIVEINPUT_TRC

Reference Manual to LL API cross reference:

- CCMR1 CC1S LL_TIM_IC_GetActiveInput
- CCMR1 CC2S LL_TIM_IC_GetActiveInput
- CCMR2 CC3S LL_TIM_IC_GetActiveInput
- CCMR2 CC4S LL_TIM_IC_GetActiveInput

LL_TIM_IC_SetPrescaler

Function name

__STATIC_INLINE void LL_TIM_IC_SetPrescaler (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICPrescaler)

Function description

Set the prescaler of input channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **ICPrescaler:** This parameter can be one of the following values:
  - LL_TIM_ICPSC_DIV1
  - LL_TIM_ICPSC_DIV2
  - LL_TIM_ICPSC_DIV4
  - LL_TIM_ICPSC_DIV8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 IC1PSC LL_TIM_IC_SetPrescaler
- CCMR1 IC2PSC LL_TIM_IC_SetPrescaler
- CCMR2 IC3PSC LL_TIM_IC_SetPrescaler
- CCMR2 IC4PSC LL_TIM_IC_SetPrescaler

LL_TIM_IC_GetPrescaler

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetPrescaler (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the current prescaler value acting on an input channel.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_ICPSC_DIV1
  - LL_TIM_ICPSC_DIV2
  - LL_TIM_ICPSC_DIV4
  - LL_TIM_ICPSC_DIV8

Reference Manual to LL API cross reference:

- CCMR1 IC1PSC LL_TIM_IC_GetPrescaler
- CCMR1 IC2PSC LL_TIM_IC_GetPrescaler
- CCMR2 IC3PSC LL_TIM_IC_GetPrescaler
- CCMR2 IC4PSC LL_TIM_IC_GetPrescaler

LL_TIM_IC_SetFilter

Function name

__STATIC_INLINE void LL_TIM_IC_SetFilter (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICFilter)

Function description

Set the input filter duration.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **ICFilter:** This parameter can be one of the following values:
  - LL_TIM_IC_FILTER_FDIV1
  - LL_TIM_IC_FILTER_FDIV1_N2
  - LL_TIM_IC_FILTER_FDIV1_N4
  - LL_TIM_IC_FILTER_FDIV1_N8
  - LL_TIM_IC_FILTER_FDIV2_N6
  - LL_TIM_IC_FILTER_FDIV2_N8
  - LL_TIM_IC_FILTER_FDIV4_N6
  - LL_TIM_IC_FILTER_FDIV4_N8
  - LL_TIM_IC_FILTER_FDIV8_N6
  - LL_TIM_IC_FILTER_FDIV8_N8
  - LL_TIM_IC_FILTER_FDIV16_N5
  - LL_TIM_IC_FILTER_FDIV16_N6
  - LL_TIM_IC_FILTER_FDIV16_N8
  - LL_TIM_IC_FILTER_FDIV32_N5
  - LL_TIM_IC_FILTER_FDIV32_N6
  - LL_TIM_IC_FILTER_FDIV32_N8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCMR1 IC1F LL_TIM_IC_SetFilter
- CCMR1 IC2F LL_TIM_IC_SetFilter
- CCMR2 IC3F LL_TIM_IC_SetFilter
- CCMR2 IC4F LL_TIM_IC_SetFilter

LL_TIM_IC_GetFilter

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetFilter (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the input filter duration.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_IC_FILTER_FDIV1
  - LL_TIM_IC_FILTER_FDIV1_N2
  - LL_TIM_IC_FILTER_FDIV1_N4
  - LL_TIM_IC_FILTER_FDIV1_N8
  - LL_TIM_IC_FILTER_FDIV2_N6
  - LL_TIM_IC_FILTER_FDIV2_N8
  - LL_TIM_IC_FILTER_FDIV4_N6
  - LL_TIM_IC_FILTER_FDIV4_N8
  - LL_TIM_IC_FILTER_FDIV8_N6
  - LL_TIM_IC_FILTER_FDIV8_N8
  - LL_TIM_IC_FILTER_FDIV16_N5
  - LL_TIM_IC_FILTER_FDIV16_N6
  - LL_TIM_IC_FILTER_FDIV16_N8
  - LL_TIM_IC_FILTER_FDIV32_N5
  - LL_TIM_IC_FILTER_FDIV32_N6
  - LL_TIM_IC_FILTER_FDIV32_N8

Reference Manual to LL API cross reference:

- CCMR1 IC1F LL_TIM_IC_GetFilter
- CCMR1 IC2F LL_TIM_IC_GetFilter
- CCMR2 IC3F LL_TIM_IC_GetFilter
- CCMR2 IC4F LL_TIM_IC_GetFilter

LL_TIM_IC_SetPolarity

Function name

__STATIC_INLINE void LL_TIM_IC_SetPolarity (TIM_TypeDef * TIMx, uint32_t Channel, uint32_t ICPolarity)

Function description

Set the input channel polarity.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **ICPolarity:** This parameter can be one of the following values:
  - LL_TIM_IC_POLARITY_RISING
  - LL_TIM_IC_POLARITY_FALLING
  - LL_TIM_IC_POLARITY_BOTHEDGE

Return values

- **None:**

Reference Manual to LL API cross reference:

- CCER CC1P LL_TIM_IC_SetPolarity
- CCER CC1NP LL_TIM_IC_SetPolarity
- CCER CC2P LL_TIM_IC_SetPolarity
- CCER CC2NP LL_TIM_IC_SetPolarity
- CCER CC3P LL_TIM_IC_SetPolarity
- CCER CC3NP LL_TIM_IC_SetPolarity
- CCER CC4P LL_TIM_IC_SetPolarity
- CCER CC4NP LL_TIM_IC_SetPolarity

`LL_TIM_IC_GetPolarity`

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetPolarity (TIM_TypeDef * TIMx, uint32_t Channel)

Function description

Get the current input channel polarity.

Parameters

- **TIMx:** Timer instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4

Return values

- **Returned:** value can be one of the following values:
  - LL_TIM_IC_POLARITY_RISING
  - LL_TIM_IC_POLARITY_FALLING
  - LL_TIM_IC_POLARITY_BOTHEDGE

Reference Manual to LL API cross reference:

- CCER CC1P LL_TIM_IC_GetPolarity
- CCER CC1NP LL_TIM_IC_GetPolarity
- CCER CC2P LL_TIM_IC_GetPolarity
- CCER CC2NP LL_TIM_IC_GetPolarity
- CCER CC3P LL_TIM_IC_GetPolarity
- CCER CC3NP LL_TIM_IC_GetPolarity
- CCER CC4P LL_TIM_IC_GetPolarity
- CCER CC4NP LL_TIM_IC_GetPolarity

`LL_TIM_IC_EnableXORCombination`

Function name

__STATIC_INLINE void LL_TIM_IC_EnableXORCombination (TIM_TypeDef * TIMx)

Function description

Connect the TIMx_CH1, CH2 and CH3 pins to the TI1 input (XOR combination).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_XOR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an XOR input.

Reference Manual to LL API cross reference:

- CR2 TI1S LL_TIM_IC_EnableXORCombination

`LL_TIM_IC_DisableXORCombination`

Function name

__STATIC_INLINE void LL_TIM_IC_DisableXORCombination (TIM_TypeDef * TIMx)

Function description

Disconnect the TIMx_CH1, CH2 and CH3 pins from the TI1 input.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_XOR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an XOR input.

Reference Manual to LL API cross reference:

- CR2 TI1S LL_TIM_IC_DisableXORCombination

`LL_TIM_IC_IsEnabledXORCombination`

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_IsEnabledXORCombination (TIM_TypeDef * TIMx)

Function description

Indicates whether the TIMx_CH1, CH2 and CH3 pins are connectected to the TI1 input.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_TIM_XOR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an XOR input.

Reference Manual to LL API cross reference:

- CR2 TI1S LL_TIM_IC_IsEnabledXORCombination

`LL_TIM_IC_GetCaptureCH1`

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH1 (TIM_TypeDef * TIMx)

Function description

Get captured value for input channel 1.

Parameters

- **TIMx:** Timer instance

Return values

- **CapturedValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC1_INSTANCE(TIMx) can be used to check whether or not input channel 1 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR1 CCR1 LL_TIM_IC_GetCaptureCH1

LL_TIM_IC_GetCaptureCH2

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH2 (TIM_TypeDef * TIMx)

Function description

Get captured value for input channel 2.

Parameters

- **TIMx:** Timer instance

Return values

- **CapturedValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC2_INSTANCE(TIMx) can be used to check whether or not input channel 2 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR2 CCR2 LL_TIM_IC_GetCaptureCH2

LL_TIM_IC_GetCaptureCH3

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH3 (TIM_TypeDef * TIMx)

Function description

Get captured value for input channel 3.

Parameters

- **TIMx:** Timer instance

Return values

- **CapturedValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC3_INSTANCE(TIMx) can be used to check whether or not input channel 3 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR3 CCR3 LL_TIM_IC_GetCaptureCH3

LL_TIM_IC_GetCaptureCH4

Function name

__STATIC_INLINE uint32_t LL_TIM_IC_GetCaptureCH4 (TIM_TypeDef * TIMx)

Function description

Get captured value for input channel 4.

Parameters

- **TIMx:** Timer instance

Return values

- **CapturedValue:** (between Min_Data=0 and Max_Data=65535)

Notes

- In 32-bit timer implementations returned captured value can be between 0x00000000 and 0xFFFFFFFF.
- Macro IS_TIM_32B_COUNTER_INSTANCE(TIMx) can be used to check whether or not a timer instance supports a 32 bits counter.
- Macro IS_TIM_CC4_INSTANCE(TIMx) can be used to check whether or not input channel 4 is supported by a timer instance.

Reference Manual to LL API cross reference:

- CCR4 CCR4 LL_TIM_IC_GetCaptureCH4

LL_TIM_EnableExternalClock

Function name

__STATIC_INLINE void LL_TIM_EnableExternalClock (TIM_TypeDef * TIMx)

Function description

Enable external clock mode 2.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- When external clock mode 2 is enabled the counter is clocked by any active edge on the ETRF signal.
- Macro IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode2.

Reference Manual to LL API cross reference:

- SMCR ECE LL_TIM_EnableExternalClock

`LL_TIM_DisableExternalClock`

Function name

__STATIC_INLINE void LL_TIM_DisableExternalClock (TIM_TypeDef * TIMx)

Function description

Disable external clock mode 2.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode2.

Reference Manual to LL API cross reference:

- SMCR ECE LL_TIM_DisableExternalClock

`LL_TIM_IsEnabledExternalClock`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledExternalClock (TIM_TypeDef * TIMx)

Function description

Indicate whether external clock mode 2 is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode2.

Reference Manual to LL API cross reference:

- SMCR ECE LL_TIM_IsEnabledExternalClock

`LL_TIM_SetClockSource`

Function name

__STATIC_INLINE void LL_TIM_SetClockSource (TIM_TypeDef * TIMx, uint32_t ClockSource)

Function description

Set the clock source of the counter clock.

Parameters

- **TIMx:** Timer instance
- **ClockSource:** This parameter can be one of the following values:
  - LL_TIM_CLOCKSOURCE_INTERNAL
  - LL_TIM_CLOCKSOURCE_EXT_MODE1
  - LL_TIM_CLOCKSOURCE_EXT_MODE2

Return values

- **None:**

Notes

- when selected clock source is external clock mode 1, the timer input the external clock is applied is selected by calling the LL_TIM_SetTriggerInput() function. This timer input must be configured by calling the LL_TIM_IC_Config() function.
- Macro IS_TIM_CLOCKSOURCE_ETRMODE1_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode1.
- Macro IS_TIM_CLOCKSOURCE_ETRMODE2_INSTANCE(TIMx) can be used to check whether or not a timer instance supports external clock mode2.

Reference Manual to LL API cross reference:

- SMCR SMS LL_TIM_SetClockSource
- SMCR ECE LL_TIM_SetClockSource

`LL_TIM_SetEncoderMode`

Function name

__STATIC_INLINE void LL_TIM_SetEncoderMode (TIM_TypeDef * TIMx, uint32_t EncoderMode)

Function description

Set the encoder interface mode.

Parameters

- **TIMx:** Timer instance
- **EncoderMode:** This parameter can be one of the following values:
  - LL_TIM_ENCODERMODE_X2_TI1
  - LL_TIM_ENCODERMODE_X2_TI2
  - LL_TIM_ENCODERMODE_X4_TI12

Return values

- **None:**

Notes

- Macro IS_TIM_ENCODER_INTERFACE_INSTANCE(TIMx) can be used to check whether or not a timer instance supports the encoder mode.

Reference Manual to LL API cross reference:

- SMCR SMS LL_TIM_SetEncoderMode

`LL_TIM_SetTriggerOutput`

Function name

__STATIC_INLINE void LL_TIM_SetTriggerOutput (TIM_TypeDef * TIMx, uint32_t TimerSynchronization)

Function description

Set the trigger output (TRGO) used for timer synchronization .

Parameters

- **TIMx:** Timer instance
- **TimerSynchronization:** This parameter can be one of the following values:
  - LL_TIM_TRGO_RESET
  - LL_TIM_TRGO_ENABLE
  - LL_TIM_TRGO_UPDATE
  - LL_TIM_TRGO_CC1IF
  - LL_TIM_TRGO_OC1REF
  - LL_TIM_TRGO_OC2REF
  - LL_TIM_TRGO_OC3REF
  - LL_TIM_TRGO_OC4REF

Return values

- **None:**

Notes

- Macro IS_TIM_MASTER_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a master timer.

Reference Manual to LL API cross reference:

- CR2 MMS LL_TIM_SetTriggerOutput

LL_TIM_SetTriggerOutput2

Function name

__STATIC_INLINE void LL_TIM_SetTriggerOutput2 (TIM_TypeDef * TIMx, uint32_t ADCSynchronization)

Function description

Set the trigger output 2 (TRGO2) used for ADC synchronization .

Parameters

- **TIMx:** Timer Instance
- **ADCSynchronization:** This parameter can be one of the following values:
  - LL_TIM_TRGO2_RESET
  - LL_TIM_TRGO2_ENABLE
  - LL_TIM_TRGO2_UPDATE
  - LL_TIM_TRGO2_CC1F
  - LL_TIM_TRGO2_OC1
  - LL_TIM_TRGO2_OC2
  - LL_TIM_TRGO2_OC3
  - LL_TIM_TRGO2_OC4
  - LL_TIM_TRGO2_OC5
  - LL_TIM_TRGO2_OC6
  - LL_TIM_TRGO2_OC4_RISINGFALLING
  - LL_TIM_TRGO2_OC6_RISINGFALLING
  - LL_TIM_TRGO2_OC4_RISING_OC6_RISING
  - LL_TIM_TRGO2_OC4_RISING_OC6_FALLING
  - LL_TIM_TRGO2_OC5_RISING_OC6_RISING
  - LL_TIM_TRGO2_OC5_RISING_OC6_FALLING

Return values

- **None:**

Notes

- Macro IS_TIM_TRGO2_INSTANCE(TIMx) can be used to check whether or not a timer instance can be used for ADC synchronization.

Reference Manual to LL API cross reference:

- CR2 MMS2 LL_TIM_SetTriggerOutput2

LL_TIM_SetSlaveMode

Function name

__STATIC_INLINE void LL_TIM_SetSlaveMode (TIM_TypeDef * TIMx, uint32_t SlaveMode)

Function description

Set the synchronization mode of a slave timer.

Parameters

- **TIMx:** Timer instance
- **SlaveMode:** This parameter can be one of the following values:
  - LL_TIM_SLAVEMODE_DISABLED
  - LL_TIM_SLAVEMODE_RESET
  - LL_TIM_SLAVEMODE_GATED
  - LL_TIM_SLAVEMODE_TRIGGER
  - LL_TIM_SLAVEMODE_COMBINED_RESETTRIGGER

Return values

- **None:**

Notes

- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.

Reference Manual to LL API cross reference:

- SMCR SMS LL_TIM_SetSlaveMode

LL_TIM_SetTriggerInput

Function name

__STATIC_INLINE void LL_TIM_SetTriggerInput (TIM_TypeDef * TIMx, uint32_t TriggerInput)

Function description

Set the selects the trigger input to be used to synchronize the counter.

Parameters

- **TIMx:** Timer instance
- **TriggerInput:** This parameter can be one of the following values:
  - LL_TIM_TS_ITR0
  - LL_TIM_TS_ITR1
  - LL_TIM_TS_ITR2
  - LL_TIM_TS_ITR3
  - LL_TIM_TS_TI1F_ED
  - LL_TIM_TS_TI1FP1
  - LL_TIM_TS_TI2FP2
  - LL_TIM_TS_ETRF

Return values

- **None:**

Notes

- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.

Reference Manual to LL API cross reference:

- SMCR TS LL_TIM_SetTriggerInput

`LL_TIM_EnableMasterSlaveMode`

Function name

__STATIC_INLINE void LL_TIM_EnableMasterSlaveMode (TIM_TypeDef * TIMx)

Function description

Enable the Master/Slave mode.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.

Reference Manual to LL API cross reference:

- SMCR MSM LL_TIM_EnableMasterSlaveMode

`LL_TIM_DisableMasterSlaveMode`

Function name

__STATIC_INLINE void LL_TIM_DisableMasterSlaveMode (TIM_TypeDef * TIMx)

Function description

Disable the Master/Slave mode.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.

Reference Manual to LL API cross reference:

- SMCR MSM LL_TIM_DisableMasterSlaveMode

`LL_TIM_IsEnabledMasterSlaveMode`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledMasterSlaveMode (TIM_TypeDef * TIMx)

Function description

Indicates whether the Master/Slave mode is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_TIM_SLAVE_INSTANCE(TIMx) can be used to check whether or not a timer instance can operate as a slave timer.

Reference Manual to LL API cross reference:

- SMCR MSM LL_TIM_IsEnabledMasterSlaveMode

LL_TIM_ConfigETR

Function name

__STATIC_INLINE void LL_TIM_ConfigETR (TIM_TypeDef * TIMx, uint32_t ETRPolarity, uint32_t ETRPrescaler, uint32_t ETRFilter)

Function description

Configure the external trigger (ETR) input.

Parameters

- **TIMx:** Timer instance
- **ETRPolarity:** This parameter can be one of the following values:
  - LL_TIM_ETR_POLARITY_NONINVERTED
  - LL_TIM_ETR_POLARITY_INVERTED
- **ETRPrescaler:** This parameter can be one of the following values:
  - LL_TIM_ETR_PRESCALER_DIV1
  - LL_TIM_ETR_PRESCALER_DIV2
  - LL_TIM_ETR_PRESCALER_DIV4
  - LL_TIM_ETR_PRESCALER_DIV8
- **ETRFilter:** This parameter can be one of the following values:
  - LL_TIM_ETR_FILTER_FDIV1
  - LL_TIM_ETR_FILTER_FDIV1_N2
  - LL_TIM_ETR_FILTER_FDIV1_N4
  - LL_TIM_ETR_FILTER_FDIV1_N8
  - LL_TIM_ETR_FILTER_FDIV2_N6
  - LL_TIM_ETR_FILTER_FDIV2_N8
  - LL_TIM_ETR_FILTER_FDIV4_N6
  - LL_TIM_ETR_FILTER_FDIV4_N8
  - LL_TIM_ETR_FILTER_FDIV8_N6
  - LL_TIM_ETR_FILTER_FDIV8_N8
  - LL_TIM_ETR_FILTER_FDIV16_N5
  - LL_TIM_ETR_FILTER_FDIV16_N6
  - LL_TIM_ETR_FILTER_FDIV16_N8
  - LL_TIM_ETR_FILTER_FDIV32_N5
  - LL_TIM_ETR_FILTER_FDIV32_N6
  - LL_TIM_ETR_FILTER_FDIV32_N8

Return values

- **None:**

Notes

- Macro IS_TIM_ETR_INSTANCE(TIMx) can be used to check whether or not a timer instance provides an external trigger input.

Reference Manual to LL API cross reference:

- SMCR ETP LL_TIM_ConfigETR
- SMCR ETPS LL_TIM_ConfigETR
- SMCR ETF LL_TIM_ConfigETR

`LL_TIM_SetETRSource`

Function name

__STATIC_INLINE void LL_TIM_SetETRSource (TIM_TypeDef * TIMx, uint32_t ETRSource)

Function description

Select the external trigger (ETR) input source.

Parameters

- **TIMx:** Timer instance
- **ETRSource:** This parameter can be one of the following values:
  - LL_TIM_ETRSOURCE_LEGACY
  - LL_TIM_ETRSOURCE_COMP1
  - LL_TIM_ETRSOURCE_COMP2

Return values

- **None:**

Notes

- Macro IS_TIM_ETRSEL_INSTANCE(TIMx) can be used to check whether or not a timer instance supports ETR source selection.

Reference Manual to LL API cross reference:

- OR2 ETRSEL LL_TIM_SetETRSource

`LL_TIM_EnableBRK`

Function name

__STATIC_INLINE void LL_TIM_EnableBRK (TIM_TypeDef * TIMx)

Function description

Enable the break function.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR BKE LL_TIM_EnableBRK

`LL_TIM_DisableBRK`

Function name

__STATIC_INLINE void LL_TIM_DisableBRK (TIM_TypeDef * TIMx)

Function description

Disable the break function.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR BKE LL_TIM_DisableBRK

`LL_TIM_ConfigBRK`

Function name

__STATIC_INLINE void LL_TIM_ConfigBRK (TIM_TypeDef * TIMx, uint32_t BreakPolarity, uint32_t BreakFilter)

Function description

Configure the break input.

Parameters

- **TIMx:** Timer instance
- **BreakPolarity:** This parameter can be one of the following values:
  - LL_TIM_BREAK_POLARITY_LOW
  - LL_TIM_BREAK_POLARITY_HIGH
- **BreakFilter:** This parameter can be one of the following values:
  - LL_TIM_BREAK_FILTER_FDIV1
  - LL_TIM_BREAK_FILTER_FDIV1_N2
  - LL_TIM_BREAK_FILTER_FDIV1_N4
  - LL_TIM_BREAK_FILTER_FDIV1_N8
  - LL_TIM_BREAK_FILTER_FDIV2_N6
  - LL_TIM_BREAK_FILTER_FDIV2_N8
  - LL_TIM_BREAK_FILTER_FDIV4_N6
  - LL_TIM_BREAK_FILTER_FDIV4_N8
  - LL_TIM_BREAK_FILTER_FDIV8_N6
  - LL_TIM_BREAK_FILTER_FDIV8_N8
  - LL_TIM_BREAK_FILTER_FDIV16_N5
  - LL_TIM_BREAK_FILTER_FDIV16_N6
  - LL_TIM_BREAK_FILTER_FDIV16_N8
  - LL_TIM_BREAK_FILTER_FDIV32_N5
  - LL_TIM_BREAK_FILTER_FDIV32_N6
  - LL_TIM_BREAK_FILTER_FDIV32_N8

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR BKP LL_TIM_ConfigBRK
- BDTR BKF LL_TIM_ConfigBRK

LL_TIM_EnableBRK2

Function name

__STATIC_INLINE void LL_TIM_EnableBRK2 (TIM_TypeDef * TIMx)

Function description

Enable the break 2 function.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.

Reference Manual to LL API cross reference:

- BDTR BK2E LL_TIM_EnableBRK2

`LL_TIM_DisableBRK2`

Function name

__STATIC_INLINE void LL_TIM_DisableBRK2 (TIM_TypeDef * TIMx)

Function description

Disable the break 2 function.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.

Reference Manual to LL API cross reference:

- BDTR BK2E LL_TIM_DisableBRK2

`LL_TIM_ConfigBRK2`

Function name

__STATIC_INLINE void LL_TIM_ConfigBRK2 (TIM_TypeDef * TIMx, uint32_t Break2Polarity, uint32_t Break2Filter)

Function description

Configure the break 2 input.

Parameters

- **TIMx:** Timer instance
- **Break2Polarity:** This parameter can be one of the following values:
  - LL_TIM_BREAK2_POLARITY_LOW
  - LL_TIM_BREAK2_POLARITY_HIGH
- **Break2Filter:** This parameter can be one of the following values:
  - LL_TIM_BREAK2_FILTER_FDIV1
  - LL_TIM_BREAK2_FILTER_FDIV1_N2
  - LL_TIM_BREAK2_FILTER_FDIV1_N4
  - LL_TIM_BREAK2_FILTER_FDIV1_N8
  - LL_TIM_BREAK2_FILTER_FDIV2_N6
  - LL_TIM_BREAK2_FILTER_FDIV2_N8
  - LL_TIM_BREAK2_FILTER_FDIV4_N6
  - LL_TIM_BREAK2_FILTER_FDIV4_N8
  - LL_TIM_BREAK2_FILTER_FDIV8_N6
  - LL_TIM_BREAK2_FILTER_FDIV8_N8
  - LL_TIM_BREAK2_FILTER_FDIV16_N5
  - LL_TIM_BREAK2_FILTER_FDIV16_N6
  - LL_TIM_BREAK2_FILTER_FDIV16_N8
  - LL_TIM_BREAK2_FILTER_FDIV32_N5
  - LL_TIM_BREAK2_FILTER_FDIV32_N6
  - LL_TIM_BREAK2_FILTER_FDIV32_N8

Return values

- **None:**

Notes

- Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.

Reference Manual to LL API cross reference:

- BDTR BK2P LL_TIM_ConfigBRK2
- BDTR BK2F LL_TIM_ConfigBRK2

LL_TIM_SetOffStates

Function name

__STATIC_INLINE void LL_TIM_SetOffStates (TIM_TypeDef * TIMx, uint32_t OffStateIdle, uint32_t OffStateRun)

Function description

Select the outputs off state (enabled v.s.

Parameters

- **TIMx:** Timer instance
- **OffStateIdle:** This parameter can be one of the following values:
  - LL_TIM_OSSI_DISABLE
  - LL_TIM_OSSI_ENABLE
- **OffStateRun:** This parameter can be one of the following values:
  - LL_TIM_OSSR_DISABLE
  - LL_TIM_OSSR_ENABLE

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR OSSI LL_TIM_SetOffStates
- BDTR OSSR LL_TIM_SetOffStates

`LL_TIM_EnableAutomaticOutput`

Function name

__STATIC_INLINE void LL_TIM_EnableAutomaticOutput (TIM_TypeDef * TIMx)

Function description

Enable automatic output (MOE can be set by software or automatically when a break input is active).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR AOE LL_TIM_EnableAutomaticOutput

`LL_TIM_DisableAutomaticOutput`

Function name

__STATIC_INLINE void LL_TIM_DisableAutomaticOutput (TIM_TypeDef * TIMx)

Function description

Disable automatic output (MOE can be set only by software).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR AOE LL_TIM_DisableAutomaticOutput

`LL_TIM_IsEnabledAutomaticOutput`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledAutomaticOutput (TIM_TypeDef * TIMx)

Function description

Indicate whether automatic output is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR AOE LL_TIM_IsEnabledAutomaticOutput

`LL_TIM_EnableAllOutputs`

Function name

__STATIC_INLINE void LL_TIM_EnableAllOutputs (TIM_TypeDef * TIMx)

Function description

Enable the outputs (set the MOE bit in TIMx_BDTR register).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- The MOE bit in TIMx_BDTR register allows to enable /disable the outputs by software and is reset in case of break or break2 event
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR MOE LL_TIM_EnableAllOutputs

`LL_TIM_DisableAllOutputs`

Function name

__STATIC_INLINE void LL_TIM_DisableAllOutputs (TIM_TypeDef * TIMx)

Function description

Disable the outputs (reset the MOE bit in TIMx_BDTR register).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Notes

- The MOE bit in TIMx_BDTR register allows to enable /disable the outputs by software and is reset in case of break or break2 event.
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR MOE LL_TIM_DisableAllOutputs

LL_TIM_IsEnabledAllOutputs

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledAllOutputs (TIM_TypeDef * TIMx)

Function description

Indicates whether outputs are enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.

Reference Manual to LL API cross reference:

- BDTR MOE LL_TIM_IsEnabledAllOutputs

LL_TIM_EnableBreakInputSource

Function name

__STATIC_INLINE void LL_TIM_EnableBreakInputSource (TIM_TypeDef * TIMx, uint32_t BreakInput, uint32_t Source)

Function description

Enable the signals connected to the designated timer break input.

Parameters

- **TIMx:** Timer instance
- **BreakInput:** This parameter can be one of the following values:
  - LL_TIM_BREAK_INPUT_BKIN
  - LL_TIM_BREAK_INPUT_BKIN2
- **Source:** This parameter can be one of the following values:
  - LL_TIM_BKIN_SOURCE_BKIN
  - LL_TIM_BKIN_SOURCE_BKCOMP1
  - LL_TIM_BKIN_SOURCE_BKCOMP2
  - LL_TIM_BKIN_SOURCE_DF1BK

Return values

- **None:**

Notes

- Macro IS_TIM_BREAKSOURCE_INSTANCE(TIMx) can be used to check whether or not a timer instance allows for break input selection.

Reference Manual to LL API cross reference:

- OR2 BKINE LL_TIM_EnableBreakInputSource
- OR2 BKCMP1E LL_TIM_EnableBreakInputSource
- OR2 BKCMP2E LL_TIM_EnableBreakInputSource
- OR2 BKDF1BK0E LL_TIM_EnableBreakInputSource
- OR3 BK2INE LL_TIM_EnableBreakInputSource
- OR3 BK2CMP1E LL_TIM_EnableBreakInputSource
- OR3 BK2CMP2E LL_TIM_EnableBreakInputSource
- OR3 BK2DF1BK1E LL_TIM_EnableBreakInputSource

LL_TIM_DisableBreakInputSource

Function name

__STATIC_INLINE void LL_TIM_DisableBreakInputSource (TIM_TypeDef * TIMx, uint32_t BreakInput, uint32_t Source)

Function description

Disable the signals connected to the designated timer break input.

Parameters

- **TIMx:** Timer instance
- **BreakInput:** This parameter can be one of the following values:
  - LL_TIM_BREAK_INPUT_BKIN
  - LL_TIM_BREAK_INPUT_BKIN2
- **Source:** This parameter can be one of the following values:
  - LL_TIM_BKIN_SOURCE_BKIN
  - LL_TIM_BKIN_SOURCE_BKCOMP1
  - LL_TIM_BKIN_SOURCE_BKCOMP2
  - LL_TIM_BKIN_SOURCE_DF1BK

Return values

- **None:**

Notes

- Macro IS_TIM_BREAKSOURCE_INSTANCE(TIMx) can be used to check whether or not a timer instance allows for break input selection.

Reference Manual to LL API cross reference:

- OR2 BKINE LL_TIM_DisableBreakInputSource
- OR2 BKCMP1E LL_TIM_DisableBreakInputSource
- OR2 BKCMP2E LL_TIM_DisableBreakInputSource
- OR2 BKDF1BK0E LL_TIM_DisableBreakInputSource
- OR3 BK2INE LL_TIM_DisableBreakInputSource
- OR3 BK2CMP1E LL_TIM_DisableBreakInputSource
- OR3 BK2CMP2E LL_TIM_DisableBreakInputSource
- OR3 BK2DF1BK1E LL_TIM_DisableBreakInputSource

LL_TIM_SetBreakInputSourcePolarity

Function name

__STATIC_INLINE void LL_TIM_SetBreakInputSourcePolarity (TIM_TypeDef * TIMx, uint32_t BreakInput, uint32_t Source, uint32_t Polarity)

Function description

Set the polarity of the break signal for the timer break input.

Parameters

- **TIMx:** Timer instance
- **BreakInput:** This parameter can be one of the following values:
  - LL_TIM_BREAK_INPUT_BKIN
  - LL_TIM_BREAK_INPUT_BKIN2
- **Source:** This parameter can be one of the following values:
  - LL_TIM_BKIN_SOURCE_BKIN
  - LL_TIM_BKIN_SOURCE_BKCOMP1
  - LL_TIM_BKIN_SOURCE_BKCOMP2
- **Polarity:** This parameter can be one of the following values:
  - LL_TIM_BKIN_POLARITY_LOW
  - LL_TIM_BKIN_POLARITY_HIGH

Return values

- **None:**

Notes

- Macro IS_TIM_BREAKSOURCE_INSTANCE(TIMx) can be used to check whether or not a timer instance allows for break input selection.

Reference Manual to LL API cross reference:

- OR2 BKINP LL_TIM_SetBreakInputSourcePolarity
- OR2 BKCMP1P LL_TIM_SetBreakInputSourcePolarity
- OR2 BKCMP2P LL_TIM_SetBreakInputSourcePolarity
- OR3 BK2INP LL_TIM_SetBreakInputSourcePolarity
- OR3 BK2CMP1P LL_TIM_SetBreakInputSourcePolarity
- OR3 BK2CMP2P LL_TIM_SetBreakInputSourcePolarity

LL_TIM_ConfigDMABurst

Function name

__STATIC_INLINE void LL_TIM_ConfigDMABurst (TIM_TypeDef * TIMx, uint32_t DMABurstBaseAddress, uint32_t DMABurstLength)

Function description

Configures the timer DMA burst feature.

Parameters

- **TIMx:** Timer instance
- **DMABurstBaseAddress:** This parameter can be one of the following values:
  - LL_TIM_DMABURST_BASEADDR_CR1
  - LL_TIM_DMABURST_BASEADDR_CR2
  - LL_TIM_DMABURST_BASEADDR_SMCR
  - LL_TIM_DMABURST_BASEADDR_DIER
  - LL_TIM_DMABURST_BASEADDR_SR
  - LL_TIM_DMABURST_BASEADDR_EGR
  - LL_TIM_DMABURST_BASEADDR_CCMR1
  - LL_TIM_DMABURST_BASEADDR_CCMR2
  - LL_TIM_DMABURST_BASEADDR_CCER
  - LL_TIM_DMABURST_BASEADDR_CNT
  - LL_TIM_DMABURST_BASEADDR_PSC
  - LL_TIM_DMABURST_BASEADDR_ARR
  - LL_TIM_DMABURST_BASEADDR_RCR
  - LL_TIM_DMABURST_BASEADDR_CCR1
  - LL_TIM_DMABURST_BASEADDR_CCR2
  - LL_TIM_DMABURST_BASEADDR_CCR3
  - LL_TIM_DMABURST_BASEADDR_CCR4
  - LL_TIM_DMABURST_BASEADDR_BDTR
  - LL_TIM_DMABURST_BASEADDR_OR1
  - LL_TIM_DMABURST_BASEADDR_CCMR3
  - LL_TIM_DMABURST_BASEADDR_CCR5
  - LL_TIM_DMABURST_BASEADDR_CCR6
  - LL_TIM_DMABURST_BASEADDR_OR2
  - LL_TIM_DMABURST_BASEADDR_OR3
- **DMABurstLength:** This parameter can be one of the following values:
  - LL_TIM_DMABURST_LENGTH_1TRANSFER
  - LL_TIM_DMABURST_LENGTH_2TRANSFERS
  - LL_TIM_DMABURST_LENGTH_3TRANSFERS
  - LL_TIM_DMABURST_LENGTH_4TRANSFERS
  - LL_TIM_DMABURST_LENGTH_5TRANSFERS
  - LL_TIM_DMABURST_LENGTH_6TRANSFERS
  - LL_TIM_DMABURST_LENGTH_7TRANSFERS
  - LL_TIM_DMABURST_LENGTH_8TRANSFERS
  - LL_TIM_DMABURST_LENGTH_9TRANSFERS
  - LL_TIM_DMABURST_LENGTH_10TRANSFERS
  - LL_TIM_DMABURST_LENGTH_11TRANSFERS
  - LL_TIM_DMABURST_LENGTH_12TRANSFERS
  - LL_TIM_DMABURST_LENGTH_13TRANSFERS
  - LL_TIM_DMABURST_LENGTH_14TRANSFERS
  - LL_TIM_DMABURST_LENGTH_15TRANSFERS
  - LL_TIM_DMABURST_LENGTH_16TRANSFERS
  - LL_TIM_DMABURST_LENGTH_17TRANSFERS
  - LL_TIM_DMABURST_LENGTH_18TRANSFERS

Return values

- **None:**

Notes

- Macro IS_TIM_DMABURST_INSTANCE(TIMx) can be used to check whether or not a timer instance supports the DMA burst mode.

Reference Manual to LL API cross reference:

- DCR DBL LL_TIM_ConfigDMABurst
- DCR DBA LL_TIM_ConfigDMABurst

LL_TIM_SetRemap

Function name

__STATIC_INLINE void LL_TIM_SetRemap (TIM_TypeDef * TIMx, uint32_t Remap)

Function description

Remap TIM inputs (input channel, internal/external triggers).

Parameters

- **TIMx:** Timer instance
- **Remap:** Remap param depends on the TIMx. Description available only in CHM version of the User Manual (not in .pdf). Otherwise see Reference Manual description of OR registers.

Return values

- **None:**

Notes

- Macro IS_TIM_REMAP_INSTANCE(TIMx) can be used to check whether or not a some timer inputs can be remapped.

LL_TIM_SetOCRefClearInputSource

Function name

__STATIC_INLINE void LL_TIM_SetOCRefClearInputSource (TIM_TypeDef * TIMx, uint32_t OCRefClearInputSource)

Function description

Set the OCREF clear input source.

Parameters

- **TIMx:** Timer instance
- **OCRefClearInputSource:** This parameter can be one of the following values:
  - LL_TIM_OCREF_CLR_INT_NC
  - LL_TIM_OCREF_CLR_INT_ETR

Return values

- **None:**

Notes

- The OCxREF signal of a given channel can be cleared when a high level is applied on the OCREF_CLR_INPUT
- This function can only be used in Output compare and PWM modes.

Reference Manual to LL API cross reference:

- SMCR OCCS LL_TIM_SetOCRefClearInputSource

`LL_TIM_ClearFlag_UPDATE`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_UPDATE (TIM_TypeDef * TIMx)

Function description

Clear the update interrupt flag (UIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR UIF LL_TIM_ClearFlag_UPDATE

`LL_TIM_IsActiveFlag_UPDATE`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_UPDATE (TIM_TypeDef * TIMx)

Function description

Indicate whether update interrupt flag (UIF) is set (update interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR UIF LL_TIM_IsActiveFlag_UPDATE

`LL_TIM_ClearFlag_CC1`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC1 (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 1 interrupt flag (CC1F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC1IF LL_TIM_ClearFlag_CC1

`LL_TIM_IsActiveFlag_CC1`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC1 (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 1 interrupt flag (CC1F) is set (Capture/Compare 1 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC1IF LL_TIM_IsActiveFlag_CC1

`LL_TIM_ClearFlag_CC2`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC2 (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 2 interrupt flag (CC2F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC2IF LL_TIM_ClearFlag_CC2

`LL_TIM_IsActiveFlag_CC2`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC2 (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 2 interrupt flag (CC2F) is set (Capture/Compare 2 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC2IF LL_TIM_IsActiveFlag_CC2

`LL_TIM_ClearFlag_CC3`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC3 (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 3 interrupt flag (CC3F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC3IF LL_TIM_ClearFlag_CC3

`LL_TIM_IsActiveFlag_CC3`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC3 (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 3 interrupt flag (CC3F) is set (Capture/Compare 3 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC3IF LL_TIM_IsActiveFlag_CC3

`LL_TIM_ClearFlag_CC4`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC4 (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 4 interrupt flag (CC4F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC4IF LL_TIM_ClearFlag_CC4

`LL_TIM_IsActiveFlag_CC4`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC4 (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 4 interrupt flag (CC4F) is set (Capture/Compare 4 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC4IF LL_TIM_IsActiveFlag_CC4

`LL_TIM_ClearFlag_CC5`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC5 (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 5 interrupt flag (CC5F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC5IF LL_TIM_ClearFlag_CC5

`LL_TIM_IsActiveFlag_CC5`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC5 (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 5 interrupt flag (CC5F) is set (Capture/Compare 5 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC5IF LL_TIM_IsActiveFlag_CC5

`LL_TIM_ClearFlag_CC6`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC6 (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 6 interrupt flag (CC6F).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC6IF LL_TIM_ClearFlag_CC6

`LL_TIM_IsActiveFlag_CC6`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC6 (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 6 interrupt flag (CC6F) is set (Capture/Compare 6 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC6IF LL_TIM_IsActiveFlag_CC6

LL_TIM_ClearFlag_COM

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_COM (TIM_TypeDef * TIMx)

Function description

Clear the commutation interrupt flag (COMIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR COMIF LL_TIM_ClearFlag_COM

LL_TIM_IsActiveFlag_COM

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_COM (TIM_TypeDef * TIMx)

Function description

Indicate whether commutation interrupt flag (COMIF) is set (commutation interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR COMIF LL_TIM_IsActiveFlag_COM

LL_TIM_ClearFlag_TRIG

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_TRIG (TIM_TypeDef * TIMx)

Function description

Clear the trigger interrupt flag (TIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR TIF LL_TIM_ClearFlag_TRIG

`LL_TIM_IsActiveFlag_TRIG`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_TRIG (TIM_TypeDef * TIMx)

Function description

Indicate whether trigger interrupt flag (TIF) is set (trigger interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR TIF LL_TIM_IsActiveFlag_TRIG

`LL_TIM_ClearFlag_BRK`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_BRK (TIM_TypeDef * TIMx)

Function description

Clear the break interrupt flag (BIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR BIF LL_TIM_ClearFlag_BRK

`LL_TIM_IsActiveFlag_BRK`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_BRK (TIM_TypeDef * TIMx)

Function description

Indicate whether break interrupt flag (BIF) is set (break interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR BIF LL_TIM_IsActiveFlag_BRK

LL_TIM_ClearFlag_BRK2

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_BRK2 (TIM_TypeDef * TIMx)

Function description

Clear the break 2 interrupt flag (B2IF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR B2IF LL_TIM_ClearFlag_BRK2

LL_TIM_IsActiveFlag_BRK2

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_BRK2 (TIM_TypeDef * TIMx)

Function description

Indicate whether break 2 interrupt flag (B2IF) is set (break 2 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR B2IF LL_TIM_IsActiveFlag_BRK2

LL_TIM_ClearFlag_CC1OVR

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC1OVR (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 1 over-capture interrupt flag (CC1OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC1OF LL_TIM_ClearFlag_CC1OVR

LL_TIM_IsActiveFlag_CC1OVR

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC1OVR (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 1 over-capture interrupt flag (CC1OF) is set (Capture/Compare 1 interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC1OF LL_TIM_IsActiveFlag_CC1OVR

LL_TIM_ClearFlag_CC2OVR

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC2OVR (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 2 over-capture interrupt flag (CC2OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC2OF LL_TIM_ClearFlag_CC2OVR

LL_TIM_IsActiveFlag_CC2OVR

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC2OVR (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 2 over-capture interrupt flag (CC2OF) is set (Capture/Compare 2 over-capture interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC2OF LL_TIM_IsActiveFlag_CC2OVR

LL_TIM_ClearFlag_CC3OVR

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC3OVR (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 3 over-capture interrupt flag (CC3OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC3OF LL_TIM_ClearFlag_CC3OVR

`LL_TIM_IsActiveFlag_CC3OVR`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC3OVR (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 3 over-capture interrupt flag (CC3OF) is set (Capture/Compare 3 over-capture interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC3OF LL_TIM_IsActiveFlag_CC3OVR

`LL_TIM_ClearFlag_CC4OVR`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_CC4OVR (TIM_TypeDef * TIMx)

Function description

Clear the Capture/Compare 4 over-capture interrupt flag (CC4OF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR CC4OF LL_TIM_ClearFlag_CC4OVR

`LL_TIM_IsActiveFlag_CC4OVR`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_CC4OVR (TIM_TypeDef * TIMx)

Function description

Indicate whether Capture/Compare 4 over-capture interrupt flag (CC4OF) is set (Capture/Compare 4 over-capture interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR CC4OF LL_TIM_IsActiveFlag_CC4OVR

`LL_TIM_ClearFlag_SYSBRK`

Function name

__STATIC_INLINE void LL_TIM_ClearFlag_SYSBRK (TIM_TypeDef * TIMx)

Function description

Clear the system break interrupt flag (SBIF).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR SBIF LL_TIM_ClearFlag_SYSBRK

`LL_TIM_IsActiveFlag_SYSBRK`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsActiveFlag_SYSBRK (TIM_TypeDef * TIMx)

Function description

Indicate whether system break interrupt flag (SBIF) is set (system break interrupt is pending).

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- SR SBIF LL_TIM_IsActiveFlag_SYSBRK

`LL_TIM_EnableIT_UPDATE`

Function name

__STATIC_INLINE void LL_TIM_EnableIT_UPDATE (TIM_TypeDef * TIMx)

Function description

Enable update interrupt (UIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER UIE LL_TIM_EnableIT_UPDATE

LL_TIM_DisableIT_UPDATE

Function name

__STATIC_INLINE void LL_TIM_DisableIT_UPDATE (TIM_TypeDef * TIMx)

Function description

Disable update interrupt (UIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER UIE LL_TIM_DisableIT_UPDATE

LL_TIM_IsEnabledIT_UPDATE

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_UPDATE (TIM_TypeDef * TIMx)

Function description

Indicates whether the update interrupt (UIE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER UIE LL_TIM_IsEnabledIT_UPDATE

LL_TIM_EnableIT_CC1

Function name

__STATIC_INLINE void LL_TIM_EnableIT_CC1 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 1 interrupt (CC1IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC1IE LL_TIM_EnableIT_CC1

LL_TIM_DisableIT_CC1

Function name

__STATIC_INLINE void LL_TIM_DisableIT_CC1 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 1 interrupt (CC1IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC1IE LL_TIM_DisableIT_CC1

`LL_TIM_IsEnabledIT_CC1`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC1 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 1 interrupt (CC1IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC1IE LL_TIM_IsEnabledIT_CC1

`LL_TIM_EnableIT_CC2`

Function name

__STATIC_INLINE void LL_TIM_EnableIT_CC2 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 2 interrupt (CC2IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC2IE LL_TIM_EnableIT_CC2

`LL_TIM_DisableIT_CC2`

Function name

__STATIC_INLINE void LL_TIM_DisableIT_CC2 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 2 interrupt (CC2IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC2IE LL_TIM_DisableIT_CC2

`LL_TIM_IsEnabledIT_CC2`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC2 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 2 interrupt (CC2IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC2IE LL_TIM_IsEnabledIT_CC2

`LL_TIM_EnableIT_CC3`

Function name

__STATIC_INLINE void LL_TIM_EnableIT_CC3 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 3 interrupt (CC3IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3IE LL_TIM_EnableIT_CC3

`LL_TIM_DisableIT_CC3`

Function name

__STATIC_INLINE void LL_TIM_DisableIT_CC3 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 3 interrupt (CC3IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3IE LL_TIM_DisableIT_CC3

LL_TIM_IsEnabledIT_CC3

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC3 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 3 interrupt (CC3IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC3IE LL_TIM_IsEnabledIT_CC3

LL_TIM_EnableIT_CC4

Function name

__STATIC_INLINE void LL_TIM_EnableIT_CC4 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 4 interrupt (CC4IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC4IE LL_TIM_EnableIT_CC4

LL_TIM_DisableIT_CC4

Function name

__STATIC_INLINE void LL_TIM_DisableIT_CC4 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 4 interrupt (CC4IE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC4IE LL_TIM_DisableIT_CC4

LL_TIM_IsEnabledIT_CC4

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_CC4 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 4 interrupt (CC4IE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC4IE LL_TIM_IsEnabledIT_CC4

`LL_TIM_EnableIT_COM`

Function name

__STATIC_INLINE void LL_TIM_EnableIT_COM (TIM_TypeDef * TIMx)

Function description

Enable commutation interrupt (COMIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER COMIE LL_TIM_EnableIT_COM

`LL_TIM_DisableIT_COM`

Function name

__STATIC_INLINE void LL_TIM_DisableIT_COM (TIM_TypeDef * TIMx)

Function description

Disable commutation interrupt (COMIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER COMIE LL_TIM_DisableIT_COM

`LL_TIM_IsEnabledIT_COM`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_COM (TIM_TypeDef * TIMx)

Function description

Indicates whether the commutation interrupt (COMIE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER COMIE LL_TIM_IsEnabledIT_COM

`LL_TIM_EnableIT_TRIG`

Function name

__STATIC_INLINE void LL_TIM_EnableIT_TRIG (TIM_TypeDef * TIMx)

Function description

Enable trigger interrupt (TIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER TIE LL_TIM_EnableIT_TRIG

`LL_TIM_DisableIT_TRIG`

Function name

__STATIC_INLINE void LL_TIM_DisableIT_TRIG (TIM_TypeDef * TIMx)

Function description

Disable trigger interrupt (TIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER TIE LL_TIM_DisableIT_TRIG

`LL_TIM_IsEnabledIT_TRIG`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_TRIG (TIM_TypeDef * TIMx)

Function description

Indicates whether the trigger interrupt (TIE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER TIE LL_TIM_IsEnabledIT_TRIG

LL_TIM_EnableIT_BRK

Function name

__STATIC_INLINE void LL_TIM_EnableIT_BRK (TIM_TypeDef * TIMx)

Function description

Enable break interrupt (BIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER BIE LL_TIM_EnableIT_BRK

LL_TIM_DisableIT_BRK

Function name

__STATIC_INLINE void LL_TIM_DisableIT_BRK (TIM_TypeDef * TIMx)

Function description

Disable break interrupt (BIE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER BIE LL_TIM_DisableIT_BRK

LL_TIM_IsEnabledIT_BRK

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledIT_BRK (TIM_TypeDef * TIMx)

Function description

Indicates whether the break interrupt (BIE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER BIE LL_TIM_IsEnabledIT_BRK

LL_TIM_EnableDMAReq_UPDATE

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_UPDATE (TIM_TypeDef * TIMx)

Function description

Enable update DMA request (UDE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER UDE LL_TIM_EnableDMAReq_UPDATE

`LL_TIM_DisableDMAReq_UPDATE`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_UPDATE (TIM_TypeDef * TIMx)

Function description

Disable update DMA request (UDE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER UDE LL_TIM_DisableDMAReq_UPDATE

`LL_TIM_IsEnabledDMAReq_UPDATE`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_UPDATE (TIM_TypeDef * TIMx)

Function description

Indicates whether the update DMA request (UDE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER UDE LL_TIM_IsEnabledDMAReq_UPDATE

`LL_TIM_EnableDMAReq_CC1`

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_CC1 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 1 DMA request (CC1DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC1DE LL_TIM_EnableDMAReq_CC1

`LL_TIM_DisableDMAReq_CC1`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_CC1 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 1 DMA request (CC1DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC1DE LL_TIM_DisableDMAReq_CC1

`LL_TIM_IsEnabledDMAReq_CC1`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC1 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 1 DMA request (CC1DE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC1DE LL_TIM_IsEnabledDMAReq_CC1

`LL_TIM_EnableDMAReq_CC2`

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_CC2 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 2 DMA request (CC2DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC2DE LL_TIM_EnableDMAReq_CC2

`LL_TIM_DisableDMAReq_CC2`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_CC2 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 2 DMA request (CC2DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC2DE LL_TIM_DisableDMAReq_CC2

`LL_TIM_IsEnabledDMAReq_CC2`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC2 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 2 DMA request (CC2DE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC2DE LL_TIM_IsEnabledDMAReq_CC2

`LL_TIM_EnableDMAReq_CC3`

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_CC3 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 3 DMA request (CC3DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3DE LL_TIM_EnableDMAReq_CC3

`LL_TIM_DisableDMAReq_CC3`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_CC3 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 3 DMA request (CC3DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC3DE LL_TIM_DisableDMAReq_CC3

`LL_TIM_IsEnabledDMAReq_CC3`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC3 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 3 DMA request (CC3DE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC3DE LL_TIM_IsEnabledDMAReq_CC3

`LL_TIM_EnableDMAReq_CC4`

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_CC4 (TIM_TypeDef * TIMx)

Function description

Enable capture/compare 4 DMA request (CC4DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC4DE LL_TIM_EnableDMAReq_CC4

`LL_TIM_DisableDMAReq_CC4`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_CC4 (TIM_TypeDef * TIMx)

Function description

Disable capture/compare 4 DMA request (CC4DE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER CC4DE LL_TIM_DisableDMAReq_CC4

`LL_TIM_IsEnabledDMAReq_CC4`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_CC4 (TIM_TypeDef * TIMx)

Function description

Indicates whether the capture/compare 4 DMA request (CC4DE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER CC4DE LL_TIM_IsEnabledDMAReq_CC4

`LL_TIM_EnableDMAReq_COM`

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_COM (TIM_TypeDef * TIMx)

Function description

Enable commutation DMA request (COMDE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER COMDE LL_TIM_EnableDMAReq_COM

`LL_TIM_DisableDMAReq_COM`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_COM (TIM_TypeDef * TIMx)

Function description

Disable commutation DMA request (COMDE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER COMDE LL_TIM_DisableDMAReq_COM

`LL_TIM_IsEnabledDMAReq_COM`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_COM (TIM_TypeDef * TIMx)

Function description

Indicates whether the commutation DMA request (COMDE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER COMDE LL_TIM_IsEnabledDMAReq_COM

`LL_TIM_EnableDMAReq_TRIG`

Function name

__STATIC_INLINE void LL_TIM_EnableDMAReq_TRIG (TIM_TypeDef * TIMx)

Function description

Enable trigger interrupt (TDE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER TDE LL_TIM_EnableDMAReq_TRIG

`LL_TIM_DisableDMAReq_TRIG`

Function name

__STATIC_INLINE void LL_TIM_DisableDMAReq_TRIG (TIM_TypeDef * TIMx)

Function description

Disable trigger interrupt (TDE).

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- DIER TDE LL_TIM_DisableDMAReq_TRIG

`LL_TIM_IsEnabledDMAReq_TRIG`

Function name

__STATIC_INLINE uint32_t LL_TIM_IsEnabledDMAReq_TRIG (TIM_TypeDef * TIMx)

Function description

Indicates whether the trigger interrupt (TDE) is enabled.

Parameters

- **TIMx:** Timer instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- DIER TDE LL_TIM_IsEnabledDMAReq_TRIG

`LL_TIM_GenerateEvent_UPDATE`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_UPDATE (TIM_TypeDef * TIMx)

Function description

Generate an update event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR UG LL_TIM_GenerateEvent_UPDATE

`LL_TIM_GenerateEvent_CC1`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_CC1 (TIM_TypeDef * TIMx)

Function description

Generate Capture/Compare 1 event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR CC1G LL_TIM_GenerateEvent_CC1

`LL_TIM_GenerateEvent_CC2`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_CC2 (TIM_TypeDef * TIMx)

Function description

Generate Capture/Compare 2 event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR CC2G LL_TIM_GenerateEvent_CC2

`LL_TIM_GenerateEvent_CC3`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_CC3 (TIM_TypeDef * TIMx)

Function description

Generate Capture/Compare 3 event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR CC3G LL_TIM_GenerateEvent_CC3

`LL_TIM_GenerateEvent_CC4`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_CC4 (TIM_TypeDef * TIMx)

Function description

Generate Capture/Compare 4 event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR CC4G LL_TIM_GenerateEvent_CC4

`LL_TIM_GenerateEvent_COM`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_COM (TIM_TypeDef * TIMx)

Function description

Generate commutation event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR COMG LL_TIM_GenerateEvent_COM

`LL_TIM_GenerateEvent_TRIG`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_TRIG (TIM_TypeDef * TIMx)

Function description

Generate trigger event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR TG LL_TIM_GenerateEvent_TRIG

`LL_TIM_GenerateEvent_BRK`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_BRK (TIM_TypeDef * TIMx)

Function description

Generate break event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR BG LL_TIM_GenerateEvent_BRK

`LL_TIM_GenerateEvent_BRK2`

Function name

__STATIC_INLINE void LL_TIM_GenerateEvent_BRK2 (TIM_TypeDef * TIMx)

Function description

Generate break 2 event.

Parameters

- **TIMx:** Timer instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- EGR B2G LL_TIM_GenerateEvent_BRK2

`LL_TIM_DeInit`

Function name

ErrorStatus LL_TIM_DeInit (TIM_TypeDef * TIMx)

Function description

Set TIMx registers to their reset values.

Parameters

- **TIMx:** Timer instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: TIMx registers are de-initialized
  - ERROR: invalid TIMx instance

LL_TIM_StructInit

Function name

void LL_TIM_StructInit (LL_TIM_InitTypeDef * TIM_InitStruct)

Function description

Set the fields of the time base unit configuration data structure to their default values.

Parameters

- **TIM_InitStruct:** pointer to a LL_TIM_InitTypeDef structure (time base unit configuration data structure)

Return values

- **None:**

LL_TIM_Init

Function name

ErrorStatus LL_TIM_Init (TIM_TypeDef * TIMx, LL_TIM_InitTypeDef * TIM_InitStruct)

Function description

Configure the TIMx time base unit.

Parameters

- **TIMx:** Timer Instance
- **TIM_InitStruct:** pointer to a LL_TIM_InitTypeDef structure (TIMx time base unit configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: TIMx registers are de-initialized
  - ERROR: not applicable

LL_TIM_OC_StructInit

Function name

void LL_TIM_OC_StructInit (LL_TIM_OC_InitTypeDef * TIM_OC_InitStruct)

Function description

Set the fields of the TIMx output channel configuration data structure to their default values.

Parameters

- **TIM_OC_InitStruct:** pointer to a LL_TIM_OC_InitTypeDef structure (the output channel configuration data structure)

Return values

- **None:**

LL_TIM_OC_Init

Function name

ErrorStatus LL_TIM_OC_Init (TIM_TypeDef * TIMx, uint32_t Channel, LL_TIM_OC_InitTypeDef * TIM_OC_InitStruct)

Function description

Configure the TIMx output channel.

Parameters

- **TIMx:** Timer Instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
  - LL_TIM_CHANNEL_CH5
  - LL_TIM_CHANNEL_CH6
- **TIM_OC_InitStruct:** pointer to a LL_TIM_OC_InitTypeDef structure (TIMx output channel configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: TIMx output channel is initialized
  - ERROR: TIMx output channel is not initialized

LL_TIM_IC_StructInit

Function name

void LL_TIM_IC_StructInit (LL_TIM_IC_InitTypeDef * TIM_ICInitStruct)

Function description

Set the fields of the TIMx input channel configuration data structure to their default values.

Parameters

- **TIM_ICInitStruct:** pointer to a LL_TIM_IC_InitTypeDef structure (the input channel configuration data structure)

Return values

- **None:**

LL_TIM_IC_Init

Function name

ErrorStatus LL_TIM_IC_Init (TIM_TypeDef * TIMx, uint32_t Channel, LL_TIM_IC_InitTypeDef * TIM_IC_InitStruct)

Function description

Configure the TIMx input channel.

Parameters

- **TIMx:** Timer Instance
- **Channel:** This parameter can be one of the following values:
  - LL_TIM_CHANNEL_CH1
  - LL_TIM_CHANNEL_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **TIM_IC_InitStruct:** pointer to a LL_TIM_IC_InitTypeDef structure (TIMx input channel configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: TIMx output channel is initialized
  - ERROR: TIMx output channel is not initialized

`LL_TIM_ENCODER_StructInit`

Function name

void LL_TIM_ENCODER_StructInit (LL_TIM_ENCODER_InitTypeDef * TIM_EncoderInitStruct)

Function description

Fills each TIM_EncoderInitStruct field with its default value.

Parameters

- **TIM_EncoderInitStruct:** pointer to a LL_TIM_ENCODER_InitTypeDef structure (encoder interface configuration data structure)

Return values

- **None:**

`LL_TIM_ENCODER_Init`

Function name

ErrorStatus LL_TIM_ENCODER_Init (TIM_TypeDef * TIMx, LL_TIM_ENCODER_InitTypeDef * TIM_EncoderInitStruct)

Function description

Configure the encoder interface of the timer instance.

Parameters

- **TIMx:** Timer Instance
- **TIM_EncoderInitStruct:** pointer to a LL_TIM_ENCODER_InitTypeDef structure (TIMx encoder interface configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: TIMx registers are de-initialized
  - ERROR: not applicable

`LL_TIM_HALLSENSOR_StructInit`

Function name

void LL_TIM_HALLSENSOR_StructInit (LL_TIM_HALLSENSOR_InitTypeDef * TIM_HallSensorInitStruct)

Function description

Set the fields of the TIMx Hall sensor interface configuration data structure to their default values.

Parameters

- **TIM_HallSensorInitStruct:** pointer to a LL_TIM_HALLSENSOR_InitTypeDef structure (HALL sensor interface configuration data structure)

Return values

- **None:**

LL_TIM_HALLSENSOR_Init

Function name

ErrorStatus LL_TIM_HALLSENSOR_Init (TIM_TypeDef * TIMx, LL_TIM_HALLSENSOR_InitTypeDef * TIM_HallSensorInitStruct)

Function description

Configure the Hall sensor interface of the timer instance.

Parameters

- **TIMx:** Timer Instance
- **TIM_HallSensorInitStruct:** pointer to a LL_TIM_HALLSENSOR_InitTypeDef structure (TIMx HALL sensor interface configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: TIMx registers are de-initialized
  - ERROR: not applicable

Notes

- TIMx CH1, CH2 and CH3 inputs connected through a XOR to the TI1 input channel
- TIMx slave mode controller is configured in reset mode. Selected internal trigger is TI1F_ED.
- Channel 1 is configured as input, IC1 is mapped on TRC.
- Captured value stored in TIMx_CCR1 correspond to the time elapsed between 2 changes on the inputs. It gives information about motor speed.
- Channel 2 is configured in output PWM 2 mode.
- Compare value stored in TIMx_CCR2 corresponds to the commutation delay.
- OC2REF is selected as trigger output on TRGO.
- LL_TIM_IC_POLARITY_BOTHEDGE must not be used for TI1 when it is used when TIMx operates in Hall sensor interface mode.

LL_TIM_BDTR_StructInit

Function name

void LL_TIM_BDTR_StructInit (LL_TIM_BDTR_InitTypeDef * TIM_BDTRInitStruct)

Function description

Set the fields of the Break and Dead Time configuration data structure to their default values.

Parameters

- **TIM_BDTRInitStruct:** pointer to a LL_TIM_BDTR_InitTypeDef structure (Break and Dead Time configuration data structure)

Return values

- **None:**

`LL_TIM_BDTR_Init`

Function name

ErrorStatus LL_TIM_BDTR_Init (TIM_TypeDef * TIMx, LL_TIM_BDTR_InitTypeDef * TIM_BDTRInitStruct)

Function description

Configure the Break and Dead Time feature of the timer instance.

Parameters

- **TIMx:** Timer Instance
- **TIM_BDTRInitStruct:** pointer to a LL_TIM_BDTR_InitTypeDef structure (Break and Dead Time configuration data structure)

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: Break and Dead Time is initialized
  - ERROR: not applicable

Notes

- As the bits BK2P, BK2E, BK2F[3:0], BKF[3:0], AOE, BKP, BKE, OSSI, OSSR and DTG[7:0] can be write-locked depending on the LOCK configuration, it can be necessary to configure all of them during the first write access to the TIMx_BDTR register.
- Macro IS_TIM_BREAK_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a break input.
- Macro IS_TIM_BKIN2_INSTANCE(TIMx) can be used to check whether or not a timer instance provides a second break input.

104.3 TIM Firmware driver defines

The following section lists the various define and macros of the module.

104.3.1 TIM

TIM

Active Input Selection

LL_TIM_ACTIVEINPUT_DIRECTTI

ICx is mapped on TIx

LL_TIM_ACTIVEINPUT_INDIRECTTI

ICx is mapped on TIy

LL_TIM_ACTIVEINPUT_TRC

ICx is mapped on TRC

Automatic output enable

LL_TIM_AUTOMATICOUTPUT_DISABLE

MOE can be set only by software

LL_TIM_AUTOMATICOUTPUT_ENABLE

MOE can be set by software or automatically at the next update event

BKIN POLARITY

LL_TIM_BKIN_POLARITY_LOW

BRK BKIN input is active low

LL_TIM_BKIN_POLARITY_HIGH

BRK BKIN input is active high

BKIN SOURCE

LL_TIM_BKIN_SOURCE_BKIN

BKIN input from AF controller

LL_TIM_BKIN_SOURCE_BKCOMP1

internal signal: COMP1 output

LL_TIM_BKIN_SOURCE_BKCOMP2

internal signal: COMP2 output

LL_TIM_BKIN_SOURCE_DF1BK

internal signal: DFSDM1 break output

Break2 Enable

LL_TIM_BREAK2_DISABLE

Break2 function disabled

LL_TIM_BREAK2_ENABLE

Break2 function enabled

BREAK2 FILTER

LL_TIM_BREAK2_FILTER_FDIV1

No filter, BRK acts asynchronously

LL_TIM_BREAK2_FILTER_FDIV1_N2

fSAMPLING=fCK_INT, N=2

LL_TIM_BREAK2_FILTER_FDIV1_N4

fSAMPLING=fCK_INT, N=4

LL_TIM_BREAK2_FILTER_FDIV1_N8

fSAMPLING=fCK_INT, N=8

LL_TIM_BREAK2_FILTER_FDIV2_N6

fSAMPLING=fDTS/2, N=6

LL_TIM_BREAK2_FILTER_FDIV2_N8

fSAMPLING=fDTS/2, N=8

LL_TIM_BREAK2_FILTER_FDIV4_N6

fSAMPLING=fDTS/4, N=6

LL_TIM_BREAK2_FILTER_FDIV4_N8

fSAMPLING=fDTS/4, N=8

LL_TIM_BREAK2_FILTER_FDIV8_N6

fSAMPLING=fDTS/8, N=6

LL_TIM_BREAK2_FILTER_FDIV8_N8

fSAMPLING=fDTS/8, N=8

LL_TIM_BREAK2_FILTER_FDIV16_N5

fSAMPLING=fDTS/16, N=5

LL_TIM_BREAK2_FILTER_FDIV16_N6

fSAMPLING=fDTS/16, N=6

LL_TIM_BREAK2_FILTER_FDIV16_N8

fSAMPLING=fDTS/16, N=8

LL_TIM_BREAK2_FILTER_FDIV32_N5

fSAMPLING=fDTS/32, N=5

LL_TIM_BREAK2_FILTER_FDIV32_N6

fSAMPLING=fDTS/32, N=6

LL_TIM_BREAK2_FILTER_FDIV32_N8

fSAMPLING=fDTS/32, N=8

BREAK2 POLARITY

LL_TIM_BREAK2_POLARITY_LOW

Break input BRK2 is active low

LL_TIM_BREAK2_POLARITY_HIGH

Break input BRK2 is active high

Break Enable

LL_TIM_BREAK_DISABLE

Break function disabled

LL_TIM_BREAK_ENABLE

Break function enabled

break filter

LL_TIM_BREAK_FILTER_FDIV1

No filter, BRK acts asynchronously

LL_TIM_BREAK_FILTER_FDIV1_N2

fSAMPLING=fCK_INT, N=2

LL_TIM_BREAK_FILTER_FDIV1_N4

fSAMPLING=fCK_INT, N=4

LL_TIM_BREAK_FILTER_FDIV1_N8

fSAMPLING=fCK_INT, N=8

LL_TIM_BREAK_FILTER_FDIV2_N6

fSAMPLING=fDTS/2, N=6

LL_TIM_BREAK_FILTER_FDIV2_N8

fSAMPLING=fDTS/2, N=8

LL_TIM_BREAK_FILTER_FDIV4_N6

fSAMPLING=fDTS/4, N=6

LL_TIM_BREAK_FILTER_FDIV4_N8

fSAMPLING=fDTS/4, N=8

LL_TIM_BREAK_FILTER_FDIV8_N6

fSAMPLING=fDTS/8, N=6

LL_TIM_BREAK_FILTER_FDIV8_N8

fSAMPLING=fDTS/8, N=8

LL_TIM_BREAK_FILTER_FDIV16_N5

fSAMPLING=fDTS/16, N=5

LL_TIM_BREAK_FILTER_FDIV16_N6

fSAMPLING=fDTS/16, N=6

LL_TIM_BREAK_FILTER_FDIV16_N8

fSAMPLING=fDTS/16, N=8

LL_TIM_BREAK_FILTER_FDIV32_N5

fSAMPLING=fDTS/32, N=5

LL_TIM_BREAK_FILTER_FDIV32_N6

fSAMPLING=fDTS/32, N=6

LL_TIM_BREAK_FILTER_FDIV32_N8

fSAMPLING=fDTS/32, N=8

BREAK INPUT

LL_TIM_BREAK_INPUT_BKIN

TIMx_BKIN input

LL_TIM_BREAK_INPUT_BKIN2

TIMx_BKIN2 input

break polarity

LL_TIM_BREAK_POLARITY_LOW

Break input BRK is active low

LL_TIM_BREAK_POLARITY_HIGH

Break input BRK is active high

Capture Compare DMA Request

LL_TIM_CCDMAREQUEST_CC

CCx DMA request sent when CCx event occurs

LL_TIM_CCDMAREQUEST_UPDATE

CCx DMA requests sent when update event occurs

Capture Compare Update Source

LL_TIM_CCUPDATESOURCE_COMG_ONLY

Capture/compare control bits are updated by setting the COMG bit only

LL_TIM_CCUPDATESOURCE_COMG_AND_TRGI

Capture/compare control bits are updated by setting the COMG bit or when a rising edge occurs on trigger input (TRGI)

Channel

LL_TIM_CHANNEL_CH1

Timer input/output channel 1

LL_TIM_CHANNEL_CH1N

Timer complementary output channel 1

LL_TIM_CHANNEL_CH2

Timer input/output channel 2

LL_TIM_CHANNEL_CH2N

Timer complementary output channel 2

LL_TIM_CHANNEL_CH3

Timer input/output channel 3

LL_TIM_CHANNEL_CH3N

Timer complementary output channel 3

LL_TIM_CHANNEL_CH4

Timer input/output channel 4

LL_TIM_CHANNEL_CH5

Timer output channel 5

LL_TIM_CHANNEL_CH6

Timer output channel 6

Clock Division

LL_TIM_CLOCKDIVISION_DIV1

tDTS=tCK_INT

LL_TIM_CLOCKDIVISION_DIV2

tDTS=2*tCK_INT

LL_TIM_CLOCKDIVISION_DIV4

tDTS=4*tCK_INT

Clock Source

LL_TIM_CLOCKSOURCE_INTERNAL

The timer is clocked by the internal clock provided from the RCC

LL_TIM_CLOCKSOURCE_EXT_MODE1

Counter counts at each rising or falling edge on a selected input

LL_TIM_CLOCKSOURCE_EXT_MODE2

Counter counts at each rising or falling edge on the external trigger input ETR

Counter Direction

LL_TIM_COUNTERDIRECTION_UP

Timer counter counts up

LL_TIM_COUNTERDIRECTION_DOWN

Timer counter counts down

Counter Mode

LL_TIM_COUNTERMODE_UP

Counter used as upcounter

LL_TIM_COUNTERMODE_DOWN

Counter used as downcounter

LL_TIM_COUNTERMODE_CENTER_UP

The counter counts up and down alternatively. Output compare interrupt flags of output channels are set only when the counter is counting down.

LL_TIM_COUNTERMODE_CENTER_DOWN

The counter counts up and down alternatively. Output compare interrupt flags of output channels are set only when the counter is counting up

LL_TIM_COUNTERMODE_CENTER_UP_DOWN

The counter counts up and down alternatively. Output compare interrupt flags of output channels are set only when the counter is counting up or down.

DMA Burst Base Address

LL_TIM_DMABURST_BASEADDR_CR1

TIMx_CR1 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CR2

TIMx_CR2 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_SMCR

TIMx_SMCR register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_DIER

TIMx_DIER register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_SR

TIMx_SR register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_EGR

TIMx_EGR register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCMR1

TIMx_CCMR1 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCMR2

TIMx_CCMR2 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCER

TIMx_CCER register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CNT

TIMx_CNT register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_PSC

TIMx_PSC register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_ARR

TIMx_ARR register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_RCR

TIMx_RCR register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCR1

TIMx_CCR1 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCR2

TIMx_CCR2 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCR3

TIMx_CCR3 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCR4

TIMx_CCR4 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_BDTR

TIMx_BDTR register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_OR1

TIMx_OR1 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCMR3

TIMx_CCMR3 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCR5

TIMx_CCR5 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_CCR6

TIMx_CCR6 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_OR2

TIMx_OR2 register is the DMA base address for DMA burst

LL_TIM_DMABURST_BASEADDR_OR3

TIMx_OR3 register is the DMA base address for DMA burst

DMA Burst Length

LL_TIM_DMABURST_LENGTH_1TRANSFER

Transfer is done to 1 register starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_2TRANSFERS

Transfer is done to 2 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_3TRANSFERS

Transfer is done to 3 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_4TRANSFERS

Transfer is done to 4 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_5TRANSFERS

Transfer is done to 5 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_6TRANSFERS

Transfer is done to 6 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_7TRANSFERS

Transfer is done to 7 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_8TRANSFERS

Transfer is done to 1 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_9TRANSFERS

Transfer is done to 9 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_10TRANSFERS

Transfer is done to 10 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_11TRANSFERS

Transfer is done to 11 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_12TRANSFERS

Transfer is done to 12 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_13TRANSFERS

Transfer is done to 13 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_14TRANSFERS

Transfer is done to 14 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_15TRANSFERS

Transfer is done to 15 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_16TRANSFERS

Transfer is done to 16 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_17TRANSFERS

Transfer is done to 17 registers starting from the DMA burst base address

LL_TIM_DMABURST_LENGTH_18TRANSFERS

Transfer is done to 18 registers starting from the DMA burst base address

Encoder Mode

LL_TIM_ENCODERMODE_X2_TI1

Quadrature encoder mode 1, x2 mode - Counter counts up/down on TI1FP1 edge depending on TI2FP2 level

LL_TIM_ENCODERMODE_X2_TI2

Quadrature encoder mode 2, x2 mode - Counter counts up/down on TI2FP2 edge depending on TI1FP1 level

LL_TIM_ENCODERMODE_X4_TI12

Quadrature encoder mode 3, x4 mode - Counter counts up/down on both TI1FP1 and TI2FP2 edges depending on the level of the other input

External Trigger Source

LL_TIM_ETRSOURCE_LEGACY

ETR legacy mode

LL_TIM_ETRSOURCE_COMP1

COMP1 output connected to ETR input

LL_TIM_ETRSOURCE_COMP2

COMP2 output connected to ETR input

External Trigger Filter

LL_TIM_ETR_FILTER_FDIV1

No filter, sampling is done at fDTS

LL_TIM_ETR_FILTER_FDIV1_N2

fSAMPLING=fCK_INT, N=2

LL_TIM_ETR_FILTER_FDIV1_N4

fSAMPLING=fCK_INT, N=4

LL_TIM_ETR_FILTER_FDIV1_N8

fSAMPLING=fCK_INT, N=8

LL_TIM_ETR_FILTER_FDIV2_N6

fSAMPLING=fDTS/2, N=6

LL_TIM_ETR_FILTER_FDIV2_N8

fSAMPLING=fDTS/2, N=8

LL_TIM_ETR_FILTER_FDIV4_N6

fSAMPLING=fDTS/4, N=6

LL_TIM_ETR_FILTER_FDIV4_N8

fSAMPLING=fDTS/4, N=8

LL_TIM_ETR_FILTER_FDIV8_N6

fSAMPLING=fDTS/8, N=8

LL_TIM_ETR_FILTER_FDIV8_N8

fSAMPLING=fDTS/16, N=5

LL_TIM_ETR_FILTER_FDIV16_N5

fSAMPLING=fDTS/16, N=6

LL_TIM_ETR_FILTER_FDIV16_N6

fSAMPLING=fDTS/16, N=8

LL_TIM_ETR_FILTER_FDIV16_N8

fSAMPLING=fDTS/16, N=5

LL_TIM_ETR_FILTER_FDIV32_N5

fSAMPLING=fDTS/32, N=5

LL_TIM_ETR_FILTER_FDIV32_N6

fSAMPLING=fDTS/32, N=6

LL_TIM_ETR_FILTER_FDIV32_N8

fSAMPLING=fDTS/32, N=8

External Trigger Polarity

LL_TIM_ETR_POLARITY_NONINVERTED

ETR is non-inverted, active at high level or rising edge

LL_TIM_ETR_POLARITY_INVERTED

ETR is inverted, active at low level or falling edge

External Trigger Prescaler

LL_TIM_ETR_PRESCALER_DIV1

ETR prescaler OFF

LL_TIM_ETR_PRESCALER_DIV2

ETR frequency is divided by 2

LL_TIM_ETR_PRESCALER_DIV4

ETR frequency is divided by 4

LL_TIM_ETR_PRESCALER_DIV8

ETR frequency is divided by 8

Get Flags Defines

LL_TIM_SR_UIF

Update interrupt flag

LL_TIM_SR_CC1IF

Capture/compare 1 interrupt flag

LL_TIM_SR_CC2IF

Capture/compare 2 interrupt flag

LL_TIM_SR_CC3IF

Capture/compare 3 interrupt flag

LL_TIM_SR_CC4IF

Capture/compare 4 interrupt flag

LL_TIM_SR_CC5IF

Capture/compare 5 interrupt flag

LL_TIM_SR_CC6IF

Capture/compare 6 interrupt flag

LL_TIM_SR_COMIF

COM interrupt flag

LL_TIM_SR_TIF

Trigger interrupt flag

LL_TIM_SR_BIF

Break interrupt flag

LL_TIM_SR_B2IF

Second break interrupt flag

LL_TIM_SR_CC1OF

Capture/Compare 1 overcapture flag

LL_TIM_SR_CC2OF

Capture/Compare 2 overcapture flag

LL_TIM_SR_CC3OF

Capture/Compare 3 overcapture flag

LL_TIM_SR_CC4OF

Capture/Compare 4 overcapture flag

LL_TIM_SR_SBIF

System Break interrupt flag

GROUPCH5

LL_TIM_GROUPCH5_NONE

No effect of OC5REF on OC1REFC, OC2REFC and OC3REFC

LL_TIM_GROUPCH5_OC1REFC

OC1REFC is the logical AND of OC1REFC and OC5REF

LL_TIM_GROUPCH5_OC2REFC

OC2REFC is the logical AND of OC2REFC and OC5REF

LL_TIM_GROUPCH5_OC3REFC

OC3REFC is the logical AND of OC3REFC and OC5REF

Input Configuration Prescaler

LL_TIM_ICPSC_DIV1

No prescaler, capture is done each time an edge is detected on the capture input

LL_TIM_ICPSC_DIV2

Capture is done once every 2 events

LL_TIM_ICPSC_DIV4

Capture is done once every 4 events

LL_TIM_ICPSC_DIV8

Capture is done once every 8 events

Input Configuration Filter

LL_TIM_IC_FILTER_FDIV1

No filter, sampling is done at fDTS

LL_TIM_IC_FILTER_FDIV1_N2

fSAMPLING=fCK_INT, N=2

LL_TIM_IC_FILTER_FDIV1_N4

fSAMPLING=fCK_INT, N=4

LL_TIM_IC_FILTER_FDIV1_N8

fSAMPLING=fCK_INT, N=8

LL_TIM_IC_FILTER_FDIV2_N6

fSAMPLING=fDTS/2, N=6

LL_TIM_IC_FILTER_FDIV2_N8

fSAMPLING=fDTS/2, N=8

LL_TIM_IC_FILTER_FDIV4_N6

fSAMPLING=fDTS/4, N=6

LL_TIM_IC_FILTER_FDIV4_N8

fSAMPLING=fDTS/4, N=8

LL_TIM_IC_FILTER_FDIV8_N6

fSAMPLING=fDTS/8, N=6

LL_TIM_IC_FILTER_FDIV8_N8

fSAMPLING=fDTS/8, N=8

LL_TIM_IC_FILTER_FDIV16_N5

fSAMPLING=fDTS/16, N=5

LL_TIM_IC_FILTER_FDIV16_N6

fSAMPLING=fDTS/16, N=6

LL_TIM_IC_FILTER_FDIV16_N8

fSAMPLING=fDTS/16, N=8

LL_TIM_IC_FILTER_FDIV32_N5

fSAMPLING=fDTS/32, N=5

LL_TIM_IC_FILTER_FDIV32_N6

fSAMPLING=fDTS/32, N=6

LL_TIM_IC_FILTER_FDIV32_N8

fSAMPLING=fDTS/32, N=8

Input Configuration Polarity

LL_TIM_IC_POLARITY_RISING

The circuit is sensitive to TIxFP1 rising edge, TIxFP1 is not inverted

LL_TIM_IC_POLARITY_FALLING

The circuit is sensitive to TIxFP1 falling edge, TIxFP1 is inverted

LL_TIM_IC_POLARITY_BOTHEDGE

The circuit is sensitive to both TIxFP1 rising and falling edges, TIxFP1 is not inverted

IT Defines

LL_TIM_DIER_UIE

Update interrupt enable

LL_TIM_DIER_CC1IE

Capture/compare 1 interrupt enable

LL_TIM_DIER_CC2IE

Capture/compare 2 interrupt enable

LL_TIM_DIER_CC3IE

Capture/compare 3 interrupt enable

LL_TIM_DIER_CC4IE

Capture/compare 4 interrupt enable

LL_TIM_DIER_COMIE

COM interrupt enable

LL_TIM_DIER_TIE

Trigger interrupt enable

LL_TIM_DIER_BIE

Break interrupt enable

Lock Level

LL_TIM_LOCKLEVEL_OFF

LOCK OFF - No bit is write protected

LL_TIM_LOCKLEVEL_1

LOCK Level 1

LL_TIM_LOCKLEVEL_2

LOCK Level 2

LL_TIM_LOCKLEVEL_3

LOCK Level 3

Output Configuration Idle State

LL_TIM_OCIDLESTATE_LOW

OCx=0 (after a dead-time if OC is implemented) when MOE=0

LL_TIM_OCIDLESTATE_HIGH

OCx=1 (after a dead-time if OC is implemented) when MOE=0

Output Configuration Mode

LL_TIM_OCMODE_FROZEN

The comparison between the output compare register TIMx_CCRy and the counter TIMx_CNT has no effect on the output channel level

LL_TIM_OCMODE_ACTIVE

OCyREF is forced high on compare match

LL_TIM_OCMODE_INACTIVE

OCyREF is forced low on compare match

LL_TIM_OCMODE_TOGGLE

OCyREF toggles on compare match

LL_TIM_OCMODE_FORCED_INACTIVE

OCyREF is forced low

LL_TIM_OCMODE_FORCED_ACTIVE

OCyREF is forced high

LL_TIM_OCMODE_PWM1

In upcounting, channel y is active as long as TIMx_CNT<TIMx_CCRy else inactive. In downcounting, channel y is inactive as long as TIMx_CNT>TIMx_CCRy else active.

LL_TIM_OCMODE_PWM2

In upcounting, channel y is inactive as long as TIMx_CNT<TIMx_CCRy else active. In downcounting, channel y is active as long as TIMx_CNT>TIMx_CCRy else inactive

LL_TIM_OCMODE_RETRIG_OPM1

Retrigerrable OPM mode 1

LL_TIM_OCMODE_RETRIG_OPM2

Retrigerrable OPM mode 2

LL_TIM_OCMODE_COMBINED_PWM1

Combined PWM mode 1

LL_TIM_OCMODE_COMBINED_PWM2

Combined PWM mode 2

LL_TIM_OCMODE_ASSYMETRIC_PWM1

Asymmetric PWM mode 1

LL_TIM_OCMODE_ASSYMETRIC_PWM2

Asymmetric PWM mode 2

Output Configuration Polarity

LL_TIM_OCPOLARITY_HIGH

OCxactive high

LL_TIM_OCPOLARITY_LOW

OCxactive low

OCREF clear input selection

LL_TIM_OCREF_CLR_INT_NC

OCREF_CLR_INT is not connected

LL_TIM_OCREF_CLR_INT_ETR

OCREF_CLR_INT is connected to ETRF

Output Configuration State

LL_TIM_OCSTATE_DISABLE

OCx is not active

LL_TIM_OCSTATE_ENABLE

OCx signal is output on the corresponding output pin

One Pulse Mode

LL_TIM_ONEPULSEMODE_SINGLE

Counter is not stopped at update event

LL_TIM_ONEPULSEMODE_REPETITIVE

Counter stops counting at the next update event

OSSI

LL_TIM_OSSI_DISABLE

When inactive, OCx/OCxN outputs are disabled

LL_TIM_OSSI_ENABLE

When inactive, OxC/OCxN outputs are first forced with their inactive level then forced to their idle level after the deadtime

OSSR

LL_TIM_OSSR_DISABLE

When inactive, OCx/OCxN outputs are disabled

LL_TIM_OSSR_ENABLE

When inactive, OC/OCN outputs are enabled with their inactive level as soon as CCxE=1 or CCxNE=1

Slave Mode

LL_TIM_SLAVEMODE_DISABLED

Slave mode disabled

LL_TIM_SLAVEMODE_RESET

Reset Mode - Rising edge of the selected trigger input (TRGI) reinitializes the counter

LL_TIM_SLAVEMODE_GATED

Gated Mode - The counter clock is enabled when the trigger input (TRGI) is high

LL_TIM_SLAVEMODE_TRIGGER

Trigger Mode - The counter starts at a rising edge of the trigger TRGI

LL_TIM_SLAVEMODE_COMBINED_RESETTRIGGER

Combined reset + trigger mode - Rising edge of the selected trigger input (TRGI) reinitializes the counter, generates an update of the registers and starts the counter

TIM15 ENCODERMODE

LL_TIM_TIM15_ENCODERMODE_NOREDIRECTION

No redirection

LL_TIM_TIM15_ENCODERMODE_TIM2

TIM2 IC1 and TIM2 IC2 are connected to TIM15 IC1 and TIM15 IC2 respectively

LL_TIM_TIM15_ENCODERMODE_TIM3

TIM3 IC1 and TIM3 IC2 are connected to TIM15 IC1 and TIM15 IC2 respectivel y

LL_TIM_TIM15_ENCODERMODE_TIM4

TIM4 IC1 and TIM4 IC2 are connected to TIM15 IC1 and TIM15 IC2 respectively

TIM15 External Input Ch1 Remap

LL_TIM_TIM15_TI1_RMP_GPIO

TIM15 input capture 1 is connected to GPIO

LL_TIM_TIM15_TI1_RMP_LSE

TIM15 input capture 1 is connected to LSE

TIM16 External Input Ch1 Remap

LL_TIM_TIM16_TI1_RMP_GPIO

TIM16 input capture 1 is connected to GPIO

LL_TIM_TIM16_TI1_RMP_LSI

TIM16 input capture 1 is connected to LSI

LL_TIM_TIM16_TI1_RMP_LSE

TIM16 input capture 1 is connected to LSE

LL_TIM_TIM16_TI1_RMP_RTC

TIM16 input capture 1 is connected to RTC wakeup interrupt

TIM17 Timer Input Ch1 Remap

LL_TIM_TIM17_TI1_RMP_GPIO

TIM17 input capture 1 is connected to GPIO

LL_TIM_TIM17_TI1_RMP_MSI

TIM17 input capture 1 is connected to MSI

LL_TIM_TIM17_TI1_RMP_HSE_32

TIM17 input capture 1 is connected to HSE/32

LL_TIM_TIM17_TI1_RMP_MCO

TIM17 input capture 1 is connected to MCO

TIM1 External Trigger ADC1 Remap

LL_TIM_TIM1_ETR_ADC1_RMP_NC

TIM1_ETR is not connected to ADC1 analog watchdog x

LL_TIM_TIM1_ETR_ADC1_RMP_AWD1

TIM1_ETR is connected to ADC1 analog watchdog 1

LL_TIM_TIM1_ETR_ADC1_RMP_AWD2

TIM1_ETR is connected to ADC1 analog watchdog 2

LL_TIM_TIM1_ETR_ADC1_RMP_AWD3

TIM1_ETR is connected to ADC1 analog watchdog 3

TIM1 External Input Ch1 Remap

LL_TIM_TIM1_TI1_RMP_GPIO

TIM1 input capture 1 is connected to GPIO

LL_TIM_TIM1_TI1_RMP_COMP1

TIM1 input capture 1 is connected to COMP1 output

TIM2 Internal Trigger1 Remap

LL_TIM_TIM2_ITR1_RMP_TIM8_TRGO

TIM2_ITR1 is connected to TIM8_TRGO

LL_TIM_TIM2_ITR1_RMP_OTG_FS_SOF

TIM2_ITR1 is connected to OTG_FS SOF

LL_TIM_TIM2_ETR_RMP_GPIO

TIM2_ETR is connected to GPIO

LL_TIM_TIM2_ETR_RMP_LSE

TIM2_ETR is connected to LSE

TIM2 External Input Ch4 Remap

LL_TIM_TIM2_TI4_RMP_GPIO

TIM2 input capture 4 is connected to GPIO

LL_TIM_TIM2_TI4_RMP_COMP1

TIM2 input capture 4 is connected to COMP1_OUT

LL_TIM_TIM2_TI4_RMP_COMP2

TIM2 input capture 4 is connected to COMP2_OUT

LL_TIM_TIM2_TI4_RMP_COMP1_COMP2

TIM2 input capture 4 is connected to logical OR between COMP1_OUT and COMP2_OUT

TIM3 External Input Ch1 Remap

LL_TIM_TIM3_TI1_RMP_GPIO

TIM3 input capture 1 is connected to GPIO

LL_TIM_TIM3_TI1_RMP_COMP1

TIM3 input capture 1 is connected to COMP1_OUT

LL_TIM_TIM3_TI1_RMP_COMP2

TIM3 input capture 1 is connected to COMP2_OUT

LL_TIM_TIM3_TI1_RMP_COMP1_COMP2

TIM3 input capture 1 is connected to logical OR between COMP1_OUT and COMP2_OUT

TIM8 External Trigger ADC2 Remap

LL_TIM_TIM8_ETR_ADC2_RMP_NC

TIM8_ETR is not connected to ADC2 analog watchdog x

LL_TIM_TIM8_ETR_ADC2_RMP_AWD1

TIM8_ETR is connected to ADC2 analog watchdog

LL_TIM_TIM8_ETR_ADC2_RMP_AWD2

TIM8_ETR is connected to ADC2 analog watchdog 2

LL_TIM_TIM8_ETR_ADC2_RMP_AWD3

TIM8_ETR is connected to ADC2 analog watchdog 3

TIM8 External Trigger ADC3 Remap

LL_TIM_TIM8_ETR_ADC3_RMP_NC

TIM8_ETR is not connected to ADC3 analog watchdog x

LL_TIM_TIM8_ETR_ADC3_RMP_AWD1

TIM8_ETR is connected to ADC3 analog watchdog 1

LL_TIM_TIM8_ETR_ADC3_RMP_AWD2

TIM8_ETR is connected to ADC3 analog watchdog 2

LL_TIM_TIM8_ETR_ADC3_RMP_AWD3

TIM8_ETR is connected to ADC3 analog watchdog 3

TIM8 External Input Ch1 Remap

LL_TIM_TIM8_TI1_RMP_GPIO

TIM8 input capture 1 is connected to GPIO

LL_TIM_TIM8_TI1_RMP_COMP2

TIM8 input capture 1 is connected to COMP2 output

Trigger Output

LL_TIM_TRGO_RESET

UG bit from the TIMx_EGR register is used as trigger output

LL_TIM_TRGO_ENABLE

Counter Enable signal (CNT_EN) is used as trigger output

LL_TIM_TRGO_UPDATE

Update event is used as trigger output

LL_TIM_TRGO_CC1IF

CC1 capture or a compare match is used as trigger output

LL_TIM_TRGO_OC1REF

OC1REF signal is used as trigger output

LL_TIM_TRGO_OC2REF

OC2REF signal is used as trigger output

LL_TIM_TRGO_OC3REF

OC3REF signal is used as trigger output

LL_TIM_TRGO_OC4REF

OC4REF signal is used as trigger output

Trigger Output 2

LL_TIM_TRGO2_RESET

UG bit from the TIMx_EGR register is used as trigger output 2

LL_TIM_TRGO2_ENABLE

Counter Enable signal (CNT_EN) is used as trigger output 2

LL_TIM_TRGO2_UPDATE

Update event is used as trigger output 2

LL_TIM_TRGO2_CC1F

CC1 capture or a compare match is used as trigger output 2

LL_TIM_TRGO2_OC1

OC1REF signal is used as trigger output 2

LL_TIM_TRGO2_OC2

OC2REF signal is used as trigger output 2

LL_TIM_TRGO2_OC3

OC3REF signal is used as trigger output 2

LL_TIM_TRGO2_OC4

OC4REF signal is used as trigger output 2

LL_TIM_TRGO2_OC5

OC5REF signal is used as trigger output 2

LL_TIM_TRGO2_OC6

OC6REF signal is used as trigger output 2

LL_TIM_TRGO2_OC4_RISINGFALLING

OC4REF rising or falling edges are used as trigger output 2

LL_TIM_TRGO2_OC6_RISINGFALLING

OC6REF rising or falling edges are used as trigger output 2

LL_TIM_TRGO2_OC4_RISING_OC6_RISING

OC4REF or OC6REF rising edges are used as trigger output 2

LL_TIM_TRGO2_OC4_RISING_OC6_FALLING

OC4REF rising or OC6REF falling edges are used as trigger output 2

LL_TIM_TRGO2_OC5_RISING_OC6_RISING

OC5REF or OC6REF rising edges are used as trigger output 2

LL_TIM_TRGO2_OC5_RISING_OC6_FALLING

OC5REF rising or OC6REF falling edges are used as trigger output 2

Trigger Selection

LL_TIM_TS_ITR0

Internal Trigger 0 (ITR0) is used as trigger input

LL_TIM_TS_ITR1

Internal Trigger 1 (ITR1) is used as trigger input

LL_TIM_TS_ITR2

Internal Trigger 2 (ITR2) is used as trigger input

LL_TIM_TS_ITR3

Internal Trigger 3 (ITR3) is used as trigger input

LL_TIM_TS_TI1F_ED

TI1 Edge Detector (TI1F_ED) is used as trigger input

LL_TIM_TS_TI1FP1

Filtered Timer Input 1 (TI1FP1) is used as trigger input

LL_TIM_TS_TI2FP2

Filtered Timer Input 2 (TI12P2) is used as trigger input

LL_TIM_TS_ETRF

Filtered external Trigger (ETRF) is used as trigger input

Update Source

LL_TIM_UPDATESOURCE_REGULAR

Counter overflow/underflow, Setting the UG bit or Update generation through the slave mode controller generates an update request

LL_TIM_UPDATESOURCE_COUNTER

Only counter overflow/underflow generates an update request

Exported_Macros

__LL_TIM_GETFLAG_UIFCPY

Description:

- HELPER macro retrieving the UIFCPY flag from the counter value.

Parameters:

- __CNT__: Counter value

Return value:

- UIF: status bit

Notes:

- ex: __LL_TIM_GETFLAG_UIFCPY (LL_TIM_GetCounter ()); Relevant only if UIF flag remapping has been enabled (UIF status bit is copied to TIMx_CNT register bit 31)

__LL_TIM_CALC_DEADTIME

Description:

- HELPER macro calculating DTG[0:7] in the TIMx_BDTR register to achieve the requested dead time duration.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __CKD__: This parameter can be one of the following values:
  - LL_TIM_CLOCKDIVISION_DIV1
  - LL_TIM_CLOCKDIVISION_DIV2
  - LL_TIM_CLOCKDIVISION_DIV4
- __DT__: deadtime duration (in ns)

Return value:

- DTG[0:7]

Notes:

- ex: __LL_TIM_CALC_DEADTIME (80000000, LL_TIM_GetClockDivision (), 120);

__LL_TIM_CALC_PSC

Description:

- HELPER macro calculating the prescaler value to achieve the required counter clock frequency.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __CNTCLK__: counter clock frequency (in Hz)

Return value:

- Prescaler: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: __LL_TIM_CALC_PSC (80000000, 1000000);

__LL_TIM_CALC_ARR

Description:

- HELPER macro calculating the auto-reload value to achieve the required output signal frequency.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __PSC__: prescaler
- __FREQ__: output signal frequency (in Hz)

Return value:

- Auto-reload: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: __LL_TIM_CALC_ARR (1000000, LL_TIM_GetPrescaler (), 10000);

__LL_TIM_CALC_DELAY

Description:

- HELPER macro calculating the compare value required to achieve the required timer output compare active/inactive delay.

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __PSC__: prescaler
- __DELAY__: timer output compare active/inactive delay (in us)

Return value:

- Compare: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: __LL_TIM_CALC_DELAY (1000000, LL_TIM_GetPrescaler (), 10);

__LL_TIM_CALC_PULSE

Description:

- HELPER macro calculating the auto-reload value to achieve the required pulse duration (when the timer operates in one pulse mode).

Parameters:

- __TIMCLK__: timer input clock frequency (in Hz)
- __PSC__: prescaler
- __DELAY__: timer output compare active/inactive delay (in us)
- __PULSE__: pulse duration (in us)

Return value:

- Auto-reload: value (between Min_Data=0 and Max_Data=65535)

Notes:

- ex: __LL_TIM_CALC_PULSE (1000000, LL_TIM_GetPrescaler (), 10, 20);

__LL_TIM_GET_ICPSC_RATIO

Description:

- HELPER macro retrieving the ratio of the input capture prescaler.

Parameters:

- __ICPSC__: This parameter can be one of the following values:
  - LL_TIM_ICPSC_DIV1
  - LL_TIM_ICPSC_DIV2
  - LL_TIM_ICPSC_DIV4
  - LL_TIM_ICPSC_DIV8

Return value:

- Input: capture prescaler ratio (1, 2, 4 or 8)

Notes:

- ex: __LL_TIM_GET_ICPSC_RATIO (LL_TIM_IC_GetPrescaler ());

Common Write and read registers Macros

LL_TIM_WriteReg

Description:

- Write a value in TIM register.

Parameters:

- __INSTANCE__: TIM Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_TIM_ReadReg

Description:

- Read a value in TIM register.

Parameters:

- __INSTANCE__: TIM Instance
- __REG__: Register to be read

Return value:

- Register: value

105 LL USART Generic Driver

105.1 USART Firmware driver registers structures

105.1.1 LL_USART_InitTypeDef

LL_USART_InitTypeDef is defined in the stm32l4xx_ll_usart.h

Data Fields

- ***uint32_t PrescalerValue***
- ***uint32_t BaudRate***
- ***uint32_t DataWidth***
- ***uint32_t StopBits***
- ***uint32_t Parity***
- ***uint32_t TransferDirection***
- ***uint32_t HardwareFlowControl***
- ***uint32_t OverSampling***

Field Documentation

- ***uint32_t LL_USART_InitTypeDef::PrescalerValue***

  Specifies the Prescaler to compute the communication baud rate. This parameter can be a value of ***USART_LL_EC_PRESCALER***.This feature can be modified afterwards using unitary function **LL_USART_SetPrescaler()**.
- ***uint32_t LL_USART_InitTypeDef::BaudRate***

  This field defines expected Usart communication baud rate.This feature can be modified afterwards using unitary function **LL_USART_SetBaudRate()**.
- ***uint32_t LL_USART_InitTypeDef::DataWidth***

  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***USART_LL_EC_DATAWIDTH***.This feature can be modified afterwards using unitary function **LL_USART_SetDataWidth()**.
- ***uint32_t LL_USART_InitTypeDef::StopBits***

  Specifies the number of stop bits transmitted. This parameter can be a value of ***USART_LL_EC_STOPBITS***.This feature can be modified afterwards using unitary function **LL_USART_SetStopBitsLength()**.
- ***uint32_t LL_USART_InitTypeDef::Parity***

  Specifies the parity mode. This parameter can be a value of ***USART_LL_EC_PARITY***.This feature can be modified afterwards using unitary function **LL_USART_SetParity()**.
- ***uint32_t LL_USART_InitTypeDef::TransferDirection***

  Specifies whether the Receive and/or Transmit mode is enabled or disabled. This parameter can be a value of ***USART_LL_EC_DIRECTION***.This feature can be modified afterwards using unitary function **LL_USART_SetTransferDirection()**.
- ***uint32_t LL_USART_InitTypeDef::HardwareFlowControl***

  Specifies whether the hardware flow control mode is enabled or disabled. This parameter can be a value of ***USART_LL_EC_HWCONTROL***.This feature can be modified afterwards using unitary function **LL_USART_SetHWFlowCtrl()**.
- ***uint32_t LL_USART_InitTypeDef::OverSampling***

  Specifies whether USART oversampling mode is 16 or 8. This parameter can be a value of ***USART_LL_EC_OVERSAMPLING***.This feature can be modified afterwards using unitary function **LL_USART_SetOverSampling()**.

105.1.2 LL_USART_ClockInitTypeDef

LL_USART_ClockInitTypeDef is defined in the stm32l4xx_ll_usart.h

Data Fields

- ***uint32_t ClockOutput***
- ***uint32_t ClockPolarity***
- ***uint32_t ClockPhase***
- ***uint32_t LastBitClockPulse***

Field Documentation

- ***uint32_t LL_USART_ClockInitTypeDef::ClockOutput***

  Specifies whether the USART clock is enabled or disabled. This parameter can be a value of *USART_LL_EC_CLOCK*.USART HW configuration can be modified afterwards using unitary functions **LL_USART_EnableSCLKOutput()** or **LL_USART_DisableSCLKOutput()**. For more details, refer to description of this function.
- ***uint32_t LL_USART_ClockInitTypeDef::ClockPolarity***

  Specifies the steady state of the serial clock. This parameter can be a value of *USART_LL_EC_POLARITY*.USART HW configuration can be modified afterwards using unitary functions **LL_USART_SetClockPolarity()**. For more details, refer to description of this function.
- ***uint32_t LL_USART_ClockInitTypeDef::ClockPhase***

  Specifies the clock transition on which the bit capture is made. This parameter can be a value of *USART_LL_EC_PHASE*.USART HW configuration can be modified afterwards using unitary functions **LL_USART_SetClockPhase()**. For more details, refer to description of this function.
- ***uint32_t LL_USART_ClockInitTypeDef::LastBitClockPulse***

  Specifies whether the clock pulse corresponding to the last transmitted data bit (MSB) has to be output on the SCLK pin in synchronous mode. This parameter can be a value of *USART_LL_EC_LASTCLKPULSE*.USART HW configuration can be modified afterwards using unitary functions **LL_USART_SetLastClkPulseOutput()**. For more details, refer to description of this function.

105.2 USART Firmware driver API description

The following section lists the various functions of the USART library.

105.2.1 Detailed description of functions

`LL_USART_Enable`

Function name

__STATIC_INLINE void LL_USART_Enable (USART_TypeDef * USARTx)

Function description

USART Enable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 UE LL_USART_Enable

`LL_USART_Disable`

Function name

__STATIC_INLINE void LL_USART_Disable (USART_TypeDef * USARTx)

Function description

USART Disable (all USART prescalers and outputs are disabled)

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- When USART is disabled, USART prescalers and outputs are stopped immediately, and current operations are discarded. The configuration of the USART is kept, but all the status flags, in the USARTx_ISR are set to their default values.

Reference Manual to LL API cross reference:

- CR1 UE LL_USART_Disable

`LL_USART_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabled (USART_TypeDef * USARTx)

Function description

Indicate if USART is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 UE LL_USART_IsEnabled

`LL_USART_EnableFIFO`

Function name

__STATIC_INLINE void LL_USART_EnableFIFO (USART_TypeDef * USARTx)

Function description

FIFO Mode Enable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 FIFOEN LL_USART_EnableFIFO

`LL_USART_DisableFIFO`

Function name

__STATIC_INLINE void LL_USART_DisableFIFO (USART_TypeDef * USARTx)

Function description

FIFO Mode Disable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 FIFOEN LL_USART_DisableFIFO

LL_USART_IsEnabledFIFO

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledFIFO (USART_TypeDef * USARTx)

Function description

Indicate if FIFO Mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 FIFOEN LL_USART_IsEnabledFIFO

LL_USART_SetTXFIFOThreshold

Function name

__STATIC_INLINE void LL_USART_SetTXFIFOThreshold (USART_TypeDef * USARTx, uint32_t Threshold)

Function description

Configure TX FIFO Threshold.

Parameters

- **USARTx:** USART Instance
- **Threshold:** This parameter can be one of the following values:
  - LL_USART_FIFOTHRESHOLD_1_8
  - LL_USART_FIFOTHRESHOLD_1_4
  - LL_USART_FIFOTHRESHOLD_1_2
  - LL_USART_FIFOTHRESHOLD_3_4
  - LL_USART_FIFOTHRESHOLD_7_8
  - LL_USART_FIFOTHRESHOLD_8_8

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TXFTCFG LL_USART_SetTXFIFOThreshold

`LL_USART_GetTXFIFOThreshold`

Function name

__STATIC_INLINE uint32_t LL_USART_GetTXFIFOThreshold (USART_TypeDef * USARTx)

Function description

Return TX FIFO Threshold Configuration.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_FIFOTHRESHOLD_1_8
  - LL_USART_FIFOTHRESHOLD_1_4
  - LL_USART_FIFOTHRESHOLD_1_2
  - LL_USART_FIFOTHRESHOLD_3_4
  - LL_USART_FIFOTHRESHOLD_7_8
  - LL_USART_FIFOTHRESHOLD_8_8

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TXFTCFG LL_USART_GetTXFIFOThreshold

`LL_USART_SetRXFIFOThreshold`

Function name

__STATIC_INLINE void LL_USART_SetRXFIFOThreshold (USART_TypeDef * USARTx, uint32_t Threshold)

Function description

Configure RX FIFO Threshold.

Parameters

- **USARTx:** USART Instance
- **Threshold:** This parameter can be one of the following values:
  - LL_USART_FIFOTHRESHOLD_1_8
  - LL_USART_FIFOTHRESHOLD_1_4
  - LL_USART_FIFOTHRESHOLD_1_2
  - LL_USART_FIFOTHRESHOLD_3_4
  - LL_USART_FIFOTHRESHOLD_7_8
  - LL_USART_FIFOTHRESHOLD_8_8

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RXFTCFG LL_USART_SetRXFIFOThreshold

`LL_USART_GetRXFIFOThreshold`

Function name

__STATIC_INLINE uint32_t LL_USART_GetRXFIFOThreshold (USART_TypeDef * USARTx)

Function description

Return RX FIFO Threshold Configuration.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_FIFOTHRESHOLD_1_8
  - LL_USART_FIFOTHRESHOLD_1_4
  - LL_USART_FIFOTHRESHOLD_1_2
  - LL_USART_FIFOTHRESHOLD_3_4
  - LL_USART_FIFOTHRESHOLD_7_8
  - LL_USART_FIFOTHRESHOLD_8_8

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RXFTCFG LL_USART_GetRXFIFOThreshold

`LL_USART_ConfigFIFOsThreshold`

Function name

__STATIC_INLINE void LL_USART_ConfigFIFOsThreshold (USART_TypeDef * USARTx, uint32_t TXThreshold, uint32_t RXThreshold)

Function description

Configure TX and RX FIFOs Threshold.

Parameters

- **USARTx:** USART Instance
- **TXThreshold:** This parameter can be one of the following values:
  - LL_USART_FIFOTHRESHOLD_1_8
  - LL_USART_FIFOTHRESHOLD_1_4
  - LL_USART_FIFOTHRESHOLD_1_2
  - LL_USART_FIFOTHRESHOLD_3_4
  - LL_USART_FIFOTHRESHOLD_7_8
  - LL_USART_FIFOTHRESHOLD_8_8
- **RXThreshold:** This parameter can be one of the following values:
  - LL_USART_FIFOTHRESHOLD_1_8
  - LL_USART_FIFOTHRESHOLD_1_4
  - LL_USART_FIFOTHRESHOLD_1_2
  - LL_USART_FIFOTHRESHOLD_3_4
  - LL_USART_FIFOTHRESHOLD_7_8
  - LL_USART_FIFOTHRESHOLD_8_8

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TXFTCFG LL_USART_ConfigFIFOsThreshold
- CR3 RXFTCFG LL_USART_ConfigFIFOsThreshold

LL_USART_EnableInStopMode

Function name

__STATIC_INLINE void LL_USART_EnableInStopMode (USART_TypeDef * USARTx)

Function description

USART enabled in STOP Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- When this function is enabled, USART is able to wake up the MCU from Stop mode, provided that USART clock selection is HSI or LSE in RCC.
- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 UESM LL_USART_EnableInStopMode

`LL_USART_DisableInStopMode`

Function name

__STATIC_INLINE void LL_USART_DisableInStopMode (USART_TypeDef * USARTx)

Function description

USART disabled in STOP Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- When this function is disabled, USART is not able to wake up the MCU from Stop mode
- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 UESM LL_USART_DisableInStopMode

`LL_USART_IsEnabledInStopMode`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledInStopMode (USART_TypeDef * USARTx)

Function description

Indicate if USART is enabled in STOP Mode (able to wake up MCU from Stop mode or not)

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 UESM LL_USART_IsEnabledInStopMode

`LL_USART_EnableDirectionRx`

Function name

__STATIC_INLINE void LL_USART_EnableDirectionRx (USART_TypeDef * USARTx)

Function description

Receiver Enable (Receiver is enabled and begins searching for a start bit)

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RE LL_USART_EnableDirectionRx

`LL_USART_DisableDirectionRx`

Function name

__STATIC_INLINE void LL_USART_DisableDirectionRx (USART_TypeDef * USARTx)

Function description

Receiver Disable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RE LL_USART_DisableDirectionRx

`LL_USART_EnableDirectionTx`

Function name

__STATIC_INLINE void LL_USART_EnableDirectionTx (USART_TypeDef * USARTx)

Function description

Transmitter Enable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TE LL_USART_EnableDirectionTx

`LL_USART_DisableDirectionTx`

Function name

__STATIC_INLINE void LL_USART_DisableDirectionTx (USART_TypeDef * USARTx)

Function description

Transmitter Disable.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TE LL_USART_DisableDirectionTx

`LL_USART_SetTransferDirection`

Function name

__STATIC_INLINE void LL_USART_SetTransferDirection (USART_TypeDef * USARTx, uint32_t TransferDirection)

Function description

Configure simultaneously enabled/disabled states of Transmitter and Receiver.

Parameters

- **USARTx:** USART Instance
- **TransferDirection:** This parameter can be one of the following values:
  - LL_USART_DIRECTION_NONE
  - LL_USART_DIRECTION_RX
  - LL_USART_DIRECTION_TX
  - LL_USART_DIRECTION_TX_RX

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RE LL_USART_SetTransferDirection
- CR1 TE LL_USART_SetTransferDirection

`LL_USART_GetTransferDirection`

Function name

__STATIC_INLINE uint32_t LL_USART_GetTransferDirection (USART_TypeDef * USARTx)

Function description

Return enabled/disabled states of Transmitter and Receiver.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_DIRECTION_NONE
  - LL_USART_DIRECTION_RX
  - LL_USART_DIRECTION_TX
  - LL_USART_DIRECTION_TX_RX

Reference Manual to LL API cross reference:

- CR1 RE LL_USART_GetTransferDirection
- CR1 TE LL_USART_GetTransferDirection

`LL_USART_SetParity`

Function name

__STATIC_INLINE void LL_USART_SetParity (USART_TypeDef * USARTx, uint32_t Parity)

Function description

Configure Parity (enabled/disabled and parity mode if enabled).

Parameters

- **USARTx:** USART Instance
- **Parity:** This parameter can be one of the following values:
  - LL_USART_PARITY_NONE
  - LL_USART_PARITY_EVEN
  - LL_USART_PARITY_ODD

Return values

- **None:**

Notes

- This function selects if hardware parity control (generation and detection) is enabled or disabled. When the parity control is enabled (Odd or Even), computed parity bit is inserted at the MSB position (9th or 8th bit depending on data width) and parity is checked on the received data.

Reference Manual to LL API cross reference:

- CR1 PS LL_USART_SetParity
- CR1 PCE LL_USART_SetParity

LL_USART_GetParity

Function name

__STATIC_INLINE uint32_t LL_USART_GetParity (USART_TypeDef * USARTx)

Function description

Return Parity configuration (enabled/disabled and parity mode if enabled)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_PARITY_NONE
  - LL_USART_PARITY_EVEN
  - LL_USART_PARITY_ODD

Reference Manual to LL API cross reference:

- CR1 PS LL_USART_GetParity
- CR1 PCE LL_USART_GetParity

LL_USART_SetWakeUpMethod

Function name

__STATIC_INLINE void LL_USART_SetWakeUpMethod (USART_TypeDef * USARTx, uint32_t Method)

Function description

Set Receiver Wake Up method from Mute mode.

Parameters

- **USARTx:** USART Instance
- **Method:** This parameter can be one of the following values:
  - LL_USART_WAKEUP_IDLELINE
  - LL_USART_WAKEUP_ADDRESSMARK

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 WAKE LL_USART_SetWakeUpMethod

`LL_USART_GetWakeUpMethod`

Function name

__STATIC_INLINE uint32_t LL_USART_GetWakeUpMethod (USART_TypeDef * USARTx)

Function description

Return Receiver Wake Up method from Mute mode.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_WAKEUP_IDLELINE
  - LL_USART_WAKEUP_ADDRESSMARK

Reference Manual to LL API cross reference:

- CR1 WAKE LL_USART_GetWakeUpMethod

`LL_USART_SetDataWidth`

Function name

__STATIC_INLINE void LL_USART_SetDataWidth (USART_TypeDef * USARTx, uint32_t DataWidth)

Function description

Set Word length (i.e.

Parameters

- **USARTx:** USART Instance
- **DataWidth:** This parameter can be one of the following values:
  - LL_USART_DATAWIDTH_7B
  - LL_USART_DATAWIDTH_8B
  - LL_USART_DATAWIDTH_9B

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 M0 LL_USART_SetDataWidth
- CR1 M1 LL_USART_SetDataWidth

`LL_USART_GetDataWidth`

Function name

__STATIC_INLINE uint32_t LL_USART_GetDataWidth (USART_TypeDef * USARTx)

Function description

Return Word length (i.e.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_DATAWIDTH_7B
  - LL_USART_DATAWIDTH_8B
  - LL_USART_DATAWIDTH_9B

Reference Manual to LL API cross reference:

- CR1 M0 LL_USART_GetDataWidth
- CR1 M1 LL_USART_GetDataWidth

`LL_USART_EnableMuteMode`

Function name

__STATIC_INLINE void LL_USART_EnableMuteMode (USART_TypeDef * USARTx)

Function description

Allow switch between Mute Mode and Active mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 MME LL_USART_EnableMuteMode

`LL_USART_DisableMuteMode`

Function name

__STATIC_INLINE void LL_USART_DisableMuteMode (USART_TypeDef * USARTx)

Function description

Prevent Mute Mode use.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 MME LL_USART_DisableMuteMode

`LL_USART_IsEnabledMuteMode`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledMuteMode (USART_TypeDef * USARTx)

Function description

Indicate if switch between Mute Mode and Active mode is allowed.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 MME LL_USART_IsEnabledMuteMode

`LL_USART_SetOverSampling`

Function name

__STATIC_INLINE void LL_USART_SetOverSampling (USART_TypeDef * USARTx, uint32_t OverSampling)

Function description

Set Oversampling to 8-bit or 16-bit mode.

Parameters

- **USARTx:** USART Instance
- **OverSampling:** This parameter can be one of the following values:
  - LL_USART_OVERSAMPLING_16
  - LL_USART_OVERSAMPLING_8

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 OVER8 LL_USART_SetOverSampling

`LL_USART_GetOverSampling`

Function name

__STATIC_INLINE uint32_t LL_USART_GetOverSampling (USART_TypeDef * USARTx)

Function description

Return Oversampling mode.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_OVERSAMPLING_16
  - LL_USART_OVERSAMPLING_8

Reference Manual to LL API cross reference:

- CR1 OVER8 LL_USART_GetOverSampling

`LL_USART_SetLastClkPulseOutput`

Function name

__STATIC_INLINE void LL_USART_SetLastClkPulseOutput (USART_TypeDef * USARTx, uint32_t LastBitClockPulse)

Function description

Configure if Clock pulse of the last data bit is output to the SCLK pin or not.

Parameters

- **USARTx:** USART Instance
- **LastBitClockPulse:** This parameter can be one of the following values:
  - LL_USART_LASTCLKPULSE_NO_OUTPUT
  - LL_USART_LASTCLKPULSE_OUTPUT

Return values

- **None:**

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBCL LL_USART_SetLastClkPulseOutput

LL_USART_GetLastClkPulseOutput

Function name

__STATIC_INLINE uint32_t LL_USART_GetLastClkPulseOutput (USART_TypeDef * USARTx)

Function description

Retrieve Clock pulse of the last data bit output configuration (Last bit Clock pulse output to the SCLK pin or not)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_LASTCLKPULSE_NO_OUTPUT
  - LL_USART_LASTCLKPULSE_OUTPUT

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBCL LL_USART_GetLastClkPulseOutput

LL_USART_SetClockPhase

Function name

__STATIC_INLINE void LL_USART_SetClockPhase (USART_TypeDef * USARTx, uint32_t ClockPhase)

Function description

Select the phase of the clock output on the SCLK pin in synchronous mode.

Parameters

- **USARTx:** USART Instance
- **ClockPhase:** This parameter can be one of the following values:
  - LL_USART_PHASE_1EDGE
  - LL_USART_PHASE_2EDGE

Return values

- **None:**

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CPHA LL_USART_SetClockPhase

`LL_USART_GetClockPhase`

Function name

__STATIC_INLINE uint32_t LL_USART_GetClockPhase (USART_TypeDef * USARTx)

Function description

Return phase of the clock output on the SCLK pin in synchronous mode.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_PHASE_1EDGE
  - LL_USART_PHASE_2EDGE

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CPHA LL_USART_GetClockPhase

`LL_USART_SetClockPolarity`

Function name

__STATIC_INLINE void LL_USART_SetClockPolarity (USART_TypeDef * USARTx, uint32_t ClockPolarity)

Function description

Select the polarity of the clock output on the SCLK pin in synchronous mode.

Parameters

- **USARTx:** USART Instance
- **ClockPolarity:** This parameter can be one of the following values:
  - LL_USART_POLARITY_LOW
  - LL_USART_POLARITY_HIGH

Return values

- **None:**

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CPOL LL_USART_SetClockPolarity

`LL_USART_GetClockPolarity`

Function name

__STATIC_INLINE uint32_t LL_USART_GetClockPolarity (USART_TypeDef * USARTx)

Function description

Return polarity of the clock output on the SCLK pin in synchronous mode.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_POLARITY_LOW
  - LL_USART_POLARITY_HIGH

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CPOL LL_USART_GetClockPolarity

`LL_USART_ConfigClock`

Function name

__STATIC_INLINE void LL_USART_ConfigClock (USART_TypeDef * USARTx, uint32_t Phase, uint32_t Polarity, uint32_t LBCPOutput)

Function description

Configure Clock signal format (Phase Polarity and choice about output of last bit clock pulse)

Parameters

- **USARTx:** USART Instance
- **Phase:** This parameter can be one of the following values:
  - LL_USART_PHASE_1EDGE
  - LL_USART_PHASE_2EDGE
- **Polarity:** This parameter can be one of the following values:
  - LL_USART_POLARITY_LOW
  - LL_USART_POLARITY_HIGH
- **LBCPOutput:** This parameter can be one of the following values:
  - LL_USART_LASTCLKPULSE_NO_OUTPUT
  - LL_USART_LASTCLKPULSE_OUTPUT

Return values

- **None:**

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
- Call of this function is equivalent to following function call sequence : Clock Phase configuration using LL_USART_SetClockPhase() functionClock Polarity configuration using LL_USART_SetClockPolarity() functionOutput of Last bit Clock pulse configuration using LL_USART_SetLastClkPulseOutput() function

Reference Manual to LL API cross reference:

- CR2 CPHA LL_USART_ConfigClock
- CR2 CPOL LL_USART_ConfigClock
- CR2 LBCL LL_USART_ConfigClock

`LL_USART_SetPrescaler`

Function name

__STATIC_INLINE void LL_USART_SetPrescaler (USART_TypeDef * USARTx, uint32_t PrescalerValue)

Function description

Configure Clock source prescaler for baudrate generator and oversampling.

Parameters

- **USARTx:** USART Instance
- **PrescalerValue:** This parameter can be one of the following values:
  - LL_USART_PRESCALER_DIV1
  - LL_USART_PRESCALER_DIV2
  - LL_USART_PRESCALER_DIV4
  - LL_USART_PRESCALER_DIV6
  - LL_USART_PRESCALER_DIV8
  - LL_USART_PRESCALER_DIV10
  - LL_USART_PRESCALER_DIV12
  - LL_USART_PRESCALER_DIV16
  - LL_USART_PRESCALER_DIV32
  - LL_USART_PRESCALER_DIV64
  - LL_USART_PRESCALER_DIV128
  - LL_USART_PRESCALER_DIV256

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- PRESC PRESCALER LL_USART_SetPrescaler

`LL_USART_GetPrescaler`

Function name

__STATIC_INLINE uint32_t LL_USART_GetPrescaler (USART_TypeDef * USARTx)

Function description

Retrieve the Clock source prescaler for baudrate generator and oversampling.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_PRESCALER_DIV1
  - LL_USART_PRESCALER_DIV2
  - LL_USART_PRESCALER_DIV4
  - LL_USART_PRESCALER_DIV6
  - LL_USART_PRESCALER_DIV8
  - LL_USART_PRESCALER_DIV10
  - LL_USART_PRESCALER_DIV12
  - LL_USART_PRESCALER_DIV16
  - LL_USART_PRESCALER_DIV32
  - LL_USART_PRESCALER_DIV64
  - LL_USART_PRESCALER_DIV128
  - LL_USART_PRESCALER_DIV256

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- PRESC PRESCALER LL_USART_GetPrescaler

LL_USART_EnableSCLKOutput

Function name

__STATIC_INLINE void LL_USART_EnableSCLKOutput (USART_TypeDef * USARTx)

Function description

Enable Clock output on SCLK pin.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CLKEN LL_USART_EnableSCLKOutput

LL_USART_DisableSCLKOutput

Function name

__STATIC_INLINE void LL_USART_DisableSCLKOutput (USART_TypeDef * USARTx)

Function description

Disable Clock output on SCLK pin.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CLKEN LL_USART_DisableSCLKOutput

`LL_USART_IsEnabledSCLKOutput`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledSCLKOutput (USART_TypeDef * USARTx)

Function description

Indicate if Clock output on SCLK pin is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 CLKEN LL_USART_IsEnabledSCLKOutput

`LL_USART_SetStopBitsLength`

Function name

__STATIC_INLINE void LL_USART_SetStopBitsLength (USART_TypeDef * USARTx, uint32_t StopBits)

Function description

Set the length of the stop bits.

Parameters

- **USARTx:** USART Instance
- **StopBits:** This parameter can be one of the following values:
  - LL_USART_STOPBITS_0_5
  - LL_USART_STOPBITS_1
  - LL_USART_STOPBITS_1_5
  - LL_USART_STOPBITS_2

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 STOP LL_USART_SetStopBitsLength

`LL_USART_GetStopBitsLength`

Function name

__STATIC_INLINE uint32_t LL_USART_GetStopBitsLength (USART_TypeDef * USARTx)

Function description

Retrieve the length of the stop bits.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_STOPBITS_0_5
  - LL_USART_STOPBITS_1
  - LL_USART_STOPBITS_1_5
  - LL_USART_STOPBITS_2

Reference Manual to LL API cross reference:

- CR2 STOP LL_USART_GetStopBitsLength

`LL_USART_ConfigCharacter`

Function name

__STATIC_INLINE void LL_USART_ConfigCharacter (USART_TypeDef * USARTx, uint32_t DataWidth, uint32_t Parity, uint32_t StopBits)

Function description

Configure Character frame format (Datawidth, Parity control, Stop Bits)

Parameters

- **USARTx:** USART Instance
- **DataWidth:** This parameter can be one of the following values:
  - LL_USART_DATAWIDTH_7B
  - LL_USART_DATAWIDTH_8B
  - LL_USART_DATAWIDTH_9B
- **Parity:** This parameter can be one of the following values:
  - LL_USART_PARITY_NONE
  - LL_USART_PARITY_EVEN
  - LL_USART_PARITY_ODD
- **StopBits:** This parameter can be one of the following values:
  - LL_USART_STOPBITS_0_5
  - LL_USART_STOPBITS_1
  - LL_USART_STOPBITS_1_5
  - LL_USART_STOPBITS_2

Return values

- **None:**

Notes

- Call of this function is equivalent to following function call sequence : Data Width configuration using LL_USART_SetDataWidth() functionParity Control and mode configuration using LL_USART_SetParity() functionStop bits configuration using LL_USART_SetStopBitsLength() function

Reference Manual to LL API cross reference:

- CR1 PS LL_USART_ConfigCharacter
- CR1 PCE LL_USART_ConfigCharacter
- CR1 M0 LL_USART_ConfigCharacter
- CR1 M1 LL_USART_ConfigCharacter
- CR2 STOP LL_USART_ConfigCharacter

`LL_USART_SetTXRXSwap`

Function name

__STATIC_INLINE void LL_USART_SetTXRXSwap (USART_TypeDef * USARTx, uint32_t SwapConfig)

Function description

Configure TX/RX pins swapping setting.

Parameters

- **USARTx:** USART Instance
- **SwapConfig:** This parameter can be one of the following values:
  - LL_USART_TXRX_STANDARD
  - LL_USART_TXRX_SWAPPED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 SWAP LL_USART_SetTXRXSwap

`LL_USART_GetTXRXSwap`

Function name

__STATIC_INLINE uint32_t LL_USART_GetTXRXSwap (USART_TypeDef * USARTx)

Function description

Retrieve TX/RX pins swapping configuration.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_TXRX_STANDARD
  - LL_USART_TXRX_SWAPPED

Reference Manual to LL API cross reference:

- CR2 SWAP LL_USART_GetTXRXSwap

`LL_USART_SetRXPinLevel`

Function name

__STATIC_INLINE void LL_USART_SetRXPinLevel (USART_TypeDef * USARTx, uint32_t PinInvMethod)

Function description

Configure RX pin active level logic.

Parameters

- **USARTx:** USART Instance
- **PinInvMethod:** This parameter can be one of the following values:
  - LL_USART_RXPIN_LEVEL_STANDARD
  - LL_USART_RXPIN_LEVEL_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RXINV LL_USART_SetRXPinLevel

`LL_USART_GetRXPinLevel`

Function name

__STATIC_INLINE uint32_t LL_USART_GetRXPinLevel (USART_TypeDef * USARTx)

Function description

Retrieve RX pin active level logic configuration.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_RXPIN_LEVEL_STANDARD
  - LL_USART_RXPIN_LEVEL_INVERTED

Reference Manual to LL API cross reference:

- CR2 RXINV LL_USART_GetRXPinLevel

`LL_USART_SetTXPinLevel`

Function name

__STATIC_INLINE void LL_USART_SetTXPinLevel (USART_TypeDef * USARTx, uint32_t PinInvMethod)

Function description

Configure TX pin active level logic.

Parameters

- **USARTx:** USART Instance
- **PinInvMethod:** This parameter can be one of the following values:
  - LL_USART_TXPIN_LEVEL_STANDARD
  - LL_USART_TXPIN_LEVEL_INVERTED

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 TXINV LL_USART_SetTXPinLevel

`LL_USART_GetTXPinLevel`

Function name

__STATIC_INLINE uint32_t LL_USART_GetTXPinLevel (USART_TypeDef * USARTx)

Function description

Retrieve TX pin active level logic configuration.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_TXPIN_LEVEL_STANDARD
  - LL_USART_TXPIN_LEVEL_INVERTED

Reference Manual to LL API cross reference:

- CR2 TXINV LL_USART_GetTXPinLevel

`LL_USART_SetBinaryDataLogic`

Function name

__STATIC_INLINE void LL_USART_SetBinaryDataLogic (USART_TypeDef * USARTx, uint32_t DataLogic)

Function description

Configure Binary data logic.

Parameters

- **USARTx:** USART Instance
- **DataLogic:** This parameter can be one of the following values:
  - LL_USART_BINARY_LOGIC_POSITIVE
  - LL_USART_BINARY_LOGIC_NEGATIVE

Return values

- **None:**

Notes

- Allow to define how Logical data from the data register are send/received : either in positive/direct logic (1=H, 0=L) or in negative/inverse logic (1=L, 0=H)

Reference Manual to LL API cross reference:

- CR2 DATAINV LL_USART_SetBinaryDataLogic

`LL_USART_GetBinaryDataLogic`

Function name

__STATIC_INLINE uint32_t LL_USART_GetBinaryDataLogic (USART_TypeDef * USARTx)

Function description

Retrieve Binary data configuration.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_BINARY_LOGIC_POSITIVE
  - LL_USART_BINARY_LOGIC_NEGATIVE

Reference Manual to LL API cross reference:

- CR2 DATAINV LL_USART_GetBinaryDataLogic

`LL_USART_SetTransferBitOrder`

Function name

__STATIC_INLINE void LL_USART_SetTransferBitOrder (USART_TypeDef * USARTx, uint32_t BitOrder)

Function description

Configure transfer bit order (either Less or Most Significant Bit First)

Parameters

- **USARTx:** USART Instance
- **BitOrder:** This parameter can be one of the following values:
  - LL_USART_BITORDER_LSBFIRST
  - LL_USART_BITORDER_MSBFIRST

Return values

- **None:**

Notes

- MSB First means data is transmitted/received with the MSB first, following the start bit. LSB First means data is transmitted/received with data bit 0 first, following the start bit.

Reference Manual to LL API cross reference:

- CR2 MSBFIRST LL_USART_SetTransferBitOrder

`LL_USART_GetTransferBitOrder`

Function name

__STATIC_INLINE uint32_t LL_USART_GetTransferBitOrder (USART_TypeDef * USARTx)

Function description

Return transfer bit order (either Less or Most Significant Bit First)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_BITORDER_LSBFIRST
  - LL_USART_BITORDER_MSBFIRST

Notes

- MSB First means data is transmitted/received with the MSB first, following the start bit. LSB First means data is transmitted/received with data bit 0 first, following the start bit.

Reference Manual to LL API cross reference:

- CR2 MSBFIRST LL_USART_GetTransferBitOrder

`LL_USART_EnableAutoBaudRate`

Function name

__STATIC_INLINE void LL_USART_EnableAutoBaudRate (USART_TypeDef * USARTx)

Function description

Enable Auto Baud-Rate Detection.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 ABREN LL_USART_EnableAutoBaudRate

`LL_USART_DisableAutoBaudRate`

Function name

__STATIC_INLINE void LL_USART_DisableAutoBaudRate (USART_TypeDef * USARTx)

Function description

Disable Auto Baud-Rate Detection.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 ABREN LL_USART_DisableAutoBaudRate

`LL_USART_IsEnabledAutoBaud`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledAutoBaud (USART_TypeDef * USARTx)

Function description

Indicate if Auto Baud-Rate Detection mechanism is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 ABREN LL_USART_IsEnabledAutoBaud

`LL_USART_SetAutoBaudRateMode`

Function name

__STATIC_INLINE void LL_USART_SetAutoBaudRateMode (USART_TypeDef * USARTx, uint32_t AutoBaudRateMode)

Function description

Set Auto Baud-Rate mode bits.

Parameters

- **USARTx:** USART Instance
- **AutoBaudRateMode:** This parameter can be one of the following values:
  - LL_USART_AUTOBAUD_DETECT_ON_STARTBIT
  - LL_USART_AUTOBAUD_DETECT_ON_FALLINGEDGE
  - LL_USART_AUTOBAUD_DETECT_ON_7F_FRAME
  - LL_USART_AUTOBAUD_DETECT_ON_55_FRAME

Return values

- **None:**

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 ABRMODE LL_USART_SetAutoBaudRateMode

`LL_USART_GetAutoBaudRateMode`

Function name

__STATIC_INLINE uint32_t LL_USART_GetAutoBaudRateMode (USART_TypeDef * USARTx)

Function description

Return Auto Baud-Rate mode.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_AUTOBAUD_DETECT_ON_STARTBIT
  - LL_USART_AUTOBAUD_DETECT_ON_FALLINGEDGE
  - LL_USART_AUTOBAUD_DETECT_ON_7F_FRAME
  - LL_USART_AUTOBAUD_DETECT_ON_55_FRAME

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 ABRMODE LL_USART_GetAutoBaudRateMode

`LL_USART_EnableRxTimeout`

Function name

__STATIC_INLINE void LL_USART_EnableRxTimeout (USART_TypeDef * USARTx)

Function description

Enable Receiver Timeout.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RTOEN LL_USART_EnableRxTimeout

`LL_USART_DisableRxTimeout`

Function name

__STATIC_INLINE void LL_USART_DisableRxTimeout (USART_TypeDef * USARTx)

Function description

Disable Receiver Timeout.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR2 RTOEN LL_USART_DisableRxTimeout

`LL_USART_IsEnabledRxTimeout`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledRxTimeout (USART_TypeDef * USARTx)

Function description

Indicate if Receiver Timeout feature is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR2 RTOEN LL_USART_IsEnabledRxTimeout

`LL_USART_ConfigNodeAddress`

Function name

__STATIC_INLINE void LL_USART_ConfigNodeAddress (USART_TypeDef * USARTx, uint32_t AddressLen, uint32_t NodeAddress)

Function description

Set Address of the USART node.

Parameters

- **USARTx:** USART Instance
- **AddressLen:** This parameter can be one of the following values:
  - LL_USART_ADDRESS_DETECT_4B
  - LL_USART_ADDRESS_DETECT_7B
- **NodeAddress:** 4 or 7 bit Address of the USART node.

Return values

- **None:**

Notes

- This is used in multiprocessor communication during Mute mode or Stop mode, for wake up with address mark detection.
- 4bits address node is used when 4-bit Address Detection is selected in ADDM7. (b7-b4 should be set to 0) 8bits address node is used when 7-bit Address Detection is selected in ADDM7. (This is used in multiprocessor communication during Mute mode or Stop mode, for wake up with 7-bit address mark detection. The MSB of the character sent by the transmitter should be equal to 1. It may also be used for character detection during normal reception, Mute mode inactive (for example, end of block detection in ModBus protocol). In this case, the whole received character (8-bit) is compared to the ADD[7:0] value and CMF flag is set on match)

Reference Manual to LL API cross reference:

- CR2 ADD LL_USART_ConfigNodeAddress
- CR2 ADDM7 LL_USART_ConfigNodeAddress

LL_USART_GetNodeAddress

Function name

__STATIC_INLINE uint32_t LL_USART_GetNodeAddress (USART_TypeDef * USARTx)

Function description

Return 8 bit Address of the USART node as set in ADD field of CR2.

Parameters

- **USARTx:** USART Instance

Return values

- **Address:** of the USART node (Value between Min_Data=0 and Max_Data=255)

Notes

- If 4-bit Address Detection is selected in ADDM7, only 4bits (b3-b0) of returned value are relevant (b31-b4 are not relevant) If 7-bit Address Detection is selected in ADDM7, only 8bits (b7-b0) of returned value are relevant (b31-b8 are not relevant)

Reference Manual to LL API cross reference:

- CR2 ADD LL_USART_GetNodeAddress

LL_USART_GetNodeAddressLen

Function name

__STATIC_INLINE uint32_t LL_USART_GetNodeAddressLen (USART_TypeDef * USARTx)

Function description

Return Length of Node Address used in Address Detection mode (7-bit or 4-bit)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_ADDRESS_DETECT_4B
  - LL_USART_ADDRESS_DETECT_7B

Reference Manual to LL API cross reference:

- CR2 ADDM7 LL_USART_GetNodeAddressLen

`LL_USART_EnableRTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_USART_EnableRTSHWFlowCtrl (USART_TypeDef * USARTx)

Function description

Enable RTS HW Flow Control.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RTSE LL_USART_EnableRTSHWFlowCtrl

`LL_USART_DisableRTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_USART_DisableRTSHWFlowCtrl (USART_TypeDef * USARTx)

Function description

Disable RTS HW Flow Control.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RTSE LL_USART_DisableRTSHWFlowCtrl

`LL_USART_EnableCTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_USART_EnableCTSHWFlowCtrl (USART_TypeDef * USARTx)

Function description

Enable CTS HW Flow Control.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 CTSE LL_USART_EnableCTSHWFlowCtrl

`LL_USART_DisableCTSHWFlowCtrl`

Function name

__STATIC_INLINE void LL_USART_DisableCTSHWFlowCtrl (USART_TypeDef * USARTx)

Function description

Disable CTS HW Flow Control.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 CTSE LL_USART_DisableCTSHWFlowCtrl

`LL_USART_SetHWFlowCtrl`

Function name

__STATIC_INLINE void LL_USART_SetHWFlowCtrl (USART_TypeDef * USARTx, uint32_t HardwareFlowControl)

Function description

Configure HW Flow Control mode (both CTS and RTS)

Parameters

- **USARTx:** USART Instance
- **HardwareFlowControl:** This parameter can be one of the following values:
  - LL_USART_HWCONTROL_NONE
  - LL_USART_HWCONTROL_RTS
  - LL_USART_HWCONTROL_CTS
  - LL_USART_HWCONTROL_RTS_CTS

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RTSE LL_USART_SetHWFlowCtrl
- CR3 CTSE LL_USART_SetHWFlowCtrl

LL_USART_GetHWFlowCtrl

Function name

__STATIC_INLINE uint32_t LL_USART_GetHWFlowCtrl (USART_TypeDef * USARTx)

Function description

Return HW Flow Control configuration (both CTS and RTS)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_HWCONTROL_NONE
  - LL_USART_HWCONTROL_RTS
  - LL_USART_HWCONTROL_CTS
  - LL_USART_HWCONTROL_RTS_CTS

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RTSE LL_USART_GetHWFlowCtrl
- CR3 CTSE LL_USART_GetHWFlowCtrl

LL_USART_EnableOneBitSamp

Function name

__STATIC_INLINE void LL_USART_EnableOneBitSamp (USART_TypeDef * USARTx)

Function description

Enable One bit sampling method.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 ONEBIT LL_USART_EnableOneBitSamp

`LL_USART_DisableOneBitSamp`

Function name

__STATIC_INLINE void LL_USART_DisableOneBitSamp (USART_TypeDef * USARTx)

Function description

Disable One bit sampling method.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 ONEBIT LL_USART_DisableOneBitSamp

`LL_USART_IsEnabledOneBitSamp`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledOneBitSamp (USART_TypeDef * USARTx)

Function description

Indicate if One bit sampling method is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 ONEBIT LL_USART_IsEnabledOneBitSamp

`LL_USART_EnableOverrunDetect`

Function name

__STATIC_INLINE void LL_USART_EnableOverrunDetect (USART_TypeDef * USARTx)

Function description

Enable Overrun detection.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 OVRDIS LL_USART_EnableOverrunDetect

`LL_USART_DisableOverrunDetect`

Function name

__STATIC_INLINE void LL_USART_DisableOverrunDetect (USART_TypeDef * USARTx)

Function description

Disable Overrun detection.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 OVRDIS LL_USART_DisableOverrunDetect

`LL_USART_IsEnabledOverrunDetect`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledOverrunDetect (USART_TypeDef * USARTx)

Function description

Indicate if Overrun detection is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 OVRDIS LL_USART_IsEnabledOverrunDetect

`LL_USART_SetWKUPType`

Function name

__STATIC_INLINE void LL_USART_SetWKUPType (USART_TypeDef * USARTx, uint32_t Type)

Function description

Select event type for Wake UP Interrupt Flag (WUS[1:0] bits)

Parameters

- **USARTx:** USART Instance
- **Type:** This parameter can be one of the following values:
  - LL_USART_WAKEUP_ON_ADDRESS
  - LL_USART_WAKEUP_ON_STARTBIT
  - LL_USART_WAKEUP_ON_RXNE

Return values

- **None:**

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 WUS LL_USART_SetWKUPType

`LL_USART_GetWKUPType`

Function name

__STATIC_INLINE uint32_t LL_USART_GetWKUPType (USART_TypeDef * USARTx)

Function description

Return event type for Wake UP Interrupt Flag (WUS[1:0] bits)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_WAKEUP_ON_ADDRESS
  - LL_USART_WAKEUP_ON_STARTBIT
  - LL_USART_WAKEUP_ON_RXNE

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 WUS LL_USART_GetWKUPType

`LL_USART_SetBaudRate`

Function name

__STATIC_INLINE void LL_USART_SetBaudRate (USART_TypeDef * USARTx, uint32_t PeriphClk, uint32_t PrescalerValue, uint32_t OverSampling, uint32_t BaudRate)

Function description

Configure USART BRR register for achieving expected Baud Rate value.

Parameters

- **USARTx:** USART Instance
- **PeriphClk:** Peripheral Clock
- **OverSampling:** This parameter can be one of the following values:
  - LL_USART_OVERSAMPLING_16
  - LL_USART_OVERSAMPLING_8
- **BaudRate:** Baud Rate

Return values

- **None:**

Notes

- Compute and set USARTDIV value in BRR Register (full BRR content) according to used Peripheral Clock, Oversampling mode, and expected Baud Rate values
- Peripheral clock and Baud rate values provided as function parameters should be valid (Baud rate value != 0)
- In case of oversampling by 16 and 8, BRR content must be greater than or equal to 16d.

Reference Manual to LL API cross reference:

- BRR BRR LL_USART_SetBaudRate

`LL_USART_GetBaudRate`

Function name

__STATIC_INLINE uint32_t LL_USART_GetBaudRate (USART_TypeDef * USARTx, uint32_t PeriphClk, uint32_t PrescalerValue, uint32_t OverSampling)

Function description

Return current Baud Rate value, according to USARTDIV present in BRR register (full BRR content), and to used Peripheral Clock and Oversampling mode values.

Parameters

- **USARTx:** USART Instance
- **PeriphClk:** Peripheral Clock
- **OverSampling:** This parameter can be one of the following values:
  - LL_USART_OVERSAMPLING_16
  - LL_USART_OVERSAMPLING_8

Return values

- **Baud:** Rate

Notes

- In case of non-initialized or invalid value stored in BRR register, value 0 will be returned.
- In case of oversampling by 16 and 8, BRR content must be greater than or equal to 16d.

Reference Manual to LL API cross reference:

- BRR BRR LL_USART_GetBaudRate

`LL_USART_SetRxTimeout`

Function name

__STATIC_INLINE void LL_USART_SetRxTimeout (USART_TypeDef * USARTx, uint32_t Timeout)

Function description

Set Receiver Time Out Value (expressed in nb of bits duration)

Parameters

- **USARTx:** USART Instance
- **Timeout:** Value between Min_Data=0x00 and Max_Data=0x00FFFFFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTOR RTO LL_USART_SetRxTimeout

`LL_USART_GetRxTimeout`

Function name

__STATIC_INLINE uint32_t LL_USART_GetRxTimeout (USART_TypeDef * USARTx)

Function description

Get Receiver Time Out Value (expressed in nb of bits duration)

Parameters

- **USARTx:** USART Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x00FFFFFF

Reference Manual to LL API cross reference:

- RTOR RTO LL_USART_GetRxTimeout

`LL_USART_SetBlockLength`

Function name

__STATIC_INLINE void LL_USART_SetBlockLength (USART_TypeDef * USARTx, uint32_t BlockLength)

Function description

Set Block Length value in reception.

Parameters

- **USARTx:** USART Instance
- **BlockLength:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- RTOR BLEN LL_USART_SetBlockLength

`LL_USART_GetBlockLength`

Function name

__STATIC_INLINE uint32_t LL_USART_GetBlockLength (USART_TypeDef * USARTx)

Function description

Get Block Length value in reception.

Parameters

- **USARTx:** USART Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- RTOR BLEN LL_USART_GetBlockLength

`LL_USART_EnableIrda`

Function name

__STATIC_INLINE void LL_USART_EnableIrda (USART_TypeDef * USARTx)

Function description

Enable IrDA mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IREN LL_USART_EnableIrda

`LL_USART_DisableIrda`

Function name

__STATIC_INLINE void LL_USART_DisableIrda (USART_TypeDef * USARTx)

Function description

Disable IrDA mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IREN LL_USART_DisableIrda

`LL_USART_IsEnabledIrda`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIrda (USART_TypeDef * USARTx)

Function description

Indicate if IrDA mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IREN LL_USART_IsEnabledIrda

`LL_USART_SetIrdaPowerMode`

Function name

__STATIC_INLINE void LL_USART_SetIrdaPowerMode (USART_TypeDef * USARTx, uint32_t PowerMode)

Function description

Configure IrDA Power Mode (Normal or Low Power)

Parameters

- **USARTx:** USART Instance
- **PowerMode:** This parameter can be one of the following values:
  - LL_USART_IRDA_POWER_NORMAL
  - LL_USART_IRDA_POWER_LOW

Return values

- **None:**

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IRLP LL_USART_SetIrdaPowerMode

LL_USART_GetIrdaPowerMode

Function name

__STATIC_INLINE uint32_t LL_USART_GetIrdaPowerMode (USART_TypeDef * USARTx)

Function description

Retrieve IrDA Power Mode configuration (Normal or Low Power)

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_IRDA_POWER_NORMAL
  - LL_USART_PHASE_2EDGE

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 IRLP LL_USART_GetIrdaPowerMode

LL_USART_SetIrdaPrescaler

Function name

__STATIC_INLINE void LL_USART_SetIrdaPrescaler (USART_TypeDef * USARTx, uint32_t PrescalerValue)

Function description

Set Irda prescaler value, used for dividing the USART clock source to achieve the Irda Low Power frequency (8 bits value)

Parameters

- **USARTx:** USART Instance
- **PrescalerValue:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- GTPR PSC LL_USART_SetIrdaPrescaler

`LL_USART_GetIrdaPrescaler`

Function name

__STATIC_INLINE uint32_t LL_USART_GetIrdaPrescaler (USART_TypeDef * USARTx)

Function description

Return Irda prescaler value, used for dividing the USART clock source to achieve the Irda Low Power frequency (8 bits value)

Parameters

- **USARTx:** USART Instance

Return values

- **Irda:** prescaler value (Value between Min_Data=0x00 and Max_Data=0xFF)

Notes

- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- GTPR PSC LL_USART_GetIrdaPrescaler

`LL_USART_EnableSmartcardNACK`

Function name

__STATIC_INLINE void LL_USART_EnableSmartcardNACK (USART_TypeDef * USARTx)

Function description

Enable Smartcard NACK transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 NACK LL_USART_EnableSmartcardNACK

`LL_USART_DisableSmartcardNACK`

Function name

__STATIC_INLINE void LL_USART_DisableSmartcardNACK (USART_TypeDef * USARTx)

Function description

Disable Smartcard NACK transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 NACK LL_USART_DisableSmartcardNACK

`LL_USART_IsEnabledSmartcardNACK`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledSmartcardNACK (USART_TypeDef * USARTx)

Function description

Indicate if Smartcard NACK transmission is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 NACK LL_USART_IsEnabledSmartcardNACK

`LL_USART_EnableSmartcard`

Function name

__STATIC_INLINE void LL_USART_EnableSmartcard (USART_TypeDef * USARTx)

Function description

Enable Smartcard mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 SCEN LL_USART_EnableSmartcard

LL_USART_DisableSmartcard

Function name

__STATIC_INLINE void LL_USART_DisableSmartcard (USART_TypeDef * USARTx)

Function description

Disable Smartcard mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 SCEN LL_USART_DisableSmartcard

LL_USART_IsEnabledSmartcard

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledSmartcard (USART_TypeDef * USARTx)

Function description

Indicate if Smartcard mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 SCEN LL_USART_IsEnabledSmartcard

LL_USART_SetSmartcardAutoRetryCount

Function name

__STATIC_INLINE void LL_USART_SetSmartcardAutoRetryCount (USART_TypeDef * USARTx, uint32_t AutoRetryCount)

Function description

Set Smartcard Auto-Retry Count value (SCARCNT[2:0] bits)

Parameters

- **USARTx:** USART Instance
- **AutoRetryCount:** Value between Min_Data=0 and Max_Data=7

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
- This bit-field specifies the number of retries in transmit and receive, in Smartcard mode. In transmission mode, it specifies the number of automatic retransmission retries, before generating a transmission error (FE bit set). In reception mode, it specifies the number or erroneous reception trials, before generating a reception error (RXNE and PE bits set)

Reference Manual to LL API cross reference:

- CR3 SCARCNT LL_USART_SetSmartcardAutoRetryCount

LL_USART_GetSmartcardAutoRetryCount

Function name

__STATIC_INLINE uint32_t LL_USART_GetSmartcardAutoRetryCount (USART_TypeDef * USARTx)

Function description

Return Smartcard Auto-Retry Count value (SCARCNT[2:0] bits)

Parameters

- **USARTx:** USART Instance

Return values

- **Smartcard:** Auto-Retry Count value (Value between Min_Data=0 and Max_Data=7)

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 SCARCNT LL_USART_GetSmartcardAutoRetryCount

LL_USART_SetSmartcardPrescaler

Function name

__STATIC_INLINE void LL_USART_SetSmartcardPrescaler (USART_TypeDef * USARTx, uint32_t PrescalerValue)

Function description

Set Smartcard prescaler value, used for dividing the USART clock source to provide the SMARTCARD Clock (5 bits value)

Parameters

- **USARTx:** USART Instance
- **PrescalerValue:** Value between Min_Data=0 and Max_Data=31

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- GTPR PSC LL_USART_SetSmartcardPrescaler

`LL_USART_GetSmartcardPrescaler`

Function name

__STATIC_INLINE uint32_t LL_USART_GetSmartcardPrescaler (USART_TypeDef * USARTx)

Function description

Return Smartcard prescaler value, used for dividing the USART clock source to provide the SMARTCARD Clock (5 bits value)

Parameters

- **USARTx:** USART Instance

Return values

- **Smartcard:** prescaler value (Value between Min_Data=0 and Max_Data=31)

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- GTPR PSC LL_USART_GetSmartcardPrescaler

`LL_USART_SetSmartcardGuardTime`

Function name

__STATIC_INLINE void LL_USART_SetSmartcardGuardTime (USART_TypeDef * USARTx, uint32_t GuardTime)

Function description

Set Smartcard Guard time value, expressed in nb of baud clocks periods (GT[7:0] bits : Guard time value)

Parameters

- **USARTx:** USART Instance
- **GuardTime:** Value between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- GTPR GT LL_USART_SetSmartcardGuardTime

`LL_USART_GetSmartcardGuardTime`

Function name

__STATIC_INLINE uint32_t LL_USART_GetSmartcardGuardTime (USART_TypeDef * USARTx)

Function description

Return Smartcard Guard time value, expressed in nb of baud clocks periods (GT[7:0] bits : Guard time value)

Parameters

- **USARTx:** USART Instance

Return values

- **Smartcard:** Guard time value (Value between Min_Data=0x00 and Max_Data=0xFF)

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- GTPR GT LL_USART_GetSmartcardGuardTime

`LL_USART_EnableHalfDuplex`

Function name

__STATIC_INLINE void LL_USART_EnableHalfDuplex (USART_TypeDef * USARTx)

Function description

Enable Single Wire Half-Duplex mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HALFDUPLEX_INSTANCE(USARTx) can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 HDSEL LL_USART_EnableHalfDuplex

`LL_USART_DisableHalfDuplex`

Function name

__STATIC_INLINE void LL_USART_DisableHalfDuplex (USART_TypeDef * USARTx)

Function description

Disable Single Wire Half-Duplex mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HALFDUPLEX_INSTANCE(USARTx) can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 HDSEL LL_USART_DisableHalfDuplex

`LL_USART_IsEnabledHalfDuplex`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledHalfDuplex (USART_TypeDef * USARTx)

Function description

Indicate if Single Wire Half-Duplex mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_HALFDUPLEX_INSTANCE(USARTx) can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 HDSEL LL_USART_IsEnabledHalfDuplex

`LL_USART_EnableSPISlave`

Function name

__STATIC_INLINE void LL_USART_EnableSPISlave (USART_TypeDef * USARTx)

Function description

Enable SPI Synchronous Slave mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 SLVEN LL_USART_EnableSPISlave

`LL_USART_DisableSPISlave`

Function name

__STATIC_INLINE void LL_USART_DisableSPISlave (USART_TypeDef * USARTx)

Function description

Disable SPI Synchronous Slave mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 SLVEN LL_USART_DisableSPISlave

`LL_USART_IsEnabledSPISlave`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledSPISlave (USART_TypeDef * USARTx)

Function description

Indicate if SPI Synchronous Slave mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 SLVEN LL_USART_IsEnabledSPISlave

`LL_USART_EnableSPISlaveSelect`

Function name

__STATIC_INLINE void LL_USART_EnableSPISlaveSelect (USART_TypeDef * USARTx)

Function description

Enable SPI Slave Selection using NSS input pin.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.
- SPI Slave Selection depends on NSS input pin (The slave is selected when NSS is low and deselected when NSS is high).

Reference Manual to LL API cross reference:

- CR2 DIS_NSS LL_USART_EnableSPISlaveSelect

`LL_USART_DisableSPISlaveSelect`

Function name

__STATIC_INLINE void LL_USART_DisableSPISlaveSelect (USART_TypeDef * USARTx)

Function description

Disable SPI Slave Selection using NSS input pin.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.
- SPI Slave will be always selected and NSS input pin will be ignored.

Reference Manual to LL API cross reference:

- CR2 DIS_NSS LL_USART_DisableSPISlaveSelect

LL_USART_IsEnabledSPISlaveSelect

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledSPISlaveSelect (USART_TypeDef * USARTx)

Function description

Indicate if SPI Slave Selection depends on NSS input pin.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 DIS_NSS LL_USART_IsEnabledSPISlaveSelect

LL_USART_SetLINBrkDetectionLen

Function name

__STATIC_INLINE void LL_USART_SetLINBrkDetectionLen (USART_TypeDef * USARTx, uint32_t LINBDLength)

Function description

Set LIN Break Detection Length.

Parameters

- **USARTx:** USART Instance
- **LINBDLength:** This parameter can be one of the following values:
  - LL_USART_LINBREAK_DETECT_10B
  - LL_USART_LINBREAK_DETECT_11B

Return values

- **None:**

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBDL LL_USART_SetLINBrkDetectionLen

`LL_USART_GetLINBrkDetectionLen`

Function name

__STATIC_INLINE uint32_t LL_USART_GetLINBrkDetectionLen (USART_TypeDef * USARTx)

Function description

Return LIN Break Detection Length.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_LINBREAK_DETECT_10B
  - LL_USART_LINBREAK_DETECT_11B

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBDL LL_USART_GetLINBrkDetectionLen

`LL_USART_EnableLIN`

Function name

__STATIC_INLINE void LL_USART_EnableLIN (USART_TypeDef * USARTx)

Function description

Enable LIN mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_EnableLIN

`LL_USART_DisableLIN`

Function name

__STATIC_INLINE void LL_USART_DisableLIN (USART_TypeDef * USARTx)

Function description

Disable LIN mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_DisableLIN

LL_USART_IsEnabledLIN

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledLIN (USART_TypeDef * USARTx)

Function description

Indicate if LIN mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_IsEnabledLIN

LL_USART_SetDEDeassertionTime

Function name

__STATIC_INLINE void LL_USART_SetDEDeassertionTime (USART_TypeDef * USARTx, uint32_t Time)

Function description

Set DEDT (Driver Enable De-Assertion Time), Time value expressed on 5 bits ([4:0] bits).

Parameters

- **USARTx:** USART Instance
- **Time:** Value between Min_Data=0 and Max_Data=31

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 DEDT LL_USART_SetDEDeassertionTime

`LL_USART_GetDEDeassertionTime`

Function name

__STATIC_INLINE uint32_t LL_USART_GetDEDeassertionTime (USART_TypeDef * USARTx)

Function description

Return DEDT (Driver Enable De-Assertion Time)

Parameters

- **USARTx:** USART Instance

Return values

- **Time:** value expressed on 5 bits ([4:0] bits) : Value between Min_Data=0 and Max_Data=31

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 DEDT LL_USART_GetDEDeassertionTime

`LL_USART_SetDEAssertionTime`

Function name

__STATIC_INLINE void LL_USART_SetDEAssertionTime (USART_TypeDef * USARTx, uint32_t Time)

Function description

Set DEAT (Driver Enable Assertion Time), Time value expressed on 5 bits ([4:0] bits).

Parameters

- **USARTx:** USART Instance
- **Time:** Value between Min_Data=0 and Max_Data=31

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 DEAT LL_USART_SetDEAssertionTime

`LL_USART_GetDEAssertionTime`

Function name

__STATIC_INLINE uint32_t LL_USART_GetDEAssertionTime (USART_TypeDef * USARTx)

Function description

Return DEAT (Driver Enable Assertion Time)

Parameters

- **USARTx:** USART Instance

Return values

- **Time:** value expressed on 5 bits ([4:0] bits) : Value between Min_Data=0 and Max_Data=31

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 DEAT LL_USART_GetDEAssertionTime

`LL_USART_EnableDEMode`

Function name

__STATIC_INLINE void LL_USART_EnableDEMode (USART_TypeDef * USARTx)

Function description

Enable Driver Enable (DE) Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEM LL_USART_EnableDEMode

`LL_USART_DisableDEMode`

Function name

__STATIC_INLINE void LL_USART_DisableDEMode (USART_TypeDef * USARTx)

Function description

Disable Driver Enable (DE) Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEM LL_USART_DisableDEMode

`LL_USART_IsEnabledDEMode`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledDEMode (USART_TypeDef * USARTx)

Function description

Indicate if Driver Enable (DE) Mode is enabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEM LL_USART_IsEnabledDEMode

LL_USART_SetDESignalPolarity

Function name

__STATIC_INLINE void LL_USART_SetDESignalPolarity (USART_TypeDef * USARTx, uint32_t Polarity)

Function description

Select Driver Enable Polarity.

Parameters

- **USARTx:** USART Instance
- **Polarity:** This parameter can be one of the following values:
  - LL_USART_DE_POLARITY_HIGH
  - LL_USART_DE_POLARITY_LOW

Return values

- **None:**

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEP LL_USART_SetDESignalPolarity

LL_USART_GetDESignalPolarity

Function name

__STATIC_INLINE uint32_t LL_USART_GetDESignalPolarity (USART_TypeDef * USARTx)

Function description

Return Driver Enable Polarity.

Parameters

- **USARTx:** USART Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_USART_DE_POLARITY_HIGH
  - LL_USART_DE_POLARITY_LOW

Notes

- Macro IS_UART_DRIVER_ENABLE_INSTANCE(USARTx) can be used to check whether or not Driver Enable feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 DEP LL_USART_GetDESignalPolarity

LL_USART_ConfigAsyncMode

Function name

__STATIC_INLINE void LL_USART_ConfigAsyncMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in Asynchronous Mode (UART)

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In UART mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,CLKEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register.
- Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() function
- Other remaining configurations items related to Asynchronous Mode (as Baud Rate, Word length, Parity, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_ConfigAsyncMode
- CR2 CLKEN LL_USART_ConfigAsyncMode
- CR3 SCEN LL_USART_ConfigAsyncMode
- CR3 IREN LL_USART_ConfigAsyncMode
- CR3 HDSEL LL_USART_ConfigAsyncMode

LL_USART_ConfigSyncMode

Function name

__STATIC_INLINE void LL_USART_ConfigSyncMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in Synchronous Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In Synchronous mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register. This function also sets the USART in Synchronous mode.
- Macro IS_USART_INSTANCE(USARTx) can be used to check whether or not Synchronous mode is supported by the USARTx instance.
- Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() functionSet CLKEN in CR2 using LL_USART_EnableSCLKOutput() function
- Other remaining configurations items related to Synchronous Mode (as Baud Rate, Word length, Parity, Clock Polarity, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_ConfigSyncMode
- CR2 CLKEN LL_USART_ConfigSyncMode
- CR3 SCEN LL_USART_ConfigSyncMode
- CR3 IREN LL_USART_ConfigSyncMode
- CR3 HDSEL LL_USART_ConfigSyncMode

LL_USART_ConfigLINMode

Function name

__STATIC_INLINE void LL_USART_ConfigLINMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in LIN Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In LIN mode, the following bits must be kept cleared: STOP and CLKEN bits in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register. This function also set the UART/USART in LIN mode.
- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.
- Call of this function is equivalent to following function call sequence : Clear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear STOP in CR2 using LL_USART_SetStopBitsLength() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() functionSet LINEN in CR2 using LL_USART_EnableLIN() function
- Other remaining configurations items related to LIN Mode (as Baud Rate, Word length, LIN Break Detection Length, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 CLKEN LL_USART_ConfigLINMode
- CR2 STOP LL_USART_ConfigLINMode
- CR2 LINEN LL_USART_ConfigLINMode
- CR3 IREN LL_USART_ConfigLINMode
- CR3 SCEN LL_USART_ConfigLINMode
- CR3 HDSEL LL_USART_ConfigLINMode

`LL_USART_ConfigHalfDuplexMode`

Function name

__STATIC_INLINE void LL_USART_ConfigHalfDuplexMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in Half Duplex Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In Half Duplex mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,CLKEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register, This function also sets the UART/USART in Half Duplex mode.
- Macro IS_UART_HALFDUPLEX_INSTANCE(USARTx) can be used to check whether or not Half-Duplex mode is supported by the USARTx instance.
- Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionSet HDSEL in CR3 using LL_USART_EnableHalfDuplex() function
- Other remaining configurations items related to Half Duplex Mode (as Baud Rate, Word length, Parity, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_ConfigHalfDuplexMode
- CR2 CLKEN LL_USART_ConfigHalfDuplexMode
- CR3 HDSEL LL_USART_ConfigHalfDuplexMode
- CR3 SCEN LL_USART_ConfigHalfDuplexMode
- CR3 IREN LL_USART_ConfigHalfDuplexMode

`LL_USART_ConfigSmartcardMode`

Function name

__STATIC_INLINE void LL_USART_ConfigSmartcardMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in Smartcard Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In Smartcard mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register. This function also configures Stop bits to 1.5 bits and sets the USART in Smartcard mode (SCEN bit). Clock Output is also enabled (CLKEN).
- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.
- Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() functionConfigure STOP in CR2 using LL_USART_SetStopBitsLength() functionSet CLKEN in CR2 using LL_USART_EnableSCLKOutput() functionSet SCEN in CR3 using LL_USART_EnableSmartcard() function
- Other remaining configurations items related to Smartcard Mode (as Baud Rate, Word length, Parity, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_ConfigSmartcardMode
- CR2 STOP LL_USART_ConfigSmartcardMode
- CR2 CLKEN LL_USART_ConfigSmartcardMode
- CR3 HDSEL LL_USART_ConfigSmartcardMode
- CR3 SCEN LL_USART_ConfigSmartcardMode

LL_USART_ConfigIrdaMode

Function name

__STATIC_INLINE void LL_USART_ConfigIrdaMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in Irda Mode.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In IRDA mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,STOP and CLKEN bits in the USART_CR2 register,SCEN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register. This function also sets the UART/USART in IRDA mode (IREN bit).
- Macro IS_IRDA_INSTANCE(USARTx) can be used to check whether or not IrDA feature is supported by the USARTx instance.
- Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() functionConfigure STOP in CR2 using LL_USART_SetStopBitsLength() functionSet IREN in CR3 using LL_USART_EnableIrda() function
- Other remaining configurations items related to Irda Mode (as Baud Rate, Word length, Power mode, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_ConfigIrdaMode
- CR2 CLKEN LL_USART_ConfigIrdaMode
- CR2 STOP LL_USART_ConfigIrdaMode
- CR3 SCEN LL_USART_ConfigIrdaMode
- CR3 HDSEL LL_USART_ConfigIrdaMode
- CR3 IREN LL_USART_ConfigIrdaMode

`LL_USART_ConfigMultiProcessMode`

Function name

__STATIC_INLINE void LL_USART_ConfigMultiProcessMode (USART_TypeDef * USARTx)

Function description

Perform basic configuration of USART for enabling use in Multi processor Mode (several USARTs connected in a network, one of the USARTs can be the master, its TX output connected to the RX inputs of the other slaves USARTs).

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- In MultiProcessor mode, the following bits must be kept cleared: LINEN bit in the USART_CR2 register,CLKEN bit in the USART_CR2 register,SCEN bit in the USART_CR3 register,IREN bit in the USART_CR3 register,HDSEL bit in the USART_CR3 register.
- Call of this function is equivalent to following function call sequence : Clear LINEN in CR2 using LL_USART_DisableLIN() functionClear CLKEN in CR2 using LL_USART_DisableSCLKOutput() functionClear SCEN in CR3 using LL_USART_DisableSmartcard() functionClear IREN in CR3 using LL_USART_DisableIrda() functionClear HDSEL in CR3 using LL_USART_DisableHalfDuplex() function
- Other remaining configurations items related to Multi processor Mode (as Baud Rate, Wake Up Method, Node address, ...) should be set using dedicated functions

Reference Manual to LL API cross reference:

- CR2 LINEN LL_USART_ConfigMultiProcessMode
- CR2 CLKEN LL_USART_ConfigMultiProcessMode
- CR3 SCEN LL_USART_ConfigMultiProcessMode
- CR3 HDSEL LL_USART_ConfigMultiProcessMode
- CR3 IREN LL_USART_ConfigMultiProcessMode

`LL_USART_IsActiveFlag_PE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_PE (USART_TypeDef * USARTx)

Function description

Check if the USART Parity Error Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR PE LL_USART_IsActiveFlag_PE

`LL_USART_IsActiveFlag_FE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_FE (USART_TypeDef * USARTx)

Function description

Check if the USART Framing Error Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR FE LL_USART_IsActiveFlag_FE

`LL_USART_IsActiveFlag_NE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_NE (USART_TypeDef * USARTx)

Function description

Check if the USART Noise error detected Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR NE LL_USART_IsActiveFlag_NE

`LL_USART_IsActiveFlag_ORE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_ORE (USART_TypeDef * USARTx)

Function description

Check if the USART OverRun Error Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR ORE LL_USART_IsActiveFlag_ORE

LL_USART_IsActiveFlag_IDLE

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_IDLE (USART_TypeDef * USARTx)

Function description

Check if the USART IDLE line detected Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR IDLE LL_USART_IsActiveFlag_IDLE

LL_USART_IsActiveFlag_RXNE_RXFNE

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RXNE_RXFNE (USART_TypeDef * USARTx)

Function description

Check if the USART Read Data Register or USART RX FIFO Not Empty Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR RXNE_RXFNE LL_USART_IsActiveFlag_RXNE_RXFNE

LL_USART_IsActiveFlag_TC

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TC (USART_TypeDef * USARTx)

Function description

Check if the USART Transmission Complete Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TC LL_USART_IsActiveFlag_TC

LL_USART_IsActiveFlag_TXE_TXFNF

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TXE_TXFNF (USART_TypeDef * USARTx)

Function description

Check if the USART Transmit Data Register Empty or USART TX FIFO Not Full Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR TXE_TXFNF LL_USART_IsActiveFlag_TXE_TXFNF

LL_USART_IsActiveFlag_LBD

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_LBD (USART_TypeDef * USARTx)

Function description

Check if the USART LIN Break Detection Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR LBDF LL_USART_IsActiveFlag_LBD

LL_USART_IsActiveFlag_nCTS

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_nCTS (USART_TypeDef * USARTx)

Function description

Check if the USART CTS interrupt Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR CTSIF LL_USART_IsActiveFlag_nCTS

`LL_USART_IsActiveFlag_CTS`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_CTS (USART_TypeDef * USARTx)

Function description

Check if the USART CTS Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR CTS LL_USART_IsActiveFlag_CTS

`LL_USART_IsActiveFlag_RTO`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RTO (USART_TypeDef * USARTx)

Function description

Check if the USART Receiver Time Out Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RTOF LL_USART_IsActiveFlag_RTO

`LL_USART_IsActiveFlag_EOB`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_EOB (USART_TypeDef * USARTx)

Function description

Check if the USART End Of Block Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR EOBF LL_USART_IsActiveFlag_EOB

`LL_USART_IsActiveFlag_UDR`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_UDR (USART_TypeDef * USARTx)

Function description

Check if the SPI Slave Underrun error flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR UDR LL_USART_IsActiveFlag_UDR

`LL_USART_IsActiveFlag_ABRE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_ABRE (USART_TypeDef * USARTx)

Function description

Check if the USART Auto-Baud Rate Error Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR ABRE LL_USART_IsActiveFlag_ABRE

`LL_USART_IsActiveFlag_ABR`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_ABR (USART_TypeDef * USARTx)

Function description

Check if the USART Auto-Baud Rate Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR ABRF LL_USART_IsActiveFlag_ABR

`LL_USART_IsActiveFlag_BUSY`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_BUSY (USART_TypeDef * USARTx)

Function description

Check if the USART Busy Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR BUSY LL_USART_IsActiveFlag_BUSY

`LL_USART_IsActiveFlag_CM`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_CM (USART_TypeDef * USARTx)

Function description

Check if the USART Character Match Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR CMF LL_USART_IsActiveFlag_CM

`LL_USART_IsActiveFlag_SBK`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_SBK (USART_TypeDef * USARTx)

Function description

Check if the USART Send Break Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR SBKF LL_USART_IsActiveFlag_SBK

`LL_USART_IsActiveFlag_RWU`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RWU (USART_TypeDef * USARTx)

Function description

Check if the USART Receive Wake Up from mute mode Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR RWU LL_USART_IsActiveFlag_RWU

`LL_USART_IsActiveFlag_WKUP`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_WKUP (USART_TypeDef * USARTx)

Function description

Check if the USART Wake Up from stop mode Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR WUF LL_USART_IsActiveFlag_WKUP

`LL_USART_IsActiveFlag_TEACK`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TEACK (USART_TypeDef * USARTx)

Function description

Check if the USART Transmit Enable Acknowledge Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TEACK LL_USART_IsActiveFlag_TEACK

`LL_USART_IsActiveFlag_REACK`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_REACK (USART_TypeDef * USARTx)

Function description

Check if the USART Receive Enable Acknowledge Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR REACK LL_USART_IsActiveFlag_REACK

`LL_USART_IsActiveFlag_TXFE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TXFE (USART_TypeDef * USARTx)

Function description

Check if the USART TX FIFO Empty Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR TXFE LL_USART_IsActiveFlag_TXFE

`LL_USART_IsActiveFlag_RXFF`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RXFF (USART_TypeDef * USARTx)

Function description

Check if the USART RX FIFO Full Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR RXFF LL_USART_IsActiveFlag_RXFF

`LL_USART_IsActiveFlag_TCBGT`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TCBGT (USART_TypeDef * USARTx)

Function description

Check if the Smartcard Transmission Complete Before Guard Time Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- ISR TCBGT LL_USART_IsActiveFlag_TCBGT

`LL_USART_IsActiveFlag_TXFT`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TXFT (USART_TypeDef * USARTx)

Function description

Check if the USART TX FIFO Threshold Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR TXFT LL_USART_IsActiveFlag_TXFT

`LL_USART_IsActiveFlag_RXFT`

Function name

__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RXFT (USART_TypeDef * USARTx)

Function description

Check if the USART RX FIFO Threshold Flag is set or not.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ISR RXFT LL_USART_IsActiveFlag_RXFT

`LL_USART_ClearFlag_PE`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_PE (USART_TypeDef * USARTx)

Function description

Clear Parity Error Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR PECF LL_USART_ClearFlag_PE

`LL_USART_ClearFlag_FE`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_FE (USART_TypeDef * USARTx)

Function description

Clear Framing Error Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR FECF LL_USART_ClearFlag_FE

`LL_USART_ClearFlag_NE`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_NE (USART_TypeDef * USARTx)

Function description

Clear Noise Error detected Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR NECF LL_USART_ClearFlag_NE

`LL_USART_ClearFlag_ORE`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_ORE (USART_TypeDef * USARTx)

Function description

Clear OverRun Error Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR ORECF LL_USART_ClearFlag_ORE

`LL_USART_ClearFlag_IDLE`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_IDLE (USART_TypeDef * USARTx)

Function description

Clear IDLE line detected Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR IDLECF LL_USART_ClearFlag_IDLE

`LL_USART_ClearFlag_TXFE`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_TXFE (USART_TypeDef * USARTx)

Function description

Clear TX FIFO Empty Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ICR TXFECF LL_USART_ClearFlag_TXFE

`LL_USART_ClearFlag_TC`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_TC (USART_TypeDef * USARTx)

Function description

Clear Transmission Complete Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR TCCF LL_USART_ClearFlag_TC

`LL_USART_ClearFlag_TCBGT`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_TCBGT (USART_TypeDef * USARTx)

Function description

Clear Smartcard Transmission Complete Before Guard Time Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR TCBGTCF LL_USART_ClearFlag_TCBGT

`LL_USART_ClearFlag_LBD`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_LBD (USART_TypeDef * USARTx)

Function description

Clear LIN Break Detection Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ICR LBDCF LL_USART_ClearFlag_LBD

`LL_USART_ClearFlag_nCTS`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_nCTS (USART_TypeDef * USARTx)

Function description

Clear CTS Interrupt Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ICR CTSCF LL_USART_ClearFlag_nCTS

`LL_USART_ClearFlag_RTO`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_RTO (USART_TypeDef * USARTx)

Function description

Clear Receiver Time Out Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR RTOCF LL_USART_ClearFlag_RTO

`LL_USART_ClearFlag_EOB`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_EOB (USART_TypeDef * USARTx)

Function description

Clear End Of Block Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ICR EOBCF LL_USART_ClearFlag_EOB

`LL_USART_ClearFlag_UDR`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_UDR (USART_TypeDef * USARTx)

Function description

Clear SPI Slave Underrun Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_SPI_SLAVE_INSTANCE(USARTx) can be used to check whether or not SPI Slave mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ICR UDRCF LL_USART_ClearFlag_UDR

`LL_USART_ClearFlag_CM`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_CM (USART_TypeDef * USARTx)

Function description

Clear Character Match Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- ICR CMCF LL_USART_ClearFlag_CM

`LL_USART_ClearFlag_WKUP`

Function name

__STATIC_INLINE void LL_USART_ClearFlag_WKUP (USART_TypeDef * USARTx)

Function description

Clear Wake Up from stop mode Flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- ICR WUCF LL_USART_ClearFlag_WKUP

`LL_USART_EnableIT_IDLE`

Function name

__STATIC_INLINE void LL_USART_EnableIT_IDLE (USART_TypeDef * USARTx)

Function description

Enable IDLE Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 IDLEIE LL_USART_EnableIT_IDLE

`LL_USART_EnableIT_RXNE_RXFNE`

Function name

__STATIC_INLINE void LL_USART_EnableIT_RXNE_RXFNE (USART_TypeDef * USARTx)

Function description

Enable RX Not Empty and RX FIFO Not Empty Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 RXNEIE_RXFNEIE LL_USART_EnableIT_RXNE_RXFNE

`LL_USART_EnableIT_TC`

Function name

__STATIC_INLINE void LL_USART_EnableIT_TC (USART_TypeDef * USARTx)

Function description

Enable Transmission Complete Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TCIE LL_USART_EnableIT_TC

`LL_USART_EnableIT_TXE_TXFNF`

Function name

__STATIC_INLINE void LL_USART_EnableIT_TXE_TXFNF (USART_TypeDef * USARTx)

Function description

Enable TX Empty and TX FIFO Not Full Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 TXEIE_TXFNFIE LL_USART_EnableIT_TXE_TXFNF

`LL_USART_EnableIT_PE`

Function name

__STATIC_INLINE void LL_USART_EnableIT_PE (USART_TypeDef * USARTx)

Function description

Enable Parity Error Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PEIE LL_USART_EnableIT_PE

`LL_USART_EnableIT_CM`

Function name

__STATIC_INLINE void LL_USART_EnableIT_CM (USART_TypeDef * USARTx)

Function description

Enable Character Match Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CMIE LL_USART_EnableIT_CM

`LL_USART_EnableIT_RTO`

Function name

__STATIC_INLINE void LL_USART_EnableIT_RTO (USART_TypeDef * USARTx)

Function description

Enable Receiver Timeout Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RTOIE LL_USART_EnableIT_RTO

`LL_USART_EnableIT_EOB`

Function name

__STATIC_INLINE void LL_USART_EnableIT_EOB (USART_TypeDef * USARTx)

Function description

Enable End Of Block Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 EOBIE LL_USART_EnableIT_EOB

`LL_USART_EnableIT_TXFE`

Function name

__STATIC_INLINE void LL_USART_EnableIT_TXFE (USART_TypeDef * USARTx)

Function description

Enable TX FIFO Empty Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 TXFEIE LL_USART_EnableIT_TXFE

`LL_USART_EnableIT_RXFF`

Function name

__STATIC_INLINE void LL_USART_EnableIT_RXFF (USART_TypeDef * USARTx)

Function description

Enable RX FIFO Full Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RXFFIE LL_USART_EnableIT_RXFF

`LL_USART_EnableIT_LBD`

Function name

__STATIC_INLINE void LL_USART_EnableIT_LBD (USART_TypeDef * USARTx)

Function description

Enable LIN Break Detection Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBDIE LL_USART_EnableIT_LBD

`LL_USART_EnableIT_ERROR`

Function name

__STATIC_INLINE void LL_USART_EnableIT_ERROR (USART_TypeDef * USARTx)

Function description

Enable Error Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- When set, Error Interrupt Enable Bit is enabling interrupt generation in case of a framing error, overrun error or noise flag (FE=1 or ORE=1 or NF=1 in the USARTx_ISR register). 0: Interrupt is inhibited 1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the USARTx_ISR register.

Reference Manual to LL API cross reference:

- CR3 EIE LL_USART_EnableIT_ERROR

`LL_USART_EnableIT_CTS`

Function name

__STATIC_INLINE void LL_USART_EnableIT_CTS (USART_TypeDef * USARTx)

Function description

Enable CTS Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 CTSIE LL_USART_EnableIT_CTS

`LL_USART_EnableIT_WKUP`

Function name

__STATIC_INLINE void LL_USART_EnableIT_WKUP (USART_TypeDef * USARTx)

Function description

Enable Wake Up from Stop Mode Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 WUFIE LL_USART_EnableIT_WKUP

`LL_USART_EnableIT_TXFT`

Function name

__STATIC_INLINE void LL_USART_EnableIT_TXFT (USART_TypeDef * USARTx)

Function description

Enable TX FIFO Threshold Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TXFTIE LL_USART_EnableIT_TXFT

`LL_USART_EnableIT_TCBGT`

Function name

__STATIC_INLINE void LL_USART_EnableIT_TCBGT (USART_TypeDef * USARTx)

Function description

Enable Smartcard Transmission Complete Before Guard Time Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TCBGTIE LL_USART_EnableIT_TCBGT

`LL_USART_EnableIT_RXFT`

Function name

__STATIC_INLINE void LL_USART_EnableIT_RXFT (USART_TypeDef * USARTx)

Function description

Enable RX FIFO Threshold Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RXFTIE LL_USART_EnableIT_RXFT

LL_USART_DisableIT_IDLE

Function name

__STATIC_INLINE void LL_USART_DisableIT_IDLE (USART_TypeDef * USARTx)

Function description

Disable IDLE Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 IDLEIE LL_USART_DisableIT_IDLE

LL_USART_DisableIT_RXNE_RXFNE

Function name

__STATIC_INLINE void LL_USART_DisableIT_RXNE_RXFNE (USART_TypeDef * USARTx)

Function description

Disable RX Not Empty and RX FIFO Not Empty Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 RXNEIE_RXFNEIE LL_USART_DisableIT_RXNE_RXFNE

LL_USART_DisableIT_TC

Function name

__STATIC_INLINE void LL_USART_DisableIT_TC (USART_TypeDef * USARTx)

Function description

Disable Transmission Complete Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 TCIE LL_USART_DisableIT_TC

LL_USART_DisableIT_TXE_TXFNF

Function name

__STATIC_INLINE void LL_USART_DisableIT_TXE_TXFNF (USART_TypeDef * USARTx)

Function description

Disable TX Empty and TX FIFO Not Full Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 TXEIE_TXFNFIE LL_USART_DisableIT_TXE_TXFNF

LL_USART_DisableIT_PE

Function name

__STATIC_INLINE void LL_USART_DisableIT_PE (USART_TypeDef * USARTx)

Function description

Disable Parity Error Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 PEIE LL_USART_DisableIT_PE

LL_USART_DisableIT_CM

Function name

__STATIC_INLINE void LL_USART_DisableIT_CM (USART_TypeDef * USARTx)

Function description

Disable Character Match Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 CMIE LL_USART_DisableIT_CM

`LL_USART_DisableIT_RTO`

Function name

__STATIC_INLINE void LL_USART_DisableIT_RTO (USART_TypeDef * USARTx)

Function description

Disable Receiver Timeout Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR1 RTOIE LL_USART_DisableIT_RTO

`LL_USART_DisableIT_EOB`

Function name

__STATIC_INLINE void LL_USART_DisableIT_EOB (USART_TypeDef * USARTx)

Function description

Disable End Of Block Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 EOBIE LL_USART_DisableIT_EOB

`LL_USART_DisableIT_TXFE`

Function name

__STATIC_INLINE void LL_USART_DisableIT_TXFE (USART_TypeDef * USARTx)

Function description

Disable TX FIFO Empty Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 TXFEIE LL_USART_DisableIT_TXFE

`LL_USART_DisableIT_RXFF`

Function name

__STATIC_INLINE void LL_USART_DisableIT_RXFF (USART_TypeDef * USARTx)

Function description

Disable RX FIFO Full Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 RXFFIE LL_USART_DisableIT_RXFF

`LL_USART_DisableIT_LBD`

Function name

__STATIC_INLINE void LL_USART_DisableIT_LBD (USART_TypeDef * USARTx)

Function description

Disable LIN Break Detection Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBDIE LL_USART_DisableIT_LBD

`LL_USART_DisableIT_ERROR`

Function name

__STATIC_INLINE void LL_USART_DisableIT_ERROR (USART_TypeDef * USARTx)

Function description

Disable Error Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- When set, Error Interrupt Enable Bit is enabling interrupt generation in case of a framing error, overrun error or noise flag (FE=1 or ORE=1 or NF=1 in the USARTx_ISR register). 0: Interrupt is inhibited 1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the USARTx_ISR register.

Reference Manual to LL API cross reference:

- CR3 EIE LL_USART_DisableIT_ERROR

`LL_USART_DisableIT_CTS`

Function name

__STATIC_INLINE void LL_USART_DisableIT_CTS (USART_TypeDef * USARTx)

Function description

Disable CTS Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 CTSIE LL_USART_DisableIT_CTS

`LL_USART_DisableIT_WKUP`

Function name

__STATIC_INLINE void LL_USART_DisableIT_WKUP (USART_TypeDef * USARTx)

Function description

Disable Wake Up from Stop Mode Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 WUFIE LL_USART_DisableIT_WKUP

`LL_USART_DisableIT_TXFT`

Function name

__STATIC_INLINE void LL_USART_DisableIT_TXFT (USART_TypeDef * USARTx)

Function description

Disable TX FIFO Threshold Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TXFTIE LL_USART_DisableIT_TXFT

LL_USART_DisableIT_TCBGT

Function name

__STATIC_INLINE void LL_USART_DisableIT_TCBGT (USART_TypeDef * USARTx)

Function description

Disable Smartcard Transmission Complete Before Guard Time Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TCBGTIE LL_USART_DisableIT_TCBGT

LL_USART_DisableIT_RXFT

Function name

__STATIC_INLINE void LL_USART_DisableIT_RXFT (USART_TypeDef * USARTx)

Function description

Disable RX FIFO Threshold Interrupt.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RXFTIE LL_USART_DisableIT_RXFT

LL_USART_IsEnabledIT_IDLE

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_IDLE (USART_TypeDef * USARTx)

Function description

Check if the USART IDLE Interrupt source is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 IDLEIE LL_USART_IsEnabledIT_IDLE

LL_USART_IsEnabledIT_RXNE_RXFNE

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RXNE_RXFNE (USART_TypeDef * USARTx)

Function description

Check if the USART RX Not Empty and USART RX FIFO Not Empty Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 RXNEIE_RXFNEIE LL_USART_IsEnabledIT_RXNE_RXFNE

LL_USART_IsEnabledIT_TC

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TC (USART_TypeDef * USARTx)

Function description

Check if the USART Transmission Complete Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 TCIE LL_USART_IsEnabledIT_TC

`LL_USART_IsEnabledIT_TXE_TXFNF`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TXE_TXFNF (USART_TypeDef * USARTx)

Function description

Check if the USART TX Empty and USART TX FIFO Not Full Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 TXEIE_TXFNFIE LL_USART_IsEnabledIT_TXE_TXFNF

`LL_USART_IsEnabledIT_PE`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_PE (USART_TypeDef * USARTx)

Function description

Check if the USART Parity Error Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 PEIE LL_USART_IsEnabledIT_PE

`LL_USART_IsEnabledIT_CM`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_CM (USART_TypeDef * USARTx)

Function description

Check if the USART Character Match Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 CMIE LL_USART_IsEnabledIT_CM

LL_USART_IsEnabledIT_RTO

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RTO (USART_TypeDef * USARTx)

Function description

Check if the USART Receiver Timeout Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR1 RTOIE LL_USART_IsEnabledIT_RTO

LL_USART_IsEnabledIT_EOB

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_EOB (USART_TypeDef * USARTx)

Function description

Check if the USART End Of Block Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 EOBIE LL_USART_IsEnabledIT_EOB

LL_USART_IsEnabledIT_TXFE

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TXFE (USART_TypeDef * USARTx)

Function description

Check if the USART TX FIFO Empty Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 TXFEIE LL_USART_IsEnabledIT_TXFE

`LL_USART_IsEnabledIT_RXFF`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RXFF (USART_TypeDef * USARTx)

Function description

Check if the USART RX FIFO Full Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR1 RXFFIE LL_USART_IsEnabledIT_RXFF

`LL_USART_IsEnabledIT_LBD`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_LBD (USART_TypeDef * USARTx)

Function description

Check if the USART LIN Break Detection Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_LIN_INSTANCE(USARTx) can be used to check whether or not LIN feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR2 LBDIE LL_USART_IsEnabledIT_LBD

`LL_USART_IsEnabledIT_ERROR`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_ERROR (USART_TypeDef * USARTx)

Function description

Check if the USART Error Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 EIE LL_USART_IsEnabledIT_ERROR

`LL_USART_IsEnabledIT_CTS`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_CTS (USART_TypeDef * USARTx)

Function description

Check if the USART CTS Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_HWFLOW_INSTANCE(USARTx) can be used to check whether or not Hardware Flow control feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 CTSIE LL_USART_IsEnabledIT_CTS

`LL_USART_IsEnabledIT_WKUP`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_WKUP (USART_TypeDef * USARTx)

Function description

Check if the USART Wake Up from Stop Mode Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_WAKEUP_FROMSTOP_INSTANCE(USARTx) can be used to check whether or not Wake-up from Stop mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 WUFIE LL_USART_IsEnabledIT_WKUP

`LL_USART_IsEnabledIT_TXFT`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TXFT (USART_TypeDef * USARTx)

Function description

Check if USART TX FIFO Threshold Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TXFTIE LL_USART_IsEnabledIT_TXFT

`LL_USART_IsEnabledIT_TCBGT`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TCBGT (USART_TypeDef * USARTx)

Function description

Check if the Smartcard Transmission Complete Before Guard Time Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_SMARTCARD_INSTANCE(USARTx) can be used to check whether or not Smartcard feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 TCBGTIE LL_USART_IsEnabledIT_TCBGT

`LL_USART_IsEnabledIT_RXFT`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RXFT (USART_TypeDef * USARTx)

Function description

Check if USART RX FIFO Threshold Interrupt is enabled or disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Notes

- Macro IS_UART_FIFO_INSTANCE(USARTx) can be used to check whether or not FIFO mode feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- CR3 RXFTIE LL_USART_IsEnabledIT_RXFT

`LL_USART_EnableDMAReq_RX`

Function name

__STATIC_INLINE void LL_USART_EnableDMAReq_RX (USART_TypeDef * USARTx)

Function description

Enable DMA Mode for reception.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAR LL_USART_EnableDMAReq_RX

`LL_USART_DisableDMAReq_RX`

Function name

__STATIC_INLINE void LL_USART_DisableDMAReq_RX (USART_TypeDef * USARTx)

Function description

Disable DMA Mode for reception.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAR LL_USART_DisableDMAReq_RX

`LL_USART_IsEnabledDMAReq_RX`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledDMAReq_RX (USART_TypeDef * USARTx)

Function description

Check if DMA Mode is enabled for reception.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DMAR LL_USART_IsEnabledDMAReq_RX

`LL_USART_EnableDMAReq_TX`

Function name

__STATIC_INLINE void LL_USART_EnableDMAReq_TX (USART_TypeDef * USARTx)

Function description

Enable DMA Mode for transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAT LL_USART_EnableDMAReq_TX

`LL_USART_DisableDMAReq_TX`

Function name

__STATIC_INLINE void LL_USART_DisableDMAReq_TX (USART_TypeDef * USARTx)

Function description

Disable DMA Mode for transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DMAT LL_USART_DisableDMAReq_TX

`LL_USART_IsEnabledDMAReq_TX`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledDMAReq_TX (USART_TypeDef * USARTx)

Function description

Check if DMA Mode is enabled for transmission.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DMAT LL_USART_IsEnabledDMAReq_TX

`LL_USART_EnableDMADeactOnRxErr`

Function name

__STATIC_INLINE void LL_USART_EnableDMADeactOnRxErr (USART_TypeDef * USARTx)

Function description

Enable DMA Disabling on Reception Error.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DDRE LL_USART_EnableDMADeactOnRxErr

`LL_USART_DisableDMADeactOnRxErr`

Function name

__STATIC_INLINE void LL_USART_DisableDMADeactOnRxErr (USART_TypeDef * USARTx)

Function description

Disable DMA Disabling on Reception Error.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- CR3 DDRE LL_USART_DisableDMADeactOnRxErr

`LL_USART_IsEnabledDMADeactOnRxErr`

Function name

__STATIC_INLINE uint32_t LL_USART_IsEnabledDMADeactOnRxErr (USART_TypeDef * USARTx)

Function description

Indicate if DMA Disabling on Reception Error is disabled.

Parameters

- **USARTx:** USART Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR3 DDRE LL_USART_IsEnabledDMADeactOnRxErr

`LL_USART_DMA_GetRegAddr`

Function name

__STATIC_INLINE uint32_t LL_USART_DMA_GetRegAddr (USART_TypeDef * USARTx, uint32_t Direction)

Function description

Get the data register address used for DMA transfer.

Parameters

- **USARTx:** USART Instance
- **Direction:** This parameter can be one of the following values:
  - LL_USART_DMA_REG_DATA_TRANSMIT
  - LL_USART_DMA_REG_DATA_RECEIVE

Return values

- **Address:** of data register

Reference Manual to LL API cross reference:

- RDR RDR LL_USART_DMA_GetRegAddr
-
- TDR TDR LL_USART_DMA_GetRegAddr

`LL_USART_ReceiveData8`

Function name

__STATIC_INLINE uint8_t LL_USART_ReceiveData8 (USART_TypeDef * USARTx)

Function description

Read Receiver Data register (Receive Data value, 8 bits)

Parameters

- **USARTx:** USART Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Reference Manual to LL API cross reference:

- RDR RDR LL_USART_ReceiveData8

`LL_USART_ReceiveData9`

Function name

__STATIC_INLINE uint16_t LL_USART_ReceiveData9 (USART_TypeDef * USARTx)

Function description

Read Receiver Data register (Receive Data value, 9 bits)

Parameters

- **USARTx:** USART Instance

Return values

- **Value:** between Min_Data=0x00 and Max_Data=0x1FF

Reference Manual to LL API cross reference:

- RDR RDR LL_USART_ReceiveData9

`LL_USART_TransmitData8`

Function name

__STATIC_INLINE void LL_USART_TransmitData8 (USART_TypeDef * USARTx, uint8_t Value)

Function description

Write in Transmitter Data Register (Transmit Data value, 8 bits)

Parameters

- **USARTx:** USART Instance
- **Value:** between Min_Data=0x00 and Max_Data=0xFF

Return values

- **None:**

Reference Manual to LL API cross reference:

- TDR TDR LL_USART_TransmitData8

`LL_USART_TransmitData9`

Function name

__STATIC_INLINE void LL_USART_TransmitData9 (USART_TypeDef * USARTx, uint16_t Value)

Function description

Write in Transmitter Data Register (Transmit Data value, 9 bits)

Parameters

- **USARTx:** USART Instance
- **Value:** between Min_Data=0x00 and Max_Data=0x1FF

Return values

- **None:**

Reference Manual to LL API cross reference:

- TDR TDR LL_USART_TransmitData9

`LL_USART_RequestAutoBaudRate`

Function name

__STATIC_INLINE void LL_USART_RequestAutoBaudRate (USART_TypeDef * USARTx)

Function description

Request an Automatic Baud Rate measurement on next received data frame.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Notes

- Macro IS_USART_AUTOBAUDRATE_DETECTION_INSTANCE(USARTx) can be used to check whether or not Auto Baud Rate detection feature is supported by the USARTx instance.

Reference Manual to LL API cross reference:

- RQR ABRRQ LL_USART_RequestAutoBaudRate

`LL_USART_RequestBreakSending`

Function name

__STATIC_INLINE void LL_USART_RequestBreakSending (USART_TypeDef * USARTx)

Function description

Request Break sending.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR SBKRQ LL_USART_RequestBreakSending

`LL_USART_RequestEnterMuteMode`

Function name

__STATIC_INLINE void LL_USART_RequestEnterMuteMode (USART_TypeDef * USARTx)

Function description

Put USART in mute mode and set the RWU flag.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR MMRQ LL_USART_RequestEnterMuteMode

`LL_USART_RequestRxDataFlush`

Function name

__STATIC_INLINE void LL_USART_RequestRxDataFlush (USART_TypeDef * USARTx)

Function description

Request a Receive Data flush.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR RXFRQ LL_USART_RequestRxDataFlush

`LL_USART_RequestTxDataFlush`

Function name

__STATIC_INLINE void LL_USART_RequestTxDataFlush (USART_TypeDef * USARTx)

Function description

Request a Transmit data flush.

Parameters

- **USARTx:** USART Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- RQR TXFRQ LL_USART_RequestTxDataFlush

`LL_USART_DeInit`

Function name

ErrorStatus LL_USART_DeInit (USART_TypeDef * USARTx)

Function description

De-initialize USART registers (Registers restored to their default values).

Parameters

- **USARTx:** USART Instance

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: USART registers are de-initialized
  - ERROR: USART registers are not de-initialized

LL_USART_Init

Function name

ErrorStatus LL_USART_Init (USART_TypeDef * USARTx, LL_USART_InitTypeDef * USART_InitStruct)

Function description

Initialize USART registers according to the specified parameters in USART_InitStruct.

Parameters

- **USARTx:** USART Instance
- **USART_InitStruct:** pointer to a LL_USART_InitTypeDef structure that contains the configuration information for the specified USART peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: USART registers are initialized according to USART_InitStruct content
  - ERROR: Problem occurred during USART Registers initialization

Notes

- As some bits in USART configuration registers can only be written when the USART is disabled (USART_CR1_UE bit =0), USART Peripheral should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.
- Baud rate value stored in USART_InitStruct BaudRate field, should be valid (different from 0).

LL_USART_StructInit

Function name

void LL_USART_StructInit (LL_USART_InitTypeDef * USART_InitStruct)

Function description

Set each LL_USART_InitTypeDef field to default value.

Parameters

- **USART_InitStruct:** pointer to a LL_USART_InitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

LL_USART_ClockInit

Function name

ErrorStatus LL_USART_ClockInit (USART_TypeDef * USARTx, LL_USART_ClockInitTypeDef * USART_ClockInitStruct)

Function description

Initialize USART Clock related settings according to the specified parameters in the USART_ClockInitStruct.

Parameters

- **USARTx:** USART Instance
- **USART_ClockInitStruct:** pointer to a LL_USART_ClockInitTypeDef structure that contains the Clock configuration information for the specified USART peripheral.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: USART registers related to Clock settings are initialized according to USART_ClockInitStruct content
  - ERROR: Problem occurred during USART Registers initialization

Notes

- As some bits in USART configuration registers can only be written when the USART is disabled (USART_CR1_UE bit =0), USART Peripheral should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.

`LL_USART_ClockStructInit`

Function name

void LL_USART_ClockStructInit (LL_USART_ClockInitTypeDef * USART_ClockInitStruct)

Function description

Set each field of a LL_USART_ClockInitTypeDef type structure to default value.

Parameters

- **USART_ClockInitStruct:** pointer to a LL_USART_ClockInitTypeDef structure whose fields will be set to default values.

Return values

- **None:**

105.3 USART Firmware driver defines

The following section lists the various define and macros of the module.

105.3.1 USART

USART

Address Length Detection

LL_USART_ADDRESS_DETECT_4B

4-bit address detection method selected

LL_USART_ADDRESS_DETECT_7B

7-bit address detection (in 8-bit data mode) method selected

Autobaud Detection

LL_USART_AUTOBAUD_DETECT_ON_STARTBIT

Measurement of the start bit is used to detect the baud rate

LL_USART_AUTOBAUD_DETECT_ON_FALLINGEDGE

Falling edge to falling edge measurement. Received frame must start with a single bit = 1 -> Frame = Start10xxxxxx

LL_USART_AUTOBAUD_DETECT_ON_7F_FRAME

0x7F frame detection

LL_USART_AUTOBAUD_DETECT_ON_55_FRAME

0x55 frame detection

Binary Data Inversion

LL_USART_BINARY_LOGIC_POSITIVE

Logical data from the data register are send/received in positive/direct logic. (1=H, 0=L)

LL_USART_BINARY_LOGIC_NEGATIVE

Logical data from the data register are send/received in negative/inverse logic. (1=L, 0=H). The parity bit is also inverted.

Bit Order

LL_USART_BITORDER_LSBFIRST

data is transmitted/received with data bit 0 first, following the start bit

LL_USART_BITORDER_MSBFIRST

data is transmitted/received with the MSB first, following the start bit

Clear Flags Defines

LL_USART_ICR_PECF

Parity error flag

LL_USART_ICR_FECF

Framing error flag

LL_USART_ICR_NECF

Noise error detected flag

LL_USART_ICR_ORECF

Overrun error flag

LL_USART_ICR_IDLECF

Idle line detected flag

LL_USART_ICR_TXFECF

TX FIFO Empty Clear flag

LL_USART_ICR_TCCF

Transmission complete flag

LL_USART_ICR_TCBGTCF

Transmission completed before guard time flag

LL_USART_ICR_LBDCF

LIN break detection flag

LL_USART_ICR_CTSCF

CTS flag

LL_USART_ICR_RTOCF

Receiver timeout flag

LL_USART_ICR_EOBCF

End of block flag

LL_USART_ICR_UDRCF

SPI Slave Underrun Clear flag

LL_USART_ICR_CMCF

Character match flag

LL_USART_ICR_WUCF

Wakeup from Stop mode flag

Clock Signal

LL_USART_CLOCK_DISABLE

Clock signal not provided

LL_USART_CLOCK_ENABLE

Clock signal provided

Datawidth

LL_USART_DATAWIDTH_7B

7 bits word length : Start bit, 7 data bits, n stop bits

LL_USART_DATAWIDTH_8B

8 bits word length : Start bit, 8 data bits, n stop bits

LL_USART_DATAWIDTH_9B

9 bits word length : Start bit, 9 data bits, n stop bits

Driver Enable Polarity

LL_USART_DE_POLARITY_HIGH

DE signal is active high

LL_USART_DE_POLARITY_LOW

DE signal is active low

Communication Direction

LL_USART_DIRECTION_NONE

Transmitter and Receiver are disabled

LL_USART_DIRECTION_RX

Transmitter is disabled and Receiver is enabled

LL_USART_DIRECTION_TX

Transmitter is enabled and Receiver is disabled

LL_USART_DIRECTION_TX_RX

Transmitter and Receiver are enabled

DMA Register Data

LL_USART_DMA_REG_DATA_TRANSMIT

Get address of data register used for transmission

LL_USART_DMA_REG_DATA_RECEIVE

Get address of data register used for reception

FIFO Threshold

LL_USART_FIFOTHRESHOLD_1_8

FIFO reaches 1/8 of its depth

LL_USART_FIFOTHRESHOLD_1_4

FIFO reaches 1/4 of its depth

LL_USART_FIFOTHRESHOLD_1_2

FIFO reaches 1/2 of its depth

LL_USART_FIFOTHRESHOLD_3_4

FIFO reaches 3/4 of its depth

LL_USART_FIFOTHRESHOLD_7_8

FIFO reaches 7/8 of its depth

LL_USART_FIFOTHRESHOLD_8_8

FIFO becomes empty for TX and full for RX

Get Flags Defines

LL_USART_ISR_PE

Parity error flag

LL_USART_ISR_FE

Framing error flag

LL_USART_ISR_NE

Noise detected flag

LL_USART_ISR_ORE

Overrun error flag

LL_USART_ISR_IDLE

Idle line detected flag

LL_USART_ISR_RXNE_RXFNE

Read data register or RX FIFO not empty flag

LL_USART_ISR_TC

Transmission complete flag

LL_USART_ISR_TXE_TXFNF

Transmit data register empty or TX FIFO Not Full flag

LL_USART_ISR_LBDF

LIN break detection flag

LL_USART_ISR_CTSIF

CTS interrupt flag

LL_USART_ISR_CTS

CTS flag

LL_USART_ISR_RTOF

Receiver timeout flag

LL_USART_ISR_EOBF

End of block flag

LL_USART_ISR_UDR

SPI Slave underrun error flag

LL_USART_ISR_ABRE

Auto baud rate error flag

LL_USART_ISR_ABRF

Auto baud rate flag

LL_USART_ISR_BUSY

Busy flag

LL_USART_ISR_CMF

Character match flag

LL_USART_ISR_SBKF

Send break flag

LL_USART_ISR_RWU

Receiver wakeup from Mute mode flag

LL_USART_ISR_WUF

Wakeup from Stop mode flag

LL_USART_ISR_TEACK

Transmit enable acknowledge flag

LL_USART_ISR_REACK

Receive enable acknowledge flag

LL_USART_ISR_TXFE

TX FIFO empty flag

LL_USART_ISR_RXFF

RX FIFO full flag

LL_USART_ISR_TCBGT

Transmission complete before guard time completion flag

LL_USART_ISR_RXFT

RX FIFO threshold flag

LL_USART_ISR_TXFT

TX FIFO threshold flag

Hardware Control

LL_USART_HWCONTROL_NONE

CTS and RTS hardware flow control disabled

LL_USART_HWCONTROL_RTS

RTS output enabled, data is only requested when there is space in the receive buffer

LL_USART_HWCONTROL_CTS

CTS mode enabled, data is only transmitted when the nCTS input is asserted (tied to 0)

LL_USART_HWCONTROL_RTS_CTS

CTS and RTS hardware flow control enabled

IrDA Power

LL_USART_IRDA_POWER_NORMAL

IrDA normal power mode

LL_USART_IRDA_POWER_LOW

IrDA low power mode

IT Defines

LL_USART_CR1_IDLEIE

IDLE interrupt enable

LL_USART_CR1_RXNEIE_RXFNEIE

Read data register and RXFIFO not empty interrupt enable

LL_USART_CR1_TCIE

Transmission complete interrupt enable

LL_USART_CR1_TXEIE_TXFNFIE

Transmit data register empty and TX FIFO not full interrupt enable

LL_USART_CR1_PEIE

Parity error

LL_USART_CR1_CMIE

Character match interrupt enable

LL_USART_CR1_RTOIE

Receiver timeout interrupt enable

LL_USART_CR1_EOBIE

End of Block interrupt enable

LL_USART_CR1_TXFEIE

TX FIFO empty interrupt enable

LL_USART_CR1_RXFFIE

RX FIFO full interrupt enable

LL_USART_CR2_LBDIE

LIN break detection interrupt enable

LL_USART_CR3_EIE

Error interrupt enable

LL_USART_CR3_CTSIE

CTS interrupt enable

LL_USART_CR3_WUFIE

Wakeup from Stop mode interrupt enable

LL_USART_CR3_TXFTIE

TX FIFO threshold interrupt enable

LL_USART_CR3_TCBGTIE

Transmission complete before guard time interrupt enable

LL_USART_CR3_RXFTIE

RX FIFO threshold interrupt enable

Last Clock Pulse

LL_USART_LASTCLKPULSE_NO_OUTPUT

The clock pulse of the last data bit is not output to the SCLK pin

LL_USART_LASTCLKPULSE_OUTPUT

The clock pulse of the last data bit is output to the SCLK pin

LIN Break Detection Length

LL_USART_LINBREAK_DETECT_10B

10-bit break detection method selected

LL_USART_LINBREAK_DETECT_11B

11-bit break detection method selected

Oversampling

LL_USART_OVERSAMPLING_16

Oversampling by 16

LL_USART_OVERSAMPLING_8

Oversampling by 8

Parity Control

LL_USART_PARITY_NONE

Parity control disabled

LL_USART_PARITY_EVEN

Parity control enabled and Even Parity is selected

LL_USART_PARITY_ODD

Parity control enabled and Odd Parity is selected

Clock Phase

LL_USART_PHASE_1EDGE

The first clock transition is the first data capture edge

LL_USART_PHASE_2EDGE

The second clock transition is the first data capture edge

Clock Polarity

LL_USART_POLARITY_LOW

Steady low value on SCLK pin outside transmission window

LL_USART_POLARITY_HIGH

Steady high value on SCLK pin outside transmission window

Clock Source Prescaler

LL_USART_PRESCALER_DIV1

Input clock not devided

LL_USART_PRESCALER_DIV2

Input clock devided by 2

LL_USART_PRESCALER_DIV4

Input clock devided by 4

LL_USART_PRESCALER_DIV6

Input clock devided by 6

LL_USART_PRESCALER_DIV8

Input clock devided by 8

LL_USART_PRESCALER_DIV10

Input clock devided by 10

LL_USART_PRESCALER_DIV12

Input clock devided by 12

LL_USART_PRESCALER_DIV16

Input clock devided by 16

LL_USART_PRESCALER_DIV32

Input clock devided by 32

LL_USART_PRESCALER_DIV64

Input clock devided by 64

LL_USART_PRESCALER_DIV128

Input clock devided by 128

LL_USART_PRESCALER_DIV256

Input clock devided by 256

RX Pin Active Level Inversion

LL_USART_RXPIN_LEVEL_STANDARD

RX pin signal works using the standard logic levels

LL_USART_RXPIN_LEVEL_INVERTED

RX pin signal values are inverted.

Stop Bits

LL_USART_STOPBITS_0_5

0.5 stop bit

LL_USART_STOPBITS_1

1 stop bit

LL_USART_STOPBITS_1_5

1.5 stop bits

LL_USART_STOPBITS_2

2 stop bits

TX Pin Active Level Inversion

LL_USART_TXPIN_LEVEL_STANDARD

TX pin signal works using the standard logic levels

LL_USART_TXPIN_LEVEL_INVERTED

TX pin signal values are inverted.

TX RX Pins Swap

LL_USART_TXRX_STANDARD

TX/RX pins are used as defined in standard pinout

LL_USART_TXRX_SWAPPED

TX and RX pins functions are swapped.

Wakeup

LL_USART_WAKEUP_IDLELINE

USART wake up from Mute mode on Idle Line

LL_USART_WAKEUP_ADDRESSMARK

USART wake up from Mute mode on Address Mark

Wakeup Activation

LL_USART_WAKEUP_ON_ADDRESS

Wake up active on address match

LL_USART_WAKEUP_ON_STARTBIT

Wake up active on Start bit detection

LL_USART_WAKEUP_ON_RXNE

Wake up active on RXNE

FLAG_Management

LL_USART_IsActiveFlag_RXNE

LL_USART_IsActiveFlag_TXE

IT_Management

LL_USART_EnableIT_RXNE

LL_USART_EnableIT_TXE

LL_USART_DisableIT_RXNE

LL_USART_DisableIT_TXE

LL_USART_IsEnabledIT_RXNE

LL_USART_IsEnabledIT_TXE

Exported_Macros_Helper

__LL_USART_DIV_SAMPLING8

Description:

- Compute USARTDIV value according to Peripheral Clock and expected Baud Rate in 8 bits sampling mode (32 bits value of USARTDIV is returned)

Parameters:

- __PERIPHCLK__: Peripheral Clock frequency used for USART instance
- __BAUDRATE__: Baud rate value to achieve

Return value:

- USARTDIV: value to be used for BRR register filling in OverSampling_8 case

__LL_USART_DIV_SAMPLING16

Description:

- Compute USARTDIV value according to Peripheral Clock and expected Baud Rate in 16 bits sampling mode (32 bits value of USARTDIV is returned)

Parameters:

- __PERIPHCLK__: Peripheral Clock frequency used for USART instance
- __BAUDRATE__: Baud rate value to achieve

Return value:

- USARTDIV: value to be used for BRR register filling in OverSampling_16 case

Common Write and read registers Macros

LL_USART_WriteReg

Description:

- Write a value in USART register.

Parameters:

- __INSTANCE__: USART Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_USART_ReadReg

Description:

- Read a value in USART register.

Parameters:

- __INSTANCE__: USART Instance
- __REG__: Register to be read

Return value:

- Register: value

106 LL UTILS Generic Driver

106.1 UTILS Firmware driver registers structures

106.1.1 LL_UTILS_PLLInitTypeDef

LL_UTILS_PLLInitTypeDef is defined in the stm32l4xx_ll_utils.h

Data Fields

- ***uint32_t PLLM***
- ***uint32_t PLLN***
- ***uint32_t PLLR***

Field Documentation

- ***uint32_t LL_UTILS_PLLInitTypeDef::PLLM***

  Division factor for PLL VCO input clock. This parameter can be a value of *RCC_LL_EC_PLLM_DIV*This feature can be modified afterwards using unitary function **LL_RCC_PLL_ConfigDomain_SYS()**.
- ***uint32_t LL_UTILS_PLLInitTypeDef::PLLN***

  Multiplication factor for PLL VCO output clock. This parameter must be a number between Min_Data = 8 and Max_Data = 86This feature can be modified afterwards using unitary function **LL_RCC_PLL_ConfigDomain_SYS()**.
- ***uint32_t LL_UTILS_PLLInitTypeDef::PLLR***

  Division for the main system clock. This parameter can be a value of *RCC_LL_EC_PLLR_DIV*This feature can be modified afterwards using unitary function **LL_RCC_PLL_ConfigDomain_SYS()**.

106.1.2 LL_UTILS_ClkInitTypeDef

LL_UTILS_ClkInitTypeDef is defined in the stm32l4xx_ll_utils.h

Data Fields

- ***uint32_t AHBCLKDivider***
- ***uint32_t APB1CLKDivider***
- ***uint32_t APB2CLKDivider***

Field Documentation

- ***uint32_t LL_UTILS_ClkInitTypeDef::AHBCLKDivider***

  The AHB clock (HCLK) divider. This clock is derived from the system clock (SYSCLK). This parameter can be a value of *RCC_LL_EC_SYSCLK_DIV*This feature can be modified afterwards using unitary function **LL_RCC_SetAHBPrescaler()**.
- ***uint32_t LL_UTILS_ClkInitTypeDef::APB1CLKDivider***

  The APB1 clock (PCLK1) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of *RCC_LL_EC_APB1_DIV*This feature can be modified afterwards using unitary function **LL_RCC_SetAPB1Prescaler()**.
- ***uint32_t LL_UTILS_ClkInitTypeDef::APB2CLKDivider***

  The APB2 clock (PCLK2) divider. This clock is derived from the AHB clock (HCLK). This parameter can be a value of *RCC_LL_EC_APB2_DIV*This feature can be modified afterwards using unitary function **LL_RCC_SetAPB2Prescaler()**.

106.2 UTILS Firmware driver API description

The following section lists the various functions of the UTILS library.

106.2.1 System Configuration functions

System, AHB and APB buses clocks configuration

- The maximum frequency of the SYSCLK, HCLK, PCLK1 and PCLK2 is 120000000 Hz for STM32L4Rx/ STM32L4Sx devices and 80000000 Hz for others.

This section contains the following APIs:

- *LL_SetSystemCoreClock*
- *LL_PLL_ConfigSystemClock_MSI*
- *LL_PLL_ConfigSystemClock_HSI*
- *LL_PLL_ConfigSystemClock_HSE*

106.2.2 Detailed description of functions

`LL_GetUID_Word0`

Function name

__STATIC_INLINE uint32_t LL_GetUID_Word0 (void)

Function description

Get Word0 of the unique device identifier (UID based on 96 bits)

Return values

- **UID[31:0]:** X and Y coordinates on the wafer expressed in BCD format

`LL_GetUID_Word1`

Function name

__STATIC_INLINE uint32_t LL_GetUID_Word1 (void)

Function description

Get Word1 of the unique device identifier (UID based on 96 bits)

Return values

- **UID[63:32]:** Wafer number (UID[39:32]) & LOT_NUM[23:0] (UID[63:40])

`LL_GetUID_Word2`

Function name

__STATIC_INLINE uint32_t LL_GetUID_Word2 (void)

Function description

Get Word2 of the unique device identifier (UID based on 96 bits)

Return values

- **UID[95:64]:** Lot number (ASCII encoded) - LOT_NUM[55:24]

`LL_GetFlashSize`

Function name

__STATIC_INLINE uint32_t LL_GetFlashSize (void)

Function description

Get Flash memory size.

Return values

- **FLASH_SIZE[15:0]:** Flash memory size

Notes

- This bitfield indicates the size of the device Flash memory expressed in Kbytes. As an example, 0x040 corresponds to 64 Kbytes.

`LL_GetPackageType`

Function name

__STATIC_INLINE uint32_t LL_GetPackageType (void)

Function description

Get Package type.

Return values

- **Returned:** value can be one of the following values:
  - LL_UTILS_PACKAGETYPE_LQFP64 (*)
  - LL_UTILS_PACKAGETYPE_LQFP100 (*)
  - LL_UTILS_PACKAGETYPE_BGA132 (*)
  - LL_UTILS_PACKAGETYPE_LQFP144_CSP72 (*)
  - LL_UTILS_PACKAGETYPE_UFQFPN32 (*)
  - LL_UTILS_PACKAGETYPE_UFQFPN48 (*)
  - LL_UTILS_PACKAGETYPE_LQFP48 (*)
  - LL_UTILS_PACKAGETYPE_WLCSP49 (*)
  - LL_UTILS_PACKAGETYPE_UFBGA64 (*)
  - LL_UTILS_PACKAGETYPE_UFBGA100 (*)
  - LL_UTILS_PACKAGETYPE_UFBGA169 (*)
  - LL_UTILS_PACKAGETYPE_LQFP100_DSI (*)
  - LL_UTILS_PACKAGETYPE_WLCSP144_DSI (*)
  - LL_UTILS_PACKAGETYPE_UFBGA144_DSI (*)
  - LL_UTILS_PACKAGETYPE_UFBGA169_DSI (*)
  - LL_UTILS_PACKAGETYPE_LQFP144_DSI (*)

  (*) value not defined in all devices.

`LL_InitTick`

Function name

__STATIC_INLINE void LL_InitTick (uint32_t HCLKFrequency, uint32_t Ticks)

Function description

This function configures the Cortex-M SysTick source of the time base.

Parameters

- **HCLKFrequency:** HCLK frequency in Hz (can be calculated thanks to RCC helper macro)
- **Ticks:** Number of ticks

Return values

- **None:**

Notes

- When a RTOS is used, it is recommended to avoid changing the SysTick configuration by calling this function, for a delay use rather osDelay RTOS service.

`LL_Init1msTick`

Function name

void LL_Init1msTick (uint32_t HCLKFrequency)

Function description

This function configures the Cortex-M SysTick source to have 1ms time base.

Parameters

- **HCLKFrequency:** HCLK frequency in Hz

Return values

- **None:**

Notes

- When a RTOS is used, it is recommended to avoid changing the Systick configuration by calling this function, for a delay use rather osDelay RTOS service.
- HCLK frequency can be calculated thanks to RCC helper macro or function LL_RCC_GetSystemClocksFreq

`LL_mDelay`

Function name

void LL_mDelay (uint32_t Delay)

Function description

This function provides accurate delay (in milliseconds) based on SysTick counter flag.

Parameters

- **Delay:** specifies the delay time length, in milliseconds.

Return values

- **None:**

Notes

- When a RTOS is used, it is recommended to avoid using blocking delay and use rather osDelay service.
- To respect 1ms timebase, user should call LL_Init1msTick function which will configure Systick to 1ms

`LL_SetSystemCoreClock`

Function name

void LL_SetSystemCoreClock (uint32_t HCLKFrequency)

Function description

This function sets directly SystemCoreClock CMSIS variable.

Parameters

- **HCLKFrequency:** HCLK frequency in Hz (can be calculated thanks to RCC helper macro)

Return values

- **None:**

Notes

- Variable can be calculated also through SystemCoreClockUpdate function.

`LL_PLL_ConfigSystemClock_MSI`

Function name

ErrorStatus LL_PLL_ConfigSystemClock_MSI (LL_UTILS_PLLInitTypeDef * UTILS_PLLInitStruct, LL_UTILS_ClkInitTypeDef * UTILS_ClkInitStruct)

Function description

This function configures system clock with MSI as clock source of the PLL.

Parameters

- **UTILS_PLLInitStruct:** pointer to a LL_UTILS_PLLInitTypeDef structure that contains the configuration information for the PLL.
- **UTILS_ClkInitStruct:** pointer to a LL_UTILS_ClkInitTypeDef structure that contains the configuration information for the BUS prescalers.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: Max frequency configuration done
  - ERROR: Max frequency configuration not done

Notes

- The application needs to ensure that PLL, PLLSAI1 and/or PLLSAI2 are disabled.
- Function is based on the following formula: PLL output frequency = (((MSI frequency / PLLM) * PLLN) / PLLR)PLLM: ensure that the VCO input frequency ranges from 4 to 16 MHz (PLLVCO_input = MSI frequency / PLLM)PLLN: ensure that the VCO output frequency is between 64 and 344 MHz (PLLVCO_output = PLLVCO_input * PLLN)PLLR: ensure that max frequency at 120000000 Hz is reached (PLLVCO_output / PLLR)

LL_PLL_ConfigSystemClock_HSI

Function name

ErrorStatus LL_PLL_ConfigSystemClock_HSI (LL_UTILS_PLLInitTypeDef * UTILS_PLLInitStruct, LL_UTILS_ClkInitTypeDef * UTILS_ClkInitStruct)

Function description

This function configures system clock at maximum frequency with HSI as clock source of the PLL.

Parameters

- **UTILS_PLLInitStruct:** pointer to a LL_UTILS_PLLInitTypeDef structure that contains the configuration information for the PLL.
- **UTILS_ClkInitStruct:** pointer to a LL_UTILS_ClkInitTypeDef structure that contains the configuration information for the BUS prescalers.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: Max frequency configuration done
  - ERROR: Max frequency configuration not done

Notes

- The application need to ensure that PLL, PLLSAI1 and/or PLLSAI2 are disabled.
- Function is based on the following formula: PLL output frequency = (((HSI frequency / PLLM) * PLLN) / PLLR)PLLM: ensure that the VCO input frequency ranges from 4 to 16 MHz (PLLVCO_input = HSI frequency / PLLM)PLLN: ensure that the VCO output frequency is between 64 and 344 MHz (PLLVCO_output = PLLVCO_input * PLLN)PLLR: ensure that max frequency at 120000000 Hz is reach (PLLVCO_output / PLLR)

LL_PLL_ConfigSystemClock_HSE

Function name

ErrorStatus LL_PLL_ConfigSystemClock_HSE (uint32_t HSEFrequency, uint32_t HSEBypass, LL_UTILS_PLLInitTypeDef * UTILS_PLLInitStruct, LL_UTILS_ClkInitTypeDef * UTILS_ClkInitStruct)

Function description

This function configures system clock with HSE as clock source of the PLL.

Parameters

- **HSEFrequency:** Value between Min_Data = 4000000 and Max_Data = 48000000
- **HSEBypass:** This parameter can be one of the following values:
  - LL_UTILS_HSEBYPASS_ON
  - LL_UTILS_HSEBYPASS_OFF
- **UTILS_PLLInitStruct:** pointer to a LL_UTILS_PLLInitTypeDef structure that contains the configuration information for the PLL.
- **UTILS_ClkInitStruct:** pointer to a LL_UTILS_ClkInitTypeDef structure that contains the configuration information for the BUS prescalers.

Return values

- **An:** ErrorStatus enumeration value:
  - SUCCESS: Max frequency configuration done
  - ERROR: Max frequency configuration not done

Notes

- The application need to ensure that PLL, PLLSAI1 and/or PLLSAI2 are disabled.
- Function is based on the following formula: PLL output frequency = (((HSE frequency / PLLM) * PLLN) / PLLR)PLLM: ensure that the VCO input frequency ranges from 4 to 16 MHz (PLLVCO_input = HSE frequency / PLLM)PLLN: ensure that the VCO output frequency is between 64 and 344 MHz (PLLVCO_output = PLLVCO_input * PLLN)PLLR: ensure that max frequency at 120000000 Hz is reached (PLLVCO_output / PLLR)

106.3 UTILS Firmware driver defines

The following section lists the various define and macros of the module.

106.3.1 UTILS

UTILS

HSE Bypass activation

LL_UTILS_HSEBYPASS_OFF

HSE Bypass is not enabled

LL_UTILS_HSEBYPASS_ON

HSE Bypass is enabled

PACKAGE TYPE

LL_UTILS_PACKAGETYPE_LQFP64

LQFP64 package type

LL_UTILS_PACKAGETYPE_WLCSP64

WLCSP64 package type

LL_UTILS_PACKAGETYPE_LQFP100

LQFP100 package type

LL_UTILS_PACKAGETYPE_BGA132

BGA132 package type

LL_UTILS_PACKAGETYPE_LQFP144_CSP72

LQFP144, WLCSP81 or WLCSP72 package type

LL_UTILS_PACKAGETYPE_UFQFPN32

UFQFPN32 package type

LL_UTILS_PACKAGETYPE_UFQFPN48

UFQFPN48 package type

LL_UTILS_PACKAGETYPE_LQFP48

LQFP48 package type

LL_UTILS_PACKAGETYPE_WLCSP49

WLCSP49 package type

LL_UTILS_PACKAGETYPE_UFBGA64

UFBGA64 package type

LL_UTILS_PACKAGETYPE_UFBGA100

UFBGA100 package type

LL_UTILS_PACKAGETYPE_UFBGA169

UFBGA169 package type

LL_UTILS_PACKAGETYPE_LQFP100_DSI

LQFP100 with DSI package type

LL_UTILS_PACKAGETYPE_WLCSP144_DSI

WLCSP144 with DSI package type

LL_UTILS_PACKAGETYPE_UFBGA144_DSI

UFBGA144 with DSI package type

LL_UTILS_PACKAGETYPE_UFBGA169_DSI

UFBGA169 with DSI package type

LL_UTILS_PACKAGETYPE_LQFP144_DSI

LQFP144 with DSI package type

107 LL WWDG Generic Driver

107.1 WWDG Firmware driver API description

The following section lists the various functions of the WWDG library.

107.1.1 Detailed description of functions

`LL_WWDG_Enable`

Function name

__STATIC_INLINE void LL_WWDG_Enable (WWDG_TypeDef * WWDGx)

Function description

Enable Window Watchdog.

Parameters

- **WWDGx:** WWDG Instance

Return values

- **None:**

Notes

- It is enabled by setting the WDGA bit in the WWDG_CR register, then it cannot be disabled again except by a reset. This bit is set by software and only cleared by hardware after a reset. When WDGA = 1, the watchdog can generate a reset.

Reference Manual to LL API cross reference:

- CR WDGA LL_WWDG_Enable

`LL_WWDG_IsEnabled`

Function name

__STATIC_INLINE uint32_t LL_WWDG_IsEnabled (WWDG_TypeDef * WWDGx)

Function description

Checks if Window Watchdog is enabled.

Parameters

- **WWDGx:** WWDG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CR WDGA LL_WWDG_IsEnabled

`LL_WWDG_SetCounter`

Function name

__STATIC_INLINE void LL_WWDG_SetCounter (WWDG_TypeDef * WWDGx, uint32_t Counter)

Function description

Set the Watchdog counter value to provided value (7-bits T[6:0])

Parameters

- **WWDGx:** WWDG Instance
- **Counter:** 0..0x7F (7 bit counter value)

Return values

- **None:**

Notes

- When writing to the WWDG_CR register, always write 1 in the MSB b6 to avoid generating an immediate reset This counter is decremented every (4096 x 2expWDGTB) PCLK cycles A reset is produced when it rolls over from 0x40 to 0x3F (bit T6 becomes cleared) Setting the counter lower then 0x40 causes an immediate reset (if WWDG enabled)

Reference Manual to LL API cross reference:

- CR T LL_WWDG_SetCounter

`LL_WWDG_GetCounter`

Function name

__STATIC_INLINE uint32_t LL_WWDG_GetCounter (WWDG_TypeDef * WWDGx)

Function description

Return current Watchdog Counter Value (7 bits counter value)

Parameters

- **WWDGx:** WWDG Instance

Return values

- **7:** bit Watchdog Counter value

Reference Manual to LL API cross reference:

- CR T LL_WWDG_GetCounter

`LL_WWDG_SetPrescaler`

Function name

__STATIC_INLINE void LL_WWDG_SetPrescaler (WWDG_TypeDef * WWDGx, uint32_t Prescaler)

Function description

Set the time base of the prescaler (WDGTB).

Parameters

- **WWDGx:** WWDG Instance
- **Prescaler:** This parameter can be one of the following values:
  - LL_WWDG_PRESCALER_1
  - LL_WWDG_PRESCALER_2
  - LL_WWDG_PRESCALER_4
  - LL_WWDG_PRESCALER_8

Return values

- **None:**

Notes

- Prescaler is used to apply ratio on PCLK clock, so that Watchdog counter is decremented every (4096 x 2expWDGTB) PCLK cycles

Reference Manual to LL API cross reference:

- CFR WDGTB LL_WWDG_SetPrescaler

`LL_WWDG_GetPrescaler`

Function name

__STATIC_INLINE uint32_t LL_WWDG_GetPrescaler (WWDG_TypeDef * WWDGx)

Function description

Return current Watchdog Prescaler Value.

Parameters

- **WWDGx:** WWDG Instance

Return values

- **Returned:** value can be one of the following values:
  - LL_WWDG_PRESCALER_1
  - LL_WWDG_PRESCALER_2
  - LL_WWDG_PRESCALER_4
  - LL_WWDG_PRESCALER_8

Reference Manual to LL API cross reference:

- CFR WDGTB LL_WWDG_GetPrescaler

`LL_WWDG_SetWindow`

Function name

__STATIC_INLINE void LL_WWDG_SetWindow (WWDG_TypeDef * WWDGx, uint32_t Window)

Function description

Set the Watchdog Window value to be compared to the downcounter (7-bits W[6:0]).

Parameters

- **WWDGx:** WWDG Instance
- **Window:** 0x00..0x7F (7 bit Window value)

Return values

- **None:**

Notes

- This window value defines when write in the WWDG_CR register to program Watchdog counter is allowed. Watchdog counter value update must occur only when the counter value is lower than the Watchdog window register value. Otherwise, a MCU reset is generated if the 7-bit Watchdog counter value (in the control register) is refreshed before the downcounter has reached the watchdog window register value. Physically is possible to set the Window lower then 0x40 but it is not recommended. To generate an immediate reset, it is possible to set the Counter lower than 0x40.

Reference Manual to LL API cross reference:

- CFR W LL_WWDG_SetWindow

`LL_WWDG_GetWindow`

Function name

__STATIC_INLINE uint32_t LL_WWDG_GetWindow (WWDG_TypeDef * WWDGx)

Function description

Return current Watchdog Window Value (7 bits value)

Parameters

- **WWDGx:** WWDG Instance

Return values

- **7:** bit Watchdog Window value

Reference Manual to LL API cross reference:

- CFR W LL_WWDG_GetWindow

`LL_WWDG_IsActiveFlag_EWKUP`

Function name

__STATIC_INLINE uint32_t LL_WWDG_IsActiveFlag_EWKUP (WWDG_TypeDef * WWDGx)

Function description

Indicates if the WWDG Early Wakeup Interrupt Flag is set or not.

Parameters

- **WWDGx:** WWDG Instance

Return values

- **State:** of bit (1 or 0).

Notes

- This bit is set by hardware when the counter has reached the value 0x40. It must be cleared by software by writing 0. A write of 1 has no effect. This bit is also set if the interrupt is not enabled.

Reference Manual to LL API cross reference:

- SR EWIF LL_WWDG_IsActiveFlag_EWKUP

`LL_WWDG_ClearFlag_EWKUP`

Function name

__STATIC_INLINE void LL_WWDG_ClearFlag_EWKUP (WWDG_TypeDef * WWDGx)

Function description

Clear WWDG Early Wakeup Interrupt Flag (EWIF)

Parameters

- **WWDGx:** WWDG Instance

Return values

- **None:**

Reference Manual to LL API cross reference:

- SR EWIF LL_WWDG_ClearFlag_EWKUP

`LL_WWDG_EnableIT_EWKUP`

Function name

__STATIC_INLINE void LL_WWDG_EnableIT_EWKUP (WWDG_TypeDef * WWDGx)

Function description

Enable the Early Wakeup Interrupt.

Parameters

- **WWDGx:** WWDG Instance

Return values

- **None:**

Notes

- When set, an interrupt occurs whenever the counter reaches value 0x40. This interrupt is only cleared by hardware after a reset

Reference Manual to LL API cross reference:

- CFR EWI LL_WWDG_EnableIT_EWKUP

`LL_WWDG_IsEnabledIT_EWKUP`

Function name

__STATIC_INLINE uint32_t LL_WWDG_IsEnabledIT_EWKUP (WWDG_TypeDef * WWDGx)

Function description

Check if Early Wakeup Interrupt is enabled.

Parameters

- **WWDGx:** WWDG Instance

Return values

- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:

- CFR EWI LL_WWDG_IsEnabledIT_EWKUP

107.2 WWDG Firmware driver defines

The following section lists the various define and macros of the module.

107.2.1 WWDG

WWDG

IT Defines

LL_WWDG_CFR_EWI

PRESCALER

LL_WWDG_PRESCALER_1

WWDG counter clock = (PCLK1/4096)/1

LL_WWDG_PRESCALER_2

WWDG counter clock = (PCLK1/4096)/2

LL_WWDG_PRESCALER_4

WWDG counter clock = (PCLK1/4096)/4

LL_WWDG_PRESCALER_8

WWDG counter clock = (PCLK1/4096)/8

Common Write and read registers macros

LL_WWDG_WriteReg

Description:

- Write a value in WWDG register.

Parameters:

- __INSTANCE__: WWDG Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_WWDG_ReadReg

Description:

- Read a value in WWDG register.

Parameters:

- __INSTANCE__: WWDG Instance
- __REG__: Register to be read

Return value:

- Register: value

108 Correspondence between API registers and API low-layer driver functions

This annex contains correspondance table between the regiser or bit name, as mentionned inside the reference manual of the component, and the name of the LL functions to modify or read this register or bit.

108.1 ADC

Table 26. Correspondence between ADC registers and ADC low-layer driver functions

Register	Field	Function
AWD2CR	AWD2CH	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
AWD3CR	AWD3CH	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
CALFACT	CALFACT_D	LL_ADC_GetCalibrationFactor
		LL_ADC_SetCalibrationFactor
	CALFACT_S	LL_ADC_GetCalibrationFactor
		LL_ADC_SetCalibrationFactor
CCR	CKMODE	LL_ADC_GetCommonClock
		LL_ADC_SetCommonClock
	PRESC	LL_ADC_GetCommonClock
		LL_ADC_SetCommonClock
	TSEN	LL_ADC_GetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalChAdd
		LL_ADC_SetCommonPathInternalChRem
	VBATEN	LL_ADC_GetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalChAdd
		LL_ADC_SetCommonPathInternalChRem
	VREFEN	LL_ADC_GetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalCh
		LL_ADC_SetCommonPathInternalChAdd
		LL_ADC_SetCommonPathInternalChRem
CDR	RDATA_MST	LL_ADC_DMA_GetRegAddr
	RDATA_SLV	LL_ADC_DMA_GetRegAddr
CFGR	ALIGN	LL_ADC_GetDataAlignment
		LL_ADC_SetDataAlignment
	AUTDLY	LL_ADC_GetLowPowerMode
		LL_ADC_SetLowPowerMode

Register	Field	Function
CFGR	AWD1CH	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	AWD1EN	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	AWD1SGL	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	CONT	LL_ADC_REG_GetContinuousMode
		LL_ADC_REG_SetContinuousMode
	DFSDMCFG	LL_ADC_REG_GetDFSDMTransfer
	DISCEN	LL_ADC_REG_GetSequencerDiscont
		LL_ADC_REG_SetSequencerDiscont
	DISCNUM	LL_ADC_REG_GetSequencerDiscont
		LL_ADC_REG_SetSequencerDiscont
	DMACFG	LL_ADC_REG_GetDMATransfer
		LL_ADC_REG_SetDMATransfer
	DMAEN	LL_ADC_REG_GetDMATransfer
		LL_ADC_REG_SetDMATransfer
	EXTEN	LL_ADC_REG_GetTriggerEdge
		LL_ADC_REG_GetTriggerSource
		LL_ADC_REG_IsTriggerSourceSWStart
		LL_ADC_REG_SetTriggerEdge
		LL_ADC_REG_SetTriggerSource
	EXTSEL	LL_ADC_REG_GetTriggerSource
		LL_ADC_REG_SetTriggerSource
	JAUTO	LL_ADC_INJ_GetTrigAuto
		LL_ADC_INJ_SetTrigAuto
	JAWD1EN	LL_ADC_GetAnalogWDMonitChannels
		LL_ADC_SetAnalogWDMonitChannels
	JDISCEN	LL_ADC_INJ_GetSequencerDiscont
		LL_ADC_INJ_SetSequencerDiscont
	JQDIS	LL_ADC_INJ_GetQueueMode
		LL_ADC_INJ_SetQueueMode
	JQM	LL_ADC_INJ_GetQueueMode
		LL_ADC_INJ_SetQueueMode
	OVRMOD	LL_ADC_REG_GetOverrun
		LL_ADC_REG_SetOverrun
	RES	LL_ADC_GetResolution
		LL_ADC_SetResolution

Register	Field	Function
CFGR2	JOVSE	LL_ADC_GetOverSamplingScope
		LL_ADC_SetOverSamplingScope
	OVSR	LL_ADC_ConfigOverSamplingRatioShift
		LL_ADC_GetOverSamplingRatio
	OVSS	LL_ADC_ConfigOverSamplingRatioShift
		LL_ADC_GetOverSamplingShift
	ROVSE	LL_ADC_GetOverSamplingScope
		LL_ADC_SetOverSamplingScope
	ROVSM	LL_ADC_GetOverSamplingScope
		LL_ADC_SetOverSamplingScope
	TROVS	LL_ADC_GetOverSamplingDiscont
		LL_ADC_SetOverSamplingDiscont
CR	ADCAL	LL_ADC_IsCalibrationOnGoing
		LL_ADC_StartCalibration
	ADCALDIF	LL_ADC_StartCalibration
	ADDIS	LL_ADC_Disable
		LL_ADC_IsDisableOngoing
	ADEN	LL_ADC_Enable
		LL_ADC_IsEnabled
	ADSTART	LL_ADC_REG_IsConversionOngoing
		LL_ADC_REG_StartConversion
	ADSTP	LL_ADC_REG_IsStopConversionOngoing
		LL_ADC_REG_StopConversion
	ADVREGEN	LL_ADC_DisableInternalRegulator
		LL_ADC_EnableInternalRegulator
		LL_ADC_IsInternalRegulatorEnabled
	DEEPPWD	LL_ADC_DisableDeepPowerDown
		LL_ADC_EnableDeepPowerDown
		LL_ADC_IsDeepPowerDownEnabled
	JADSTART	LL_ADC_INJ_IsConversionOngoing
		LL_ADC_INJ_StartConversion
	JADSTP	LL_ADC_INJ_IsStopConversionOngoing
		LL_ADC_INJ_StopConversion
DIFSEL	DIFSEL	LL_ADC_GetChannelSingleDiff
		LL_ADC_SetChannelSingleDiff
DR	RDATA	LL_ADC_DMA_GetRegAddr
		LL_ADC_REG_ReadConversionData10
		LL_ADC_REG_ReadConversionData12

Register	Field	Function
DR	RDATA	LL_ADC_REG_ReadConversionData32
		LL_ADC_REG_ReadConversionData6
		LL_ADC_REG_ReadConversionData8
IER	ADRDYIE	LL_ADC_DisableIT_ADRDY
		LL_ADC_EnableIT_ADRDY
		LL_ADC_IsEnabledIT_ADRDY
	AWD1IE	LL_ADC_DisableIT_AWD1
		LL_ADC_EnableIT_AWD1
		LL_ADC_IsEnabledIT_AWD1
	AWD2IE	LL_ADC_DisableIT_AWD2
		LL_ADC_EnableIT_AWD2
		LL_ADC_IsEnabledIT_AWD2
	AWD3IE	LL_ADC_DisableIT_AWD3
		LL_ADC_EnableIT_AWD3
		LL_ADC_IsEnabledIT_AWD3
	EOCIE	LL_ADC_DisableIT_EOC
		LL_ADC_EnableIT_EOC
		LL_ADC_IsEnabledIT_EOC
	EOSIE	LL_ADC_DisableIT_EOS
		LL_ADC_EnableIT_EOS
		LL_ADC_IsEnabledIT_EOS
	EOSMPIE	LL_ADC_DisableIT_EOSMP
		LL_ADC_EnableIT_EOSMP
		LL_ADC_IsEnabledIT_EOSMP
	JEOCIE	LL_ADC_DisableIT_JEOC
		LL_ADC_EnableIT_JEOC
		LL_ADC_IsEnabledIT_JEOC
	JEOSIE	LL_ADC_DisableIT_JEOS
		LL_ADC_EnableIT_JEOS
		LL_ADC_IsEnabledIT_JEOS
	JQOVFIE	LL_ADC_DisableIT_JQOVF
		LL_ADC_EnableIT_JQOVF
		LL_ADC_IsEnabledIT_JQOVF
	OVRIE	LL_ADC_DisableIT_OVR
		LL_ADC_EnableIT_OVR
		LL_ADC_IsEnabledIT_OVR
ISR	ADRDY	LL_ADC_ClearFlag_ADRDY
		LL_ADC_IsActiveFlag_ADRDY

Register	Field	Function
ISR	AWD1	LL_ADC_ClearFlag_AWD1
		LL_ADC_IsActiveFlag_AWD1
	AWD2	LL_ADC_ClearFlag_AWD2
		LL_ADC_IsActiveFlag_AWD2
	AWD3	LL_ADC_ClearFlag_AWD3
		LL_ADC_IsActiveFlag_AWD3
	EOC	LL_ADC_ClearFlag_EOC
		LL_ADC_IsActiveFlag_EOC
	EOS	LL_ADC_ClearFlag_EOS
		LL_ADC_IsActiveFlag_EOS
	EOSMP	LL_ADC_ClearFlag_EOSMP
		LL_ADC_IsActiveFlag_EOSMP
	JEOC	LL_ADC_ClearFlag_JEOC
		LL_ADC_IsActiveFlag_JEOC
	JEOS	LL_ADC_ClearFlag_JEOS
		LL_ADC_IsActiveFlag_JEOS
	JQOVF	LL_ADC_ClearFlag_JQOVF
		LL_ADC_IsActiveFlag_JQOVF
	OVR	LL_ADC_ClearFlag_OVR
		LL_ADC_IsActiveFlag_OVR
JDR1	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JDR2	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JDR3	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JDR4	JDATA	LL_ADC_INJ_ReadConversionData10
		LL_ADC_INJ_ReadConversionData12
		LL_ADC_INJ_ReadConversionData32

Register	Field	Function
JDR4	JDATA	LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JSQR	JEXTEN	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetTriggerEdge
		LL_ADC_INJ_GetTriggerSource
		LL_ADC_INJ_IsTriggerSourceSWStart
		LL_ADC_INJ_SetTriggerEdge
		LL_ADC_INJ_SetTriggerSource
	JEXTSEL	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetTriggerSource
		LL_ADC_INJ_SetTriggerSource
	JL	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetSequencerLength
		LL_ADC_INJ_SetSequencerLength
	JSQ1	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetSequencerRanks
		LL_ADC_INJ_SetSequencerRanks
	JSQ2	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetSequencerRanks
		LL_ADC_INJ_SetSequencerRanks
	JSQ3	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetSequencerRanks
		LL_ADC_INJ_SetSequencerRanks
	JSQ4	LL_ADC_INJ_ConfigQueueContext
		LL_ADC_INJ_GetSequencerRanks
		LL_ADC_INJ_SetSequencerRanks
OFR1	OFFSET1	LL_ADC_GetOffsetLevel
		LL_ADC_SetOffset
	OFFSET1_CH	LL_ADC_GetOffsetChannel
		LL_ADC_SetOffset
	OFFSET1_EN	LL_ADC_GetOffsetState
		LL_ADC_SetOffset
		LL_ADC_SetOffsetState
OFR2	OFFSET2	LL_ADC_GetOffsetLevel
		LL_ADC_SetOffset
	OFFSET2_CH	LL_ADC_GetOffsetChannel
		LL_ADC_SetOffset
	OFFSET2_EN	LL_ADC_GetOffsetState

Register	Field	Function
OFR2	OFFSET2_EN	LL_ADC_SetOffset
		LL_ADC_SetOffsetState
OFR3	OFFSET3	LL_ADC_GetOffsetLevel
		LL_ADC_SetOffset
	OFFSET3_CH	LL_ADC_GetOffsetChannel
		LL_ADC_SetOffset
	OFFSET3_EN	LL_ADC_GetOffsetState
		LL_ADC_SetOffset
		LL_ADC_SetOffsetState
OFR4	OFFSET4	LL_ADC_GetOffsetLevel
		LL_ADC_SetOffset
	OFFSET4_CH	LL_ADC_GetOffsetChannel
		LL_ADC_SetOffset
	OFFSET4_EN	LL_ADC_GetOffsetState
		LL_ADC_SetOffset
		LL_ADC_SetOffsetState
SMPR1	SMP0	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP1	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP2	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP3	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP4	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP5	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP6	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP7	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP8	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP9	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMPPLUS	LL_ADC_GetSamplingTimeCommonConfig
		LL_ADC_SetSamplingTimeCommonConfig

Register	Field	Function
SMPR2	SMP10	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP11	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP12	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP13	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP14	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP15	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP16	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP17	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
	SMP18	LL_ADC_GetChannelSamplingTime
		LL_ADC_SetChannelSamplingTime
SQR1	L	LL_ADC_REG_GetSequencerLength
		LL_ADC_REG_SetSequencerLength
	SQ1	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ2	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ3	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ4	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
SQR2	SQ5	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ6	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ7	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ8	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ9	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks

Register	Field	Function
SQR3	SQ10	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ11	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ12	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ13	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ14	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
SQR4	SQ15	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
	SQ16	LL_ADC_REG_GetSequencerRanks
		LL_ADC_REG_SetSequencerRanks
TR1	HT1	LL_ADC_ConfigAnalogWDThresholds
		LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
	LT1	LL_ADC_ConfigAnalogWDThresholds
		LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
TR2	HT2	LL_ADC_ConfigAnalogWDThresholds
		LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
	LT2	LL_ADC_ConfigAnalogWDThresholds
		LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
TR3	HT3	LL_ADC_ConfigAnalogWDThresholds
		LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds
	LT3	LL_ADC_ConfigAnalogWDThresholds
		LL_ADC_GetAnalogWDThresholds
		LL_ADC_SetAnalogWDThresholds

108.2 BUS

Table 27. Correspondence between BUS registers and BUS low-layer driver functions

Register	Field	Function
AHB1ENR	CRCEN	LL_AHB1_GRP1_DisableClock

Register	Field	Function
AHB1ENR	CRCEN	LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA1EN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA2DEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA2EN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMAMUX1EN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	FLASHEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GFXMMUEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	TSCEN	LL_AHB1_GRP1_DisableClock
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
AHB1RSTR	CRCRST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	DMA1RST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	DMA2DRST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	DMA2RST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	DMAMUX1RST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	FLASHRST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	GFXMMURST	LL_AHB1_GRP1_ForceReset
		LL_AHB1_GRP1_ReleaseReset
	TSCRST	LL_AHB1_GRP1_ForceReset

Register	Field	Function
AHB1RSTR	TSCRST	LL_AHB1_GRP1_ReleaseReset
AHB1SMENR	CRCSMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	DMA1SMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	DMA2DSMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	DMA2SMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	DMAMUX1SMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	FLASHSMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	GFXMMUSMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	SRAM1SMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
	TSCSMEN	LL_AHB1_GRP1_DisableClockStopSleep
		LL_AHB1_GRP1_EnableClockStopSleep
AHB2ENR	ADCEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	AESEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	DCMIEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOAEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOBEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOCEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIODEN	LL_AHB2_GRP1_DisableClock

Register	Field	Function
AHB2ENR	GPIODEN	LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOEEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOFEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOGEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOHEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	GPIOIEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	HASHEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	OSPIMEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	OTGFSEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	RNGEN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
	SDMMC1EN	LL_AHB2_GRP1_DisableClock
		LL_AHB2_GRP1_EnableClock
		LL_AHB2_GRP1_IsEnabledClock
AHB2RSTR	ADCRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	AESRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	DCMIRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset

Register	Field	Function
AHB2RSTR	GPIOARST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOBRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOCRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIODRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOERST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOFRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOGRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOHRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	GPIOIRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	HASHRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	OSPIMRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	OTGFSRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	RNGRST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
	SDMMC1RST	LL_AHB2_GRP1_ForceReset
		LL_AHB2_GRP1_ReleaseReset
AHB2SMENR	ADCSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	AESSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	DCMISMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOASMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOBSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep

Register	Field	Function
AHB2SMENR	GPIOCSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIODSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOESMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOFSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOGSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOHSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	GPIOISMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	HASHSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	OSPIMSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	OTGFSSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	RNGSMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	SDMMC1SMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	SRAM2SMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
	SRAM3SMEN	LL_AHB2_GRP1_DisableClockStopSleep
		LL_AHB2_GRP1_EnableClockStopSleep
AHB3ENR	FMCEN	LL_AHB3_GRP1_DisableClock
		LL_AHB3_GRP1_EnableClock
		LL_AHB3_GRP1_IsEnabledClock
	OSPI1EN	LL_AHB3_GRP1_DisableClock
		LL_AHB3_GRP1_EnableClock
		LL_AHB3_GRP1_IsEnabledClock
	OSPI2EN	LL_AHB3_GRP1_DisableClock
		LL_AHB3_GRP1_EnableClock
		LL_AHB3_GRP1_IsEnabledClock
	QSPIEN	LL_AHB3_GRP1_DisableClock

Register	Field	Function
AHB3ENR	QSPIEN	LL_AHB3_GRP1_EnableClock
		LL_AHB3_GRP1_IsEnabledClock
AHB3RSTR	FMCRST	LL_AHB3_GRP1_ForceReset
		LL_AHB3_GRP1_ReleaseReset
	OSPI1RST	LL_AHB3_GRP1_ForceReset
		LL_AHB3_GRP1_ReleaseReset
	OSPI2RST	LL_AHB3_GRP1_ForceReset
		LL_AHB3_GRP1_ReleaseReset
	QSPIRST	LL_AHB3_GRP1_ForceReset
		LL_AHB3_GRP1_ReleaseReset
AHB3SMENR	FMCSMEN	LL_AHB3_GRP1_DisableClockStopSleep
		LL_AHB3_GRP1_EnableClockStopSleep
	OSPI1SMEN	LL_AHB3_GRP1_DisableClockStopSleep
		LL_AHB3_GRP1_EnableClockStopSleep
	OSPI2SMEN	LL_AHB3_GRP1_DisableClockStopSleep
		LL_AHB3_GRP1_EnableClockStopSleep
	QSPISMEN	LL_AHB3_GRP1_DisableClockStopSleep
		LL_AHB3_GRP1_EnableClockStopSleep
APB1ENR1	CAN1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	CAN2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	CRSEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	DAC1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	I2C3EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock

Register	Field	Function
APB1ENR1	I2C3EN	LL_APB1_GRP1_IsEnabledClock
	LCDEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	LPTIM1EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	OPAMPEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	PWREN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	RTCAPBEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	SPI2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	SPI3EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM3EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM4EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM5EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM6EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	TIM7EN	LL_APB1_GRP1_DisableClock

Register	Field	Function
APB1ENR1	TIM7EN	LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	UART4EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	UART5EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	USART2EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	USART3EN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	USBFSEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	WWDGEN	LL_APB1_GRP1_DisableClock
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
APB1ENR2	I2C4EN	LL_APB1_GRP2_DisableClock
		LL_APB1_GRP2_EnableClock
		LL_APB1_GRP2_IsEnabledClock
	LPTIM2EN	LL_APB1_GRP2_DisableClock
		LL_APB1_GRP2_EnableClock
		LL_APB1_GRP2_IsEnabledClock
	LPUART1EN	LL_APB1_GRP2_DisableClock
		LL_APB1_GRP2_EnableClock
		LL_APB1_GRP2_IsEnabledClock
	SWPMI1EN	LL_APB1_GRP2_DisableClock
		LL_APB1_GRP2_EnableClock
		LL_APB1_GRP2_IsEnabledClock
APB1RSTR1	CAN1RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	CAN2RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	CRSRST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset

Register	Field	Function
APB1RSTR1	DAC1RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	I2C1RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	I2C2RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	I2C3RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	LCDRST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	LPTIM1RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	OPAMPRST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	PWRRST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	SPI2RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	SPI3RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	TIM2RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	TIM3RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	TIM4RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	TIM5RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	TIM6RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	TIM7RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	UART4RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	UART5RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	USART2RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset

Register	Field	Function
APB1RSTR1	USART3RST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
	USBFSRST	LL_APB1_GRP1_ForceReset
		LL_APB1_GRP1_ReleaseReset
APB1RSTR2	I2C4RST	LL_APB1_GRP2_ForceReset
		LL_APB1_GRP2_ReleaseReset
	LPTIM2RST	LL_APB1_GRP2_ForceReset
		LL_APB1_GRP2_ReleaseReset
	LPUART1RST	LL_APB1_GRP2_ForceReset
		LL_APB1_GRP2_ReleaseReset
	SWPMI1RST	LL_APB1_GRP2_ForceReset
		LL_APB1_GRP2_ReleaseReset
APB1SMENR1	CAN1SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	CAN2SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	CRSSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	DAC1SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	I2C1SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	I2C2SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	I2C3SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	LCDSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	LPTIM1SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	OPAMPSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	PWRSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	RTCAPBSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	SPI2SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep

Register	Field	Function
APB1SMENR1	SPI3SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	TIM2SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	TIM3SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	TIM4SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	TIM5SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	TIM6SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	TIM7SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	UART4SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	UART5SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	USART2SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	USART3SMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	USBFSSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
	WWDGSMEN	LL_APB1_GRP1_DisableClockStopSleep
		LL_APB1_GRP1_EnableClockStopSleep
APB1SMENR2	I2C4SMEN	LL_APB1_GRP2_DisableClockStopSleep
		LL_APB1_GRP2_EnableClockStopSleep
	LPTIM2SMEN	LL_APB1_GRP2_DisableClockStopSleep
		LL_APB1_GRP2_EnableClockStopSleep
	LPUART1SMEN	LL_APB1_GRP2_DisableClockStopSleep
		LL_APB1_GRP2_EnableClockStopSleep
	SWPMI1SMEN	LL_APB1_GRP2_DisableClockStopSleep
		LL_APB1_GRP2_EnableClockStopSleep
APB2ENR	DFSDM1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	DSIEN	LL_APB2_GRP1_DisableClock

Register	Field	Function
APB2ENR	DSIEN	LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	FWEN	LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	LTDCEN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SAI1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SAI2EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SDMMC1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SPI1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SYSCFGEN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM15EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM16EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM17EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM1EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM8EN	LL_APB2_GRP1_DisableClock
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	USART1EN	LL_APB2_GRP1_DisableClock

Register	Field	Function
APB2ENR	USART1EN	LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
APB2RSTR	DFSDM1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	DSIRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	LTDCRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	SAI1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	SAI2RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	SDMMC1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	SPI1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	SYSCFGRST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	TIM15RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	TIM16RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	TIM17RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	TIM1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	TIM8RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
	USART1RST	LL_APB2_GRP1_ForceReset
		LL_APB2_GRP1_ReleaseReset
APB2SMENR	DFSDM1SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	DSISMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	LTDCSMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	SAI1SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep

Register	Field	Function
APB2SMENR	SAI2SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	SDMMC1SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	SPI1SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	SYSCFGSMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	TIM15SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	TIM16SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	TIM17SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	TIM1SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	TIM8SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep
	USART1SMEN	LL_APB2_GRP1_DisableClockStopSleep
		LL_APB2_GRP1_EnableClockStopSleep

108.3 COMP

Table 28. Correspondence between COMP registers and COMP low-layer driver functions

Register	Field	Function
CSR	BLANKING	LL_COMP_GetOutputBlankingSource
		LL_COMP_SetOutputBlankingSource
	BRGEN	LL_COMP_ConfigInputs
		LL_COMP_GetInputMinus
		LL_COMP_SetInputMinus
	EN	LL_COMP_Disable
		LL_COMP_Enable
		LL_COMP_IsEnabled
	HYST	LL_COMP_GetInputHysteresis
		LL_COMP_SetInputHysteresis
	INMSEL	LL_COMP_ConfigInputs
		LL_COMP_GetInputMinus
		LL_COMP_SetInputMinus

Register	Field	Function
CSR	INPSEL	LL_COMP_ConfigInputs
		LL_COMP_GetInputPlus
		LL_COMP_SetInputPlus
	LOCK	LL_COMP_IsLocked
		LL_COMP_Lock
	POLARITY	LL_COMP_GetOutputPolarity
		LL_COMP_SetOutputPolarity
	PWRMODE	LL_COMP_GetPowerMode
		LL_COMP_SetPowerMode
	SCALEN	LL_COMP_ConfigInputs
		LL_COMP_GetInputMinus
		LL_COMP_SetInputMinus
	VALUE	LL_COMP_ReadOutputLevel
	WINMODE	LL_COMP_GetCommonWindowMode
		LL_COMP_SetCommonWindowMode

108.4 CORTEX

Table 29. Correspondence between CORTEX registers and CORTEX low-layer driver functions

Register	Field	Function
MPU_CTRL	ENABLE	LL_MPU_Disable
		LL_MPU_Enable
		LL_MPU_IsEnabled
MPU_RASR	AP	LL_MPU_ConfigRegion
	B	LL_MPU_ConfigRegion
	C	LL_MPU_ConfigRegion
	ENABLE	LL_MPU_DisableRegion
		LL_MPU_EnableRegion
	S	LL_MPU_ConfigRegion
	SIZE	LL_MPU_ConfigRegion
	XN	LL_MPU_ConfigRegion
MPU_RBAR	ADDR	LL_MPU_ConfigRegion
	REGION	LL_MPU_ConfigRegion
MPU_RNR	REGION	LL_MPU_ConfigRegion
		LL_MPU_DisableRegion
SCB_CPUID	ARCHITECTURE	LL_CPUID_GetConstant
	IMPLEMENTER	LL_CPUID_GetImplementer
	PARTNO	LL_CPUID_GetParNo

Register	Field	Function
SCB_CPUID	REVISION	LL_CPUID_GetRevision
	VARIANT	LL_CPUID_GetVariant
SCB_SCR	SEVEONPEND	LL_LPM_DisableEventOnPend
		LL_LPM_EnableEventOnPend
	SLEEPDEEP	LL_LPM_EnableDeepSleep
		LL_LPM_EnableSleep
	SLEEPONEXIT	LL_LPM_DisableSleepOnExit
		LL_LPM_EnableSleepOnExit
SCB_SHCSR	MEMFAULTENA	LL_HANDLER_DisableFault
		LL_HANDLER_EnableFault
STK_CTRL	CLKSOURCE	LL_SYSTICK_GetClkSource
		LL_SYSTICK_SetClkSource
	COUNTFLAG	LL_SYSTICK_IsActiveCounterFlag
	TICKINT	LL_SYSTICK_DisableIT
		LL_SYSTICK_EnableIT
		LL_SYSTICK_IsEnabledIT

108.5 CRC

Table 30. Correspondence between CRC registers and CRC low-layer driver functions

Register	Field	Function
CR	POLYSIZE	LL_CRC_GetPolynomialSize
		LL_CRC_SetPolynomialSize
	RESET	LL_CRC_ResetCRCCalculationUnit
	REV_IN	LL_CRC_GetInputDataReverseMode
		LL_CRC_SetInputDataReverseMode
	REV_OUT	LL_CRC_GetOutputDataReverseMode
		LL_CRC_SetOutputDataReverseMode
DR	DR	LL_CRC_FeedData16
		LL_CRC_FeedData32
		LL_CRC_FeedData8
		LL_CRC_ReadData16
		LL_CRC_ReadData32
		LL_CRC_ReadData7
		LL_CRC_ReadData8
IDR	IDR	LL_CRC_Read_IDR
		LL_CRC_Write_IDR
INIT	INIT	LL_CRC_GetInitialData

Register	Field	Function
INIT	INIT	LL_CRC_SetInitialData
POL	POL	LL_CRC_GetPolynomialCoef
		LL_CRC_SetPolynomialCoef

108.6 CRS

Table 31. Correspondence between CRS registers and CRS low-layer driver functions

Register	Field	Function
CFGR	FELIM	LL_CRS_ConfigSynchronization
		LL_CRS_GetFreqErrorLimit
		LL_CRS_SetFreqErrorLimit
	RELOAD	LL_CRS_ConfigSynchronization
		LL_CRS_GetReloadCounter
		LL_CRS_SetReloadCounter
	SYNCDIV	LL_CRS_ConfigSynchronization
		LL_CRS_GetSyncDivider
		LL_CRS_SetSyncDivider
	SYNCPOL	LL_CRS_ConfigSynchronization
		LL_CRS_GetSyncPolarity
		LL_CRS_SetSyncPolarity
	SYNCSRC	LL_CRS_ConfigSynchronization
		LL_CRS_GetSyncSignalSource
		LL_CRS_SetSyncSignalSource
CR	AUTOTRIMEN	LL_CRS_DisableAutoTrimming
		LL_CRS_EnableAutoTrimming
		LL_CRS_IsEnabledAutoTrimming
	CEN	LL_CRS_DisableFreqErrorCounter
		LL_CRS_EnableFreqErrorCounter
		LL_CRS_IsEnabledFreqErrorCounter
	ERRIE	LL_CRS_DisableIT_ERR
		LL_CRS_EnableIT_ERR
		LL_CRS_IsEnabledIT_ERR
	ESYNCIE	LL_CRS_DisableIT_ESYNC
		LL_CRS_EnableIT_ESYNC
		LL_CRS_IsEnabledIT_ESYNC
	SWSYNC	LL_CRS_GenerateEvent_SWSYNC
	SYNCOKIE	LL_CRS_DisableIT_SYNCOK
		LL_CRS_EnableIT_SYNCOK

Register	Field	Function
CR	SYNCOKIE	LL_CRS_IsEnabledIT_SYNCOK
	SYNCWARNIE	LL_CRS_DisableIT_SYNCWARN
		LL_CRS_EnableIT_SYNCWARN
		LL_CRS_IsEnabledIT_SYNCWARN
	TRIM	LL_CRS_ConfigSynchronization
		LL_CRS_GetHSI48SmoothTrimming
		LL_CRS_SetHSI48SmoothTrimming
ICR	ERRC	LL_CRS_ClearFlag_ERR
	ESYNCC	LL_CRS_ClearFlag_ESYNC
	SYNCOKC	LL_CRS_ClearFlag_SYNCOK
	SYNCWARNC	LL_CRS_ClearFlag_SYNCWARN
ISR	ERRF	LL_CRS_IsActiveFlag_ERR
	ESYNCF	LL_CRS_IsActiveFlag_ESYNC
	FECAP	LL_CRS_GetFreqErrorCapture
	FEDIR	LL_CRS_GetFreqErrorDirection
	SYNCERR	LL_CRS_IsActiveFlag_SYNCERR
	SYNCMISS	LL_CRS_IsActiveFlag_SYNCMISS
	SYNCOKF	LL_CRS_IsActiveFlag_SYNCOK
	SYNCWARNF	LL_CRS_IsActiveFlag_SYNCWARN
	TRIMOVF	LL_CRS_IsActiveFlag_TRIMOVF

108.7 DAC

Table 32. Correspondence between DAC registers and DAC low-layer driver functions

Register	Field	Function
CCR	OTRIM1	LL_DAC_GetTrimmingValue
		LL_DAC_SetTrimmingValue
	OTRIM2	LL_DAC_GetTrimmingValue
		LL_DAC_SetTrimmingValue
CR	CEN1	LL_DAC_GetMode
		LL_DAC_SetMode
	CEN2	LL_DAC_GetMode
		LL_DAC_SetMode
	DMAEN1	LL_DAC_DisableDMAReq
		LL_DAC_EnableDMAReq
		LL_DAC_IsDMAReqEnabled
	DMAEN2	LL_DAC_DisableDMAReq
		LL_DAC_EnableDMAReq

Register	Field	Function
CR	DMAEN2	LL_DAC_IsDMAReqEnabled
	DMAUDRIE1	LL_DAC_DisableIT_DMAUDR1
		LL_DAC_EnableIT_DMAUDR1
		LL_DAC_IsEnabledIT_DMAUDR1
	DMAUDRIE2	LL_DAC_DisableIT_DMAUDR2
		LL_DAC_EnableIT_DMAUDR2
		LL_DAC_IsEnabledIT_DMAUDR2
	EN1	LL_DAC_Disable
		LL_DAC_Enable
		LL_DAC_IsEnabled
	EN2	LL_DAC_Disable
		LL_DAC_Enable
		LL_DAC_IsEnabled
	HFSEL	LL_DAC_GetHighFrequencyMode
		LL_DAC_SetHighFrequencyMode
	MAMP1	LL_DAC_GetWaveNoiseLFSR
		LL_DAC_GetWaveTriangleAmplitude
		LL_DAC_SetWaveNoiseLFSR
		LL_DAC_SetWaveTriangleAmplitude
	MAMP2	LL_DAC_GetWaveNoiseLFSR
		LL_DAC_GetWaveTriangleAmplitude
		LL_DAC_SetWaveNoiseLFSR
		LL_DAC_SetWaveTriangleAmplitude
	MODE1	LL_DAC_ConfigOutput
		LL_DAC_GetOutputBuffer
		LL_DAC_GetOutputConnection
		LL_DAC_GetOutputMode
		LL_DAC_SetOutputBuffer
		LL_DAC_SetOutputConnection
		LL_DAC_SetOutputMode
	MODE2	LL_DAC_ConfigOutput
		LL_DAC_GetOutputBuffer
		LL_DAC_GetOutputConnection
		LL_DAC_GetOutputMode
		LL_DAC_SetOutputBuffer
		LL_DAC_SetOutputConnection
		LL_DAC_SetOutputMode
	TEN1	LL_DAC_DisableTrigger

Register	Field	Function
CR	TEN1	LL_DAC_EnableTrigger
		LL_DAC_IsTriggerEnabled
	TEN2	LL_DAC_DisableTrigger
		LL_DAC_EnableTrigger
		LL_DAC_IsTriggerEnabled
	TSEL1	LL_DAC_GetTriggerSource
		LL_DAC_SetTriggerSource
	TSEL2	LL_DAC_GetTriggerSource
		LL_DAC_SetTriggerSource
	WAVE1	LL_DAC_GetWaveAutoGeneration
		LL_DAC_SetWaveAutoGeneration
	WAVE2	LL_DAC_GetWaveAutoGeneration
		LL_DAC_SetWaveAutoGeneration
DHR12L1	DACC1DHR	LL_DAC_ConvertData12LeftAligned
		LL_DAC_DMA_GetRegAddr
DHR12L2	DACC2DHR	LL_DAC_ConvertData12LeftAligned
		LL_DAC_DMA_GetRegAddr
DHR12LD	DACC1DHR	LL_DAC_ConvertDualData12LeftAligned
	DACC2DHR	LL_DAC_ConvertDualData12LeftAligned
DHR12R1	DACC1DHR	LL_DAC_ConvertData12RightAligned
		LL_DAC_DMA_GetRegAddr
DHR12R2	DACC2DHR	LL_DAC_ConvertData12RightAligned
		LL_DAC_DMA_GetRegAddr
DHR12RD	DACC1DHR	LL_DAC_ConvertDualData12RightAligned
	DACC2DHR	LL_DAC_ConvertDualData12RightAligned
DHR8R1	DACC1DHR	LL_DAC_ConvertData8RightAligned
		LL_DAC_DMA_GetRegAddr
DHR8R2	DACC2DHR	LL_DAC_ConvertData8RightAligned
		LL_DAC_DMA_GetRegAddr
DHR8RD	DACC1DHR	LL_DAC_ConvertDualData8RightAligned
	DACC2DHR	LL_DAC_ConvertDualData8RightAligned
DOR1	DACC1DOR	LL_DAC_RetrieveOutputData
DOR2	DACC2DOR	LL_DAC_RetrieveOutputData
SHHR	THOLD1	LL_DAC_GetSampleAndHoldHoldTime
		LL_DAC_SetSampleAndHoldHoldTime
	THOLD2	LL_DAC_GetSampleAndHoldHoldTime
		LL_DAC_SetSampleAndHoldHoldTime
SHRR	TREFRESH1	LL_DAC_GetSampleAndHoldRefreshTime

Register	Field	Function
SHRR	TREFRESH1	LL_DAC_SetSampleAndHoldRefreshTime
	TREFRESH2	LL_DAC_GetSampleAndHoldRefreshTime
		LL_DAC_SetSampleAndHoldRefreshTime
SHSR1	TSAMPLE1	LL_DAC_GetSampleAndHoldSampleTime
		LL_DAC_SetSampleAndHoldSampleTime
SHSR2	TSAMPLE2	LL_DAC_GetSampleAndHoldSampleTime
		LL_DAC_SetSampleAndHoldSampleTime
SR	BWST1	LL_DAC_IsActiveFlag_BWST1
	BWST2	LL_DAC_IsActiveFlag_BWST2
	CAL_FLAG1	LL_DAC_IsActiveFlag_CAL1
	CAL_FLAG2	LL_DAC_IsActiveFlag_CAL2
	DMAUDR1	LL_DAC_ClearFlag_DMAUDR1
		LL_DAC_IsActiveFlag_DMAUDR1
	DMAUDR2	LL_DAC_ClearFlag_DMAUDR2
		LL_DAC_IsActiveFlag_DMAUDR2
SWTRIGR	SWTRIG1	LL_DAC_TrigSWConversion
	SWTRIG2	LL_DAC_TrigSWConversion

108.8 DMA

Table 33. Correspondence between DMA registers and DMA low-layer driver functions

Register	Field	Function
CCR	CIRC	LL_DMA_ConfigTransfer
		LL_DMA_GetMode
		LL_DMA_SetMode
	DIR	LL_DMA_ConfigTransfer
		LL_DMA_GetDataTransferDirection
		LL_DMA_SetDataTransferDirection
	EN	LL_DMA_DisableChannel
		LL_DMA_EnableChannel
		LL_DMA_IsEnabledChannel
	HTIE	LL_DMA_DisableIT_HT
		LL_DMA_EnableIT_HT
		LL_DMA_IsEnabledIT_HT
	MEM2MEM	LL_DMA_ConfigTransfer
		LL_DMA_GetDataTransferDirection
		LL_DMA_SetDataTransferDirection
	MINC	LL_DMA_ConfigTransfer

Register	Field	Function
CCR	MINC	LL_DMA_GetMemoryIncMode
		LL_DMA_SetMemoryIncMode
	MSIZE	LL_DMA_ConfigTransfer
		LL_DMA_GetMemorySize
		LL_DMA_SetMemorySize
	PINC	LL_DMA_ConfigTransfer
		LL_DMA_GetPeriphIncMode
		LL_DMA_SetPeriphIncMode
	PL	LL_DMA_ConfigTransfer
		LL_DMA_GetChannelPriorityLevel
		LL_DMA_SetChannelPriorityLevel
	PSIZE	LL_DMA_ConfigTransfer
		LL_DMA_GetPeriphSize
		LL_DMA_SetPeriphSize
	TCIE	LL_DMA_DisableIT_TC
		LL_DMA_EnableIT_TC
		LL_DMA_IsEnabledIT_TC
	TEIE	LL_DMA_DisableIT_TE
		LL_DMA_EnableIT_TE
		LL_DMA_IsEnabledIT_TE
CMAR	MA	LL_DMA_ConfigAddresses
		LL_DMA_GetM2MDstAddress
		LL_DMA_GetMemoryAddress
		LL_DMA_SetM2MDstAddress
		LL_DMA_SetMemoryAddress
CNDTR	NDT	LL_DMA_GetDataLength
		LL_DMA_SetDataLength
CPAR	PA	LL_DMA_ConfigAddresses
		LL_DMA_GetM2MSrcAddress
		LL_DMA_GetPeriphAddress
		LL_DMA_SetM2MSrcAddress
		LL_DMA_SetPeriphAddress
CxCR	DMAREQ_ID	LL_DMA_GetPeriphRequest
		LL_DMA_SetPeriphRequest
IFCR	CGIF1	LL_DMA_ClearFlag_GI1
	CGIF2	LL_DMA_ClearFlag_GI2
	CGIF3	LL_DMA_ClearFlag_GI3
	CGIF4	LL_DMA_ClearFlag_GI4

Register	Field	Function
IFCR	CGIF5	LL_DMA_ClearFlag_GI5
	CGIF6	LL_DMA_ClearFlag_GI6
	CGIF7	LL_DMA_ClearFlag_GI7
	CHTIF1	LL_DMA_ClearFlag_HT1
	CHTIF2	LL_DMA_ClearFlag_HT2
	CHTIF3	LL_DMA_ClearFlag_HT3
	CHTIF4	LL_DMA_ClearFlag_HT4
	CHTIF5	LL_DMA_ClearFlag_HT5
	CHTIF6	LL_DMA_ClearFlag_HT6
	CHTIF7	LL_DMA_ClearFlag_HT7
	CTCIF1	LL_DMA_ClearFlag_TC1
	CTCIF2	LL_DMA_ClearFlag_TC2
	CTCIF3	LL_DMA_ClearFlag_TC3
	CTCIF4	LL_DMA_ClearFlag_TC4
	CTCIF5	LL_DMA_ClearFlag_TC5
	CTCIF6	LL_DMA_ClearFlag_TC6
	CTCIF7	LL_DMA_ClearFlag_TC7
	CTEIF1	LL_DMA_ClearFlag_TE1
	CTEIF2	LL_DMA_ClearFlag_TE2
	CTEIF3	LL_DMA_ClearFlag_TE3
	CTEIF4	LL_DMA_ClearFlag_TE4
	CTEIF5	LL_DMA_ClearFlag_TE5
	CTEIF6	LL_DMA_ClearFlag_TE6
	CTEIF7	LL_DMA_ClearFlag_TE7
ISR	GIF1	LL_DMA_IsActiveFlag_GI1
	GIF2	LL_DMA_IsActiveFlag_GI2
	GIF3	LL_DMA_IsActiveFlag_GI3
	GIF4	LL_DMA_IsActiveFlag_GI4
	GIF5	LL_DMA_IsActiveFlag_GI5
	GIF6	LL_DMA_IsActiveFlag_GI6
	GIF7	LL_DMA_IsActiveFlag_GI7
	HTIF1	LL_DMA_IsActiveFlag_HT1
	HTIF2	LL_DMA_IsActiveFlag_HT2
	HTIF3	LL_DMA_IsActiveFlag_HT3
	HTIF4	LL_DMA_IsActiveFlag_HT4
	HTIF5	LL_DMA_IsActiveFlag_HT5
	HTIF6	LL_DMA_IsActiveFlag_HT6
	HTIF7	LL_DMA_IsActiveFlag_HT7

Register	Field	Function
ISR	TCIF1	LL_DMA_IsActiveFlag_TC1
	TCIF2	LL_DMA_IsActiveFlag_TC2
	TCIF3	LL_DMA_IsActiveFlag_TC3
	TCIF4	LL_DMA_IsActiveFlag_TC4
	TCIF5	LL_DMA_IsActiveFlag_TC5
	TCIF6	LL_DMA_IsActiveFlag_TC6
	TCIF7	LL_DMA_IsActiveFlag_TC7
	TEIF1	LL_DMA_IsActiveFlag_TE1
	TEIF2	LL_DMA_IsActiveFlag_TE2
	TEIF3	LL_DMA_IsActiveFlag_TE3
	TEIF4	LL_DMA_IsActiveFlag_TE4
	TEIF5	LL_DMA_IsActiveFlag_TE5
	TEIF6	LL_DMA_IsActiveFlag_TE6
	TEIF7	LL_DMA_IsActiveFlag_TE7

108.9 DMA2D

Table 34. Correspondence between DMA2D registers and DMA2D low-layer driver functions

Register	Field	Function
AMTCR	DT	LL_DMA2D_GetDeadTime
		LL_DMA2D_SetDeadTime
	EN	LL_DMA2D_DisableDeadTime
		LL_DMA2D_EnableDeadTime
		LL_DMA2D_IsEnabledDeadTime
BGCMAR	MA	LL_DMA2D_BGND_GetCLUTMemAddr
		LL_DMA2D_BGND_SetCLUTMemAddr
BGCOLR	BLUE	LL_DMA2D_BGND_GetBlueColor
		LL_DMA2D_BGND_SetBlueColor
		LL_DMA2D_BGND_SetColor
	GREEN	LL_DMA2D_BGND_GetGreenColor
		LL_DMA2D_BGND_SetColor
		LL_DMA2D_BGND_SetGreenColor
	RED	LL_DMA2D_BGND_GetRedColor
		LL_DMA2D_BGND_SetColor
		LL_DMA2D_BGND_SetRedColor
BGMAR	MA	LL_DMA2D_BGND_GetMemAddr
		LL_DMA2D_BGND_SetMemAddr
BGOR	LO	LL_DMA2D_BGND_GetLineOffset

Register	Field	Function
BGOR	LO	LL_DMA2D_BGND_SetLineOffset
BGPFCCR	AI	LL_DMA2D_BGND_GetAlphaInvMode
		LL_DMA2D_BGND_SetAlphaInvMode
	ALPHA	LL_DMA2D_BGND_GetAlpha
		LL_DMA2D_BGND_SetAlpha
	AM	LL_DMA2D_BGND_GetAlphaMode
		LL_DMA2D_BGND_SetAlphaMode
	CCM	LL_DMA2D_BGND_GetCLUTColorMode
		LL_DMA2D_BGND_SetCLUTColorMode
	CM	LL_DMA2D_BGND_GetColorMode
		LL_DMA2D_BGND_SetColorMode
	CS	LL_DMA2D_BGND_GetCLUTSize
		LL_DMA2D_BGND_SetCLUTSize
	RBS	LL_DMA2D_BGND_GetRBSwapMode
		LL_DMA2D_BGND_SetRBSwapMode
	START	LL_DMA2D_BGND_EnableCLUTLoad
		LL_DMA2D_BGND_IsEnabledCLUTLoad
CR	ABORT	LL_DMA2D_Abort
		LL_DMA2D_IsAborted
	CAEIE	LL_DMA2D_DisableIT_CAE
		LL_DMA2D_EnableIT_CAE
		LL_DMA2D_IsEnabledIT_CAE
	CEIE	LL_DMA2D_DisableIT_CE
		LL_DMA2D_EnableIT_CE
		LL_DMA2D_IsEnabledIT_CE
	CTCIE	LL_DMA2D_DisableIT_CTC
		LL_DMA2D_EnableIT_CTC
		LL_DMA2D_IsEnabledIT_CTC
	LOM	LL_DMA2D_GetLineOffsetMode
		LL_DMA2D_SetLineOffsetMode
	MODE	LL_DMA2D_GetMode
		LL_DMA2D_SetMode
	START	LL_DMA2D_IsTransferOngoing
		LL_DMA2D_Start
	SUSP	LL_DMA2D_IsSuspended
		LL_DMA2D_Resume
		LL_DMA2D_Suspend
	TCIE	LL_DMA2D_DisableIT_TC

Register	Field	Function
CR	TCIE	LL_DMA2D_EnableIT_TC
		LL_DMA2D_IsEnabledIT_TC
	TEIE	LL_DMA2D_DisableIT_TE
		LL_DMA2D_EnableIT_TE
		LL_DMA2D_IsEnabledIT_TE
	TWIE	LL_DMA2D_DisableIT_TW
		LL_DMA2D_EnableIT_TW
		LL_DMA2D_IsEnabledIT_TW
FGCMAR	MA	LL_DMA2D_FGND_GetCLUTMemAddr
		LL_DMA2D_FGND_SetCLUTMemAddr
FGCOLR	BLUE	LL_DMA2D_FGND_GetBlueColor
		LL_DMA2D_FGND_SetBlueColor
		LL_DMA2D_FGND_SetColor
	GREEN	LL_DMA2D_FGND_GetGreenColor
		LL_DMA2D_FGND_SetColor
		LL_DMA2D_FGND_SetGreenColor
	RED	LL_DMA2D_FGND_GetRedColor
		LL_DMA2D_FGND_SetColor
		LL_DMA2D_FGND_SetRedColor
FGMAR	MA	LL_DMA2D_FGND_GetMemAddr
		LL_DMA2D_FGND_SetMemAddr
FGOR	LO	LL_DMA2D_FGND_GetLineOffset
		LL_DMA2D_FGND_SetLineOffset
FGPFCCR	AI	LL_DMA2D_FGND_GetAlphaInvMode
		LL_DMA2D_FGND_SetAlphaInvMode
	ALPHA	LL_DMA2D_FGND_GetAlpha
		LL_DMA2D_FGND_SetAlpha
	AM	LL_DMA2D_FGND_GetAlphaMode
		LL_DMA2D_FGND_SetAlphaMode
	CCM	LL_DMA2D_FGND_GetCLUTColorMode
		LL_DMA2D_FGND_SetCLUTColorMode
	CM	LL_DMA2D_FGND_GetColorMode
		LL_DMA2D_FGND_SetColorMode
	CS	LL_DMA2D_FGND_GetCLUTSize
		LL_DMA2D_FGND_SetCLUTSize
	RBS	LL_DMA2D_FGND_GetRBSwapMode
		LL_DMA2D_FGND_SetRBSwapMode
	START	LL_DMA2D_FGND_EnableCLUTLoad

Register	Field	Function
FGPFCCR	START	LL_DMA2D_FGND_IsEnabledCLUTLoad
IFCR	CAECIF	LL_DMA2D_ClearFlag_CAE
	CCEIF	LL_DMA2D_ClearFlag_CE
	CCTCIF	LL_DMA2D_ClearFlag_CTC
	CTCIF	LL_DMA2D_ClearFlag_TC
	CTEIF	LL_DMA2D_ClearFlag_TE
	CTWIF	LL_DMA2D_ClearFlag_TW
ISR	CAEIF	LL_DMA2D_IsActiveFlag_CAE
	CEIF	LL_DMA2D_IsActiveFlag_CE
	CTCIF	LL_DMA2D_IsActiveFlag_CTC
	TCIF	LL_DMA2D_IsActiveFlag_TC
	TEIF	LL_DMA2D_IsActiveFlag_TE
	TWIF	LL_DMA2D_IsActiveFlag_TW
LWR	LW	LL_DMA2D_GetLineWatermark
		LL_DMA2D_SetLineWatermark
NLR	NL	LL_DMA2D_GetNbrOfLines
		LL_DMA2D_SetNbrOfLines
	PL	LL_DMA2D_GetNbrOfPixelsPerLines
		LL_DMA2D_SetNbrOfPixelsPerLines
OCOLR	ALPHA	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
	BLUE	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
	GREEN	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
	RED	LL_DMA2D_GetOutputColor
		LL_DMA2D_SetOutputColor
OMAR	MA	LL_DMA2D_GetOutputMemAddr
		LL_DMA2D_SetOutputMemAddr
OOR	LO	LL_DMA2D_GetLineOffset
		LL_DMA2D_SetLineOffset
OPFCCR	AI	LL_DMA2D_GetOutputAlphaInvMode
		LL_DMA2D_SetOutputAlphaInvMode
	CM	LL_DMA2D_GetOutputColorMode
		LL_DMA2D_SetOutputColorMode
	RBS	LL_DMA2D_GetOutputRBSwapMode
		LL_DMA2D_SetOutputRBSwapMode
	SB	LL_DMA2D_GetOutputSwapMode

Register	Field	Function
OPFCCR	SB	LL_DMA2D_SetOutputSwapMode

108.10 DMAMUX

Table 35. Correspondence between DMAMUX registers and DMAMUX low-layer driver functions

Register	Field	Function
CFR	CSOF0	LL_DMAMUX_ClearFlag_SO0
	CSOF1	LL_DMAMUX_ClearFlag_SO1
	CSOF10	LL_DMAMUX_ClearFlag_SO10
	CSOF11	LL_DMAMUX_ClearFlag_SO11
	CSOF12	LL_DMAMUX_ClearFlag_SO12
	CSOF13	LL_DMAMUX_ClearFlag_SO13
	CSOF2	LL_DMAMUX_ClearFlag_SO2
	CSOF3	LL_DMAMUX_ClearFlag_SO3
	CSOF4	LL_DMAMUX_ClearFlag_SO4
	CSOF5	LL_DMAMUX_ClearFlag_SO5
	CSOF6	LL_DMAMUX_ClearFlag_SO6
	CSOF7	LL_DMAMUX_ClearFlag_SO7
	CSOF8	LL_DMAMUX_ClearFlag_SO8
	CSOF9	LL_DMAMUX_ClearFlag_SO9
CSR	SOF0	LL_DMAMUX_IsActiveFlag_SO0
	SOF1	LL_DMAMUX_IsActiveFlag_SO1
	SOF10	LL_DMAMUX_IsActiveFlag_SO10
	SOF11	LL_DMAMUX_IsActiveFlag_SO11
	SOF12	LL_DMAMUX_IsActiveFlag_SO12
	SOF13	LL_DMAMUX_IsActiveFlag_SO13
	SOF2	LL_DMAMUX_IsActiveFlag_SO2
	SOF3	LL_DMAMUX_IsActiveFlag_SO3
	SOF4	LL_DMAMUX_IsActiveFlag_SO4
	SOF5	LL_DMAMUX_IsActiveFlag_SO5
	SOF6	LL_DMAMUX_IsActiveFlag_SO6
	SOF7	LL_DMAMUX_IsActiveFlag_SO7
	SOF8	LL_DMAMUX_IsActiveFlag_SO8
	SOF9	LL_DMAMUX_IsActiveFlag_SO9
CxCR	DMAREQ_ID	LL_DMAMUX_GetRequestID
		LL_DMAMUX_SetRequestID
	EGE	LL_DMAMUX_DisableEventGeneration
		LL_DMAMUX_EnableEventGeneration

Register	Field	Function
CxCR	EGE	LL_DMAMUX_IsEnabledEventGeneration
	NBREQ	LL_DMAMUX_GetSyncRequestNb
		LL_DMAMUX_SetSyncRequestNb
	SE	LL_DMAMUX_DisableSync
		LL_DMAMUX_EnableSync
		LL_DMAMUX_IsEnabledSync
	SOIE	LL_DMAMUX_DisableIT_SO
		LL_DMAMUX_EnableIT_SO
		LL_DMAMUX_IsEnabledIT_SO
	SPOL	LL_DMAMUX_GetSyncPolarity
		LL_DMAMUX_SetSyncPolarity
	SYNC_ID	LL_DMAMUX_GetSyncID
		LL_DMAMUX_SetSyncID
RGCFR	COF0	LL_DMAMUX_ClearFlag_RGO0
	COF1	LL_DMAMUX_ClearFlag_RGO1
	COF2	LL_DMAMUX_ClearFlag_RGO2
	COF3	LL_DMAMUX_ClearFlag_RGO3
RGSR	OF0	LL_DMAMUX_IsActiveFlag_RGO0
	OF1	LL_DMAMUX_IsActiveFlag_RGO1
	OF2	LL_DMAMUX_IsActiveFlag_RGO2
	OF3	LL_DMAMUX_IsActiveFlag_RGO3
RGxCR	GE	LL_DMAMUX_DisableRequestGen
		LL_DMAMUX_EnableRequestGen
		LL_DMAMUX_IsEnabledRequestGen
	GNBREQ	LL_DMAMUX_GetGenRequestNb
		LL_DMAMUX_SetGenRequestNb
	GPOL	LL_DMAMUX_GetRequestGenPolarity
		LL_DMAMUX_SetRequestGenPolarity
	OIE	LL_DMAMUX_DisableIT_RGO
		LL_DMAMUX_EnableIT_RGO
		LL_DMAMUX_IsEnabledIT_RGO
	SIG_ID	LL_DMAMUX_GetRequestSignalID
		LL_DMAMUX_SetRequestSignalID

108.11 EXTI

Table 36. **Correspondence between EXTI registers and EXTI low-layer driver functions**

Register	Field	Function
EMR1	EMx	LL_EXTI_DisableEvent_0_31
		LL_EXTI_EnableEvent_0_31
		LL_EXTI_IsEnabledEvent_0_31
EMR2	EMx	LL_EXTI_DisableEvent_32_63
		LL_EXTI_EnableEvent_32_63
		LL_EXTI_IsEnabledEvent_32_63
FTSR1	FTx	LL_EXTI_DisableFallingTrig_0_31
		LL_EXTI_EnableFallingTrig_0_31
		LL_EXTI_IsEnabledFallingTrig_0_31
FTSR2	FTx	LL_EXTI_DisableFallingTrig_32_63
		LL_EXTI_EnableFallingTrig_32_63
		LL_EXTI_IsEnabledFallingTrig_32_63
IMR1	IMx	LL_EXTI_DisableIT_0_31
		LL_EXTI_EnableIT_0_31
		LL_EXTI_IsEnabledIT_0_31
IMR2	IMx	LL_EXTI_DisableIT_32_63
		LL_EXTI_EnableIT_32_63
		LL_EXTI_IsEnabledIT_32_63
PR1	PIFx	LL_EXTI_ClearFlag_0_31
		LL_EXTI_IsActiveFlag_0_31
		LL_EXTI_ReadFlag_0_31
PR2	PIFx	LL_EXTI_ClearFlag_32_63
		LL_EXTI_IsActiveFlag_32_63
		LL_EXTI_ReadFlag_32_63
RTSR1	RTx	LL_EXTI_DisableRisingTrig_0_31
		LL_EXTI_EnableRisingTrig_0_31
		LL_EXTI_IsEnabledRisingTrig_0_31
RTSR2	RTx	LL_EXTI_DisableRisingTrig_32_63
		LL_EXTI_EnableRisingTrig_32_63
		LL_EXTI_IsEnabledRisingTrig_32_63
SWIER1	SWIx	LL_EXTI_GenerateSWI_0_31
SWIER2	SWIx	LL_EXTI_GenerateSWI_32_63

108.12 GPIO

Table 37. **Correspondence between GPIO registers and GPIO low-layer driver functions**

Register	Field	Function
AFRH	AFSELy	LL_GPIO_GetAFPin_8_15
		LL_GPIO_SetAFPin_8_15
AFRL	AFSELy	LL_GPIO_GetAFPin_0_7
		LL_GPIO_SetAFPin_0_7
BRR	BRy	LL_GPIO_ResetOutputPin
BSRR	BSy	LL_GPIO_SetOutputPin
IDR	IDy	LL_GPIO_IsInputPinSet
		LL_GPIO_ReadInputPort
LCKR	LCKK	LL_GPIO_IsAnyPinLocked
		LL_GPIO_LockPin
	LCKy	LL_GPIO_IsPinLocked
MODER	MODEy	LL_GPIO_GetPinMode
		LL_GPIO_SetPinMode
ODR	ODy	LL_GPIO_IsOutputPinSet
		LL_GPIO_ReadOutputPort
		LL_GPIO_TogglePin
		LL_GPIO_WriteOutputPort
OSPEEDR	OSPEEDy	LL_GPIO_GetPinSpeed
		LL_GPIO_SetPinSpeed
OTYPER	OTy	LL_GPIO_GetPinOutputType
		LL_GPIO_SetPinOutputType
PUPDR	PUPDy	LL_GPIO_GetPinPull
		LL_GPIO_SetPinPull

108.13 I2C

Table 38. **Correspondence between I2C registers and I2C low-layer driver functions**

Register	Field	Function
CR1	ADDRIE	LL_I2C_DisableIT_ADDR
		LL_I2C_EnableIT_ADDR
		LL_I2C_IsEnabledIT_ADDR
	ALERTEN	LL_I2C_DisableSMBusAlert
		LL_I2C_EnableSMBusAlert
		LL_I2C_IsEnabledSMBusAlert
	ANFOFF	LL_I2C_ConfigFilters

Register	Field	Function
CR1	ANFOFF	LL_I2C_DisableAnalogFilter
		LL_I2C_EnableAnalogFilter
		LL_I2C_IsEnabledAnalogFilter
	DNF	LL_I2C_ConfigFilters
		LL_I2C_GetDigitalFilter
		LL_I2C_SetDigitalFilter
	ERRIE	LL_I2C_DisableIT_ERR
		LL_I2C_EnableIT_ERR
		LL_I2C_IsEnabledIT_ERR
	GCEN	LL_I2C_DisableGeneralCall
		LL_I2C_EnableGeneralCall
		LL_I2C_IsEnabledGeneralCall
	NACKIE	LL_I2C_DisableIT_NACK
		LL_I2C_EnableIT_NACK
		LL_I2C_IsEnabledIT_NACK
	NOSTRETCH	LL_I2C_DisableClockStretching
		LL_I2C_EnableClockStretching
		LL_I2C_IsEnabledClockStretching
	PE	LL_I2C_Disable
		LL_I2C_Enable
		LL_I2C_IsEnabled
	PECEN	LL_I2C_DisableSMBusPEC
		LL_I2C_EnableSMBusPEC
		LL_I2C_IsEnabledSMBusPEC
	RXDMAEN	LL_I2C_DisableDMAReq_RX
		LL_I2C_EnableDMAReq_RX
		LL_I2C_IsEnabledDMAReq_RX
	RXIE	LL_I2C_DisableIT_RX
		LL_I2C_EnableIT_RX
		LL_I2C_IsEnabledIT_RX
	SBC	LL_I2C_DisableSlaveByteControl
		LL_I2C_EnableSlaveByteControl
		LL_I2C_IsEnabledSlaveByteControl
	SMBDEN	LL_I2C_GetMode
		LL_I2C_SetMode
	SMBHEN	LL_I2C_GetMode
		LL_I2C_SetMode
	STOPIE	LL_I2C_DisableIT_STOP

Register	Field	Function
CR1	STOPIE	LL_I2C_EnableIT_STOP
		LL_I2C_IsEnabledIT_STOP
	TCIE	LL_I2C_DisableIT_TC
		LL_I2C_EnableIT_TC
		LL_I2C_IsEnabledIT_TC
	TXDMAEN	LL_I2C_DisableDMAReq_TX
		LL_I2C_EnableDMAReq_TX
		LL_I2C_IsEnabledDMAReq_TX
	TXIE	LL_I2C_DisableIT_TX
		LL_I2C_EnableIT_TX
		LL_I2C_IsEnabledIT_TX
	WUPEN	LL_I2C_DisableWakeUpFromStop
		LL_I2C_EnableWakeUpFromStop
		LL_I2C_IsEnabledWakeUpFromStop
CR2	ADD10	LL_I2C_GetMasterAddressingMode
		LL_I2C_HandleTransfer
		LL_I2C_SetMasterAddressingMode
	AUTOEND	LL_I2C_DisableAutoEndMode
		LL_I2C_EnableAutoEndMode
		LL_I2C_HandleTransfer
		LL_I2C_IsEnabledAutoEndMode
	HEAD10R	LL_I2C_DisableAuto10BitRead
		LL_I2C_EnableAuto10BitRead
		LL_I2C_HandleTransfer
		LL_I2C_IsEnabledAuto10BitRead
	NACK	LL_I2C_AcknowledgeNextData
	NBYTES	LL_I2C_GetTransferSize
		LL_I2C_HandleTransfer
		LL_I2C_SetTransferSize
	PECBYTE	LL_I2C_EnableSMBusPECCompare
		LL_I2C_IsEnabledSMBusPECCompare
	RD_WRN	LL_I2C_GetTransferRequest
		LL_I2C_HandleTransfer
		LL_I2C_SetTransferRequest
	RELOAD	LL_I2C_DisableReloadMode
		LL_I2C_EnableReloadMode
		LL_I2C_HandleTransfer
		LL_I2C_IsEnabledReloadMode

Register	Field	Function
CR2	SADD	LL_I2C_GetSlaveAddr
		LL_I2C_HandleTransfer
		LL_I2C_SetSlaveAddr
	START	LL_I2C_GenerateStartCondition
		LL_I2C_HandleTransfer
	STOP	LL_I2C_GenerateStopCondition
		LL_I2C_HandleTransfer
ICR	ADDRCF	LL_I2C_ClearFlag_ADDR
	ALERTCF	LL_I2C_ClearSMBusFlag_ALERT
	ARLOCF	LL_I2C_ClearFlag_ARLO
	BERRCF	LL_I2C_ClearFlag_BERR
	NACKCF	LL_I2C_ClearFlag_NACK
	OVRCF	LL_I2C_ClearFlag_OVR
	PECCF	LL_I2C_ClearSMBusFlag_PECERR
	STOPCF	LL_I2C_ClearFlag_STOP
	TIMOUTCF	LL_I2C_ClearSMBusFlag_TIMEOUT
ISR	ADDCODE	LL_I2C_GetAddressMatchCode
	ADDR	LL_I2C_IsActiveFlag_ADDR
	ALERT	LL_I2C_IsActiveSMBusFlag_ALERT
	ARLO	LL_I2C_IsActiveFlag_ARLO
	BERR	LL_I2C_IsActiveFlag_BERR
	BUSY	LL_I2C_IsActiveFlag_BUSY
	DIR	LL_I2C_GetTransferDirection
	NACKF	LL_I2C_IsActiveFlag_NACK
	OVR	LL_I2C_IsActiveFlag_OVR
	PECERR	LL_I2C_IsActiveSMBusFlag_PECERR
	RXNE	LL_I2C_IsActiveFlag_RXNE
	STOPF	LL_I2C_IsActiveFlag_STOP
	TC	LL_I2C_IsActiveFlag_TC
	TCR	LL_I2C_IsActiveFlag_TCR
	TIMEOUT	LL_I2C_IsActiveSMBusFlag_TIMEOUT
	TXE	LL_I2C_ClearFlag_TXE
		LL_I2C_IsActiveFlag_TXE
	TXIS	LL_I2C_IsActiveFlag_TXIS
OAR1	OA1	LL_I2C_SetOwnAddress1
	OA1EN	LL_I2C_DisableOwnAddress1
		LL_I2C_EnableOwnAddress1
		LL_I2C_IsEnabledOwnAddress1

Register	Field	Function
OAR1	OA1MODE	LL_I2C_SetOwnAddress1
OAR2	OA2	LL_I2C_SetOwnAddress2
	OA2EN	LL_I2C_DisableOwnAddress2
		LL_I2C_EnableOwnAddress2
		LL_I2C_IsEnabledOwnAddress2
	OA2MSK	LL_I2C_SetOwnAddress2
PECR	PEC	LL_I2C_GetSMBusPEC
RXDR	RXDATA	LL_I2C_DMA_GetRegAddr
		LL_I2C_ReceiveData8
TIMEOUTR	TEXTEN	LL_I2C_DisableSMBusTimeout
		LL_I2C_EnableSMBusTimeout
		LL_I2C_IsEnabledSMBusTimeout
	TIDLE	LL_I2C_ConfigSMBusTimeout
		LL_I2C_GetSMBusTimeoutAMode
		LL_I2C_SetSMBusTimeoutAMode
	TIMEOUTA	LL_I2C_ConfigSMBusTimeout
		LL_I2C_GetSMBusTimeoutA
		LL_I2C_SetSMBusTimeoutA
	TIMEOUTB	LL_I2C_ConfigSMBusTimeout
		LL_I2C_GetSMBusTimeoutB
		LL_I2C_SetSMBusTimeoutB
	TIMOUTEN	LL_I2C_DisableSMBusTimeout
		LL_I2C_EnableSMBusTimeout
		LL_I2C_IsEnabledSMBusTimeout
TIMINGR	PRESC	LL_I2C_GetTimingPrescaler
	SCLDEL	LL_I2C_GetDataSetupTime
	SCLH	LL_I2C_GetClockHighPeriod
	SCLL	LL_I2C_GetClockLowPeriod
	SDADEL	LL_I2C_GetDataHoldTime
	TIMINGR	LL_I2C_SetTiming
TXDR	TXDATA	LL_I2C_DMA_GetRegAddr
		LL_I2C_TransmitData8

108.14 IWDG

Table 39. Correspondence between IWDG registers and IWDG low-layer driver functions

Register	Field	Function
KR	KEY	LL_IWDG_DisableWriteAccess

Register	Field	Function
KR	KEY	LL_IWDG_Enable
		LL_IWDG_EnableWriteAccess
		LL_IWDG_ReloadCounter
PR	PR	LL_IWDG_GetPrescaler
		LL_IWDG_SetPrescaler
RLR	RL	LL_IWDG_GetReloadCounter
		LL_IWDG_SetReloadCounter
SR	PVU	LL_IWDG_IsActiveFlag_PVU
		LL_IWDG_IsReady
	RVU	LL_IWDG_IsActiveFlag_RVU
		LL_IWDG_IsReady
	WVU	LL_IWDG_IsActiveFlag_WVU
		LL_IWDG_IsReady
WINR	WIN	LL_IWDG_GetWindow
		LL_IWDG_SetWindow

108.15 LPTIM

Table 40. Correspondence between LPTIM registers and LPTIM low-layer driver functions

Register	Field	Function
ARR	ARR	LL_LPTIM_GetAutoReload
		LL_LPTIM_SetAutoReload
CFGR	CKFLT	LL_LPTIM_ConfigClock
		LL_LPTIM_GetClockFilter
	CKPOL	LL_LPTIM_ConfigClock
		LL_LPTIM_GetClockPolarity
		LL_LPTIM_GetEncoderMode
		LL_LPTIM_SetEncoderMode
	CKSEL	LL_LPTIM_GetClockSource
		LL_LPTIM_SetClockSource
	COUNTMODE	LL_LPTIM_GetCounterMode
		LL_LPTIM_SetCounterMode
	ENC	LL_LPTIM_DisableEncoderMode
		LL_LPTIM_EnableEncoderMode
		LL_LPTIM_IsEnabledEncoderMode
	PRELOAD	LL_LPTIM_GetUpdateMode
		LL_LPTIM_SetUpdateMode
	PRESC	LL_LPTIM_GetPrescaler

Register	Field	Function
CFGR	PRESC	LL_LPTIM_SetPrescaler
	TIMOUT	LL_LPTIM_DisableTimeout
		LL_LPTIM_EnableTimeout
		LL_LPTIM_IsEnabledTimeout
	TRGFLT	LL_LPTIM_ConfigTrigger
		LL_LPTIM_GetTriggerFilter
	TRIGEN	LL_LPTIM_ConfigTrigger
		LL_LPTIM_GetTriggerPolarity
		LL_LPTIM_TrigSw
	TRIGSEL	LL_LPTIM_ConfigTrigger
		LL_LPTIM_GetTriggerSource
	WAVE	LL_LPTIM_ConfigOutput
		LL_LPTIM_GetWaveform
		LL_LPTIM_SetWaveform
	WAVPOL	LL_LPTIM_ConfigOutput
		LL_LPTIM_GetPolarity
		LL_LPTIM_SetPolarity
CMP	CMP	LL_LPTIM_GetCompare
		LL_LPTIM_SetCompare
CNT	CNT	LL_LPTIM_GetCounter
CR	CNTSTRT	LL_LPTIM_StartCounter
	ENABLE	LL_LPTIM_Disable
		LL_LPTIM_Enable
		LL_LPTIM_IsEnabled
	SNGSTRT	LL_LPTIM_StartCounter
ICR	ARRMCF	LL_LPTIM_ClearFLAG_ARRM
	ARROKCF	LL_LPTIM_ClearFlag_ARROK
	CMPMCF	LL_LPTIM_ClearFLAG_CMPM
	CMPOKCF	LL_LPTIM_ClearFlag_CMPOK
	DOWNCF	LL_LPTIM_ClearFlag_DOWN
	EXTTRIGCF	LL_LPTIM_ClearFlag_EXTTRIG
	UPCF	LL_LPTIM_ClearFlag_UP
IER	ARRMIE	LL_LPTIM_DisableIT_ARRM
		LL_LPTIM_EnableIT_ARRM
		LL_LPTIM_IsEnabledIT_ARRM
	ARROKIE	LL_LPTIM_DisableIT_ARROK
		LL_LPTIM_EnableIT_ARROK
		LL_LPTIM_IsEnabledIT_ARROK

Register	Field	Function
IER	CMPMIE	LL_LPTIM_DisableIT_CMPM
		LL_LPTIM_EnableIT_CMPM
		LL_LPTIM_IsEnabledIT_CMPM
	CMPOKIE	LL_LPTIM_DisableIT_CMPOK
		LL_LPTIM_EnableIT_CMPOK
		LL_LPTIM_IsEnabledIT_CMPOK
	DOWNIE	LL_LPTIM_DisableIT_DOWN
		LL_LPTIM_EnableIT_DOWN
		LL_LPTIM_IsEnabledIT_DOWN
	EXTTRIGIE	LL_LPTIM_DisableIT_EXTTRIG
		LL_LPTIM_EnableIT_EXTTRIG
		LL_LPTIM_IsEnabledIT_EXTTRIG
	UPIE	LL_LPTIM_DisableIT_UP
		LL_LPTIM_EnableIT_UP
		LL_LPTIM_IsEnabledIT_UP
ISR	ARRM	LL_LPTIM_IsActiveFlag_ARRM
	ARROK	LL_LPTIM_IsActiveFlag_ARROK
	CMPM	LL_LPTIM_IsActiveFlag_CMPM
	CMPOK	LL_LPTIM_IsActiveFlag_CMPOK
	DOWN	LL_LPTIM_IsActiveFlag_DOWN
	EXTTRIG	LL_LPTIM_IsActiveFlag_EXTTRIG
	UP	LL_LPTIM_IsActiveFlag_UP
OR	OR_0	LL_LPTIM_SetInput1Src
		LL_LPTIM_SetInput2Src
	OR_1	LL_LPTIM_SetInput1Src

108.16 LPUART

Table 41. Correspondence between LPUART registers and LPUART low-layer driver functions

Register	Field	Function
BRR	BRR	LL_LPUART_GetBaudRate
		LL_LPUART_SetBaudRate
CR1	CMIE	LL_LPUART_DisableIT_CM
		LL_LPUART_EnableIT_CM
		LL_LPUART_IsEnabledIT_CM
	DEAT	LL_LPUART_GetDEAssertionTime
		LL_LPUART_SetDEAssertionTime
	DEDT	LL_LPUART_GetDEDeassertionTime

Register	Field	Function
CR1	DEDT	LL_LPUART_SetDEDeassertionTime
	FIFOEN	LL_LPUART_DisableFIFO
		LL_LPUART_EnableFIFO
		LL_LPUART_IsEnabledFIFO
	IDLEIE	LL_LPUART_DisableIT_IDLE
		LL_LPUART_EnableIT_IDLE
		LL_LPUART_IsEnabledIT_IDLE
	M	LL_LPUART_ConfigCharacter
		LL_LPUART_GetDataWidth
		LL_LPUART_SetDataWidth
	MME	LL_LPUART_DisableMuteMode
		LL_LPUART_EnableMuteMode
		LL_LPUART_IsEnabledMuteMode
	PCE	LL_LPUART_ConfigCharacter
		LL_LPUART_GetParity
		LL_LPUART_SetParity
	PEIE	LL_LPUART_DisableIT_PE
		LL_LPUART_EnableIT_PE
		LL_LPUART_IsEnabledIT_PE
	PS	LL_LPUART_ConfigCharacter
		LL_LPUART_GetParity
		LL_LPUART_SetParity
	RE	LL_LPUART_DisableDirectionRx
		LL_LPUART_EnableDirectionRx
		LL_LPUART_GetTransferDirection
		LL_LPUART_SetTransferDirection
	RXFFIE	LL_LPUART_DisableIT_RXFF
		LL_LPUART_EnableIT_RXFF
		LL_LPUART_IsEnabledIT_RXFF
	RXNEIE_RXFNEIE	LL_LPUART_DisableIT_RXNE_RXFNE
		LL_LPUART_EnableIT_RXNE_RXFNE
		LL_LPUART_IsEnabledIT_RXNE_RXFNE
	TCIE	LL_LPUART_DisableIT_TC
		LL_LPUART_EnableIT_TC
		LL_LPUART_IsEnabledIT_TC
	TE	LL_LPUART_DisableDirectionTx
		LL_LPUART_EnableDirectionTx
		LL_LPUART_GetTransferDirection

Register	Field	Function
CR1	TE	LL_LPUART_SetTransferDirection
	TXEIE_TXFNFIE	LL_LPUART_DisableIT_TXE_TXFNF
		LL_LPUART_EnableIT_TXE_TXFNF
		LL_LPUART_IsEnabledIT_TXE_TXFNF
	TXFEIE	LL_LPUART_DisableIT_TXFE
		LL_LPUART_EnableIT_TXFE
		LL_LPUART_IsEnabledIT_TXFE
	UE	LL_LPUART_Disable
		LL_LPUART_Enable
		LL_LPUART_IsEnabled
	UESM	LL_LPUART_DisableInStopMode
		LL_LPUART_EnableInStopMode
		LL_LPUART_IsEnabledInStopMode
	WAKE	LL_LPUART_GetWakeUpMethod
		LL_LPUART_SetWakeUpMethod
CR2	ADD	LL_LPUART_ConfigNodeAddress
		LL_LPUART_GetNodeAddress
	ADDM7	LL_LPUART_ConfigNodeAddress
		LL_LPUART_GetNodeAddressLen
	DATAINV	LL_LPUART_GetBinaryDataLogic
		LL_LPUART_SetBinaryDataLogic
	MSBFIRST	LL_LPUART_GetTransferBitOrder
		LL_LPUART_SetTransferBitOrder
	RXINV	LL_LPUART_GetRXPinLevel
		LL_LPUART_SetRXPinLevel
	STOP	LL_LPUART_ConfigCharacter
		LL_LPUART_GetStopBitsLength
		LL_LPUART_SetStopBitsLength
	SWAP	LL_LPUART_GetTXRXSwap
		LL_LPUART_SetTXRXSwap
	TXINV	LL_LPUART_GetTXPinLevel
		LL_LPUART_SetTXPinLevel
CR3	CTSE	LL_LPUART_DisableCTSHWFlowCtrl
		LL_LPUART_EnableCTSHWFlowCtrl
		LL_LPUART_GetHWFlowCtrl
		LL_LPUART_SetHWFlowCtrl
	CTSIE	LL_LPUART_DisableIT_CTS
		LL_LPUART_EnableIT_CTS

Register	Field	Function
CR3	CTSIE	LL_LPUART_IsEnabledIT_CTS
	DDRE	LL_LPUART_DisableDMADeactOnRxErr
		LL_LPUART_EnableDMADeactOnRxErr
		LL_LPUART_IsEnabledDMADeactOnRxErr
	DEM	LL_LPUART_DisableDEMode
		LL_LPUART_EnableDEMode
		LL_LPUART_IsEnabledDEMode
	DEP	LL_LPUART_GetDESignalPolarity
		LL_LPUART_SetDESignalPolarity
	DMAR	LL_LPUART_DisableDMAReq_RX
		LL_LPUART_EnableDMAReq_RX
		LL_LPUART_IsEnabledDMAReq_RX
	DMAT	LL_LPUART_DisableDMAReq_TX
		LL_LPUART_EnableDMAReq_TX
		LL_LPUART_IsEnabledDMAReq_TX
	EIE	LL_LPUART_DisableIT_ERROR
		LL_LPUART_EnableIT_ERROR
		LL_LPUART_IsEnabledIT_ERROR
	HDSEL	LL_LPUART_DisableHalfDuplex
		LL_LPUART_EnableHalfDuplex
		LL_LPUART_IsEnabledHalfDuplex
	OVRDIS	LL_LPUART_DisableOverrunDetect
		LL_LPUART_EnableOverrunDetect
		LL_LPUART_IsEnabledOverrunDetect
	RTSE	LL_LPUART_DisableRTSHWFlowCtrl
		LL_LPUART_EnableRTSHWFlowCtrl
		LL_LPUART_GetHWFlowCtrl
		LL_LPUART_SetHWFlowCtrl
	RXFTCFG	LL_LPUART_ConfigFIFOsThreshold
		LL_LPUART_GetRXFIFOThreshold
		LL_LPUART_SetRXFIFOThreshold
	RXFTIE	LL_LPUART_DisableIT_RXFT
		LL_LPUART_EnableIT_RXFT
		LL_LPUART_IsEnabledIT_RXFT
	TXFTCFG	LL_LPUART_ConfigFIFOsThreshold
		LL_LPUART_GetTXFIFOThreshold
		LL_LPUART_SetTXFIFOThreshold
	TXFTIE	LL_LPUART_DisableIT_TXFT

Register	Field	Function
CR3	TXFTIE	LL_LPUART_EnableIT_TXFT
		LL_LPUART_IsEnabledIT_TXFT
	WUFIE	LL_LPUART_DisableIT_WKUP
		LL_LPUART_EnableIT_WKUP
		LL_LPUART_IsEnabledIT_WKUP
	WUS	LL_LPUART_GetWKUPType
		LL_LPUART_SetWKUPType
ICR	CMCF	LL_LPUART_ClearFlag_CM
	CTSCF	LL_LPUART_ClearFlag_nCTS
	FECF	LL_LPUART_ClearFlag_FE
	IDLECF	LL_LPUART_ClearFlag_IDLE
	NECF	LL_LPUART_ClearFlag_NE
	ORECF	LL_LPUART_ClearFlag_ORE
	PECF	LL_LPUART_ClearFlag_PE
	TCCF	LL_LPUART_ClearFlag_TC
	TXFECF	LL_LPUART_ClearFlag_TXFE
	WUCF	LL_LPUART_ClearFlag_WKUP
ISR	BUSY	LL_LPUART_IsActiveFlag_BUSY
	CMF	LL_LPUART_IsActiveFlag_CM
	CTS	LL_LPUART_IsActiveFlag_CTS
	CTSIF	LL_LPUART_IsActiveFlag_nCTS
	FE	LL_LPUART_IsActiveFlag_FE
	IDLE	LL_LPUART_IsActiveFlag_IDLE
	NE	LL_LPUART_IsActiveFlag_NE
	ORE	LL_LPUART_IsActiveFlag_ORE
	PE	LL_LPUART_IsActiveFlag_PE
	REACK	LL_LPUART_IsActiveFlag_REACK
	RWU	LL_LPUART_IsActiveFlag_RWU
	RXFF	LL_LPUART_IsActiveFlag_RXFF
	RXFT	LL_LPUART_IsActiveFlag_RXFT
	RXNE_RXFNE	LL_LPUART_IsActiveFlag_RXNE_RXFNE
	SBKF	LL_LPUART_IsActiveFlag_SBK
	TC	LL_LPUART_IsActiveFlag_TC
	TEACK	LL_LPUART_IsActiveFlag_TEACK
	TXE_TXFNF	LL_LPUART_IsActiveFlag_TXE_TXFNF
	TXFE	LL_LPUART_IsActiveFlag_TXFE
	TXFT	LL_LPUART_IsActiveFlag_TXFT
	WUF	LL_LPUART_IsActiveFlag_WKUP

Register	Field	Function
PRESC	PRESCALER	LL_LPUART_GetPrescaler
		LL_LPUART_SetPrescaler
RDR	RDR	LL_LPUART_DMA_GetRegAddr
		LL_LPUART_ReceiveData8
		LL_LPUART_ReceiveData9
RQR	MMRQ	LL_LPUART_RequestEnterMuteMode
	RXFRQ	LL_LPUART_RequestRxDataFlush
	SBKRQ	LL_LPUART_RequestBreakSending
TDR	TDR	LL_LPUART_DMA_GetRegAddr
		LL_LPUART_TransmitData8
		LL_LPUART_TransmitData9

108.17 OPAMP

Table 42. Correspondence between OPAMP registers and OPAMP low-layer driver functions

Register	Field	Function
CSR	CALON	LL_OPAMP_GetMode
		LL_OPAMP_SetMode
	CALOUT	LL_OPAMP_IsCalibrationOutputSet
	CALSEL	LL_OPAMP_GetCalibrationSelection
		LL_OPAMP_SetCalibrationSelection
	OPALPM	LL_OPAMP_GetPowerMode
		LL_OPAMP_SetPowerMode
	OPAMODE	LL_OPAMP_GetFunctionalMode
		LL_OPAMP_SetFunctionalMode
	OPAMPXEN	LL_OPAMP_Disable
		LL_OPAMP_Enable
		LL_OPAMP_IsEnabled
	OPARANGE	LL_OPAMP_GetCommonPowerRange
		LL_OPAMP_SetCommonPowerRange
	PGGAIN	LL_OPAMP_GetPGAGain
		LL_OPAMP_SetPGAGain
	USERTRIM	LL_OPAMP_GetTrimmingMode
		LL_OPAMP_SetTrimmingMode
	VMSEL	LL_OPAMP_GetInputInverting
		LL_OPAMP_SetInputInverting
	VPSEL	LL_OPAMP_GetInputNonInverting
		LL_OPAMP_SetInputNonInverting

Register	Field	Function
LPOTR	TRIMLPOFFSETN	LL_OPAMP_GetTrimmingValue
		LL_OPAMP_SetTrimmingValue
	TRIMLPOFFSETP	LL_OPAMP_GetTrimmingValue
		LL_OPAMP_SetTrimmingValue
OTR	TRIMOFFSETN	LL_OPAMP_GetTrimmingValue
		LL_OPAMP_SetTrimmingValue
	TRIMOFFSETP	LL_OPAMP_GetTrimmingValue
		LL_OPAMP_SetTrimmingValue

108.18 PKA

Table 43. Correspondence between PKA registers and PKA low-layer driver functions

Register	Field	Function
CLRFR	ADDRERRFC	LL_PKA_ClearFlag_ADDERR
	PROCENDFC	LL_PKA_ClearFlag_PROCEND
	RAMERRFC	LL_PKA_ClearFlag_RAMERR
CR	ADDRERRIE	LL_PKA_DisableIT_ADDERR
		LL_PKA_EnableIT_ADDRERR
		LL_PKA_IsEnabledIT_ADDRERR
	EN	LL_PKA_Disable
		LL_PKA_Enable
		LL_PKA_IsEnabled
	MODE	LL_PKA_Config
		LL_PKA_GetMode
		LL_PKA_SetMode
	PROCENDIE	LL_PKA_DisableIT_PROCEND
		LL_PKA_EnableIT_PROCEND
		LL_PKA_IsEnabledIT_PROCEND
	RAMERRIE	LL_PKA_DisableIT_RAMERR
		LL_PKA_EnableIT_RAMERR
		LL_PKA_IsEnabledIT_RAMERR
	START	LL_PKA_Start
SR	ADDRERRF	LL_PKA_IsActiveFlag_ADDRERR
	BUSY	LL_PKA_IsActiveFlag_BUSY
	PROCENDF	LL_PKA_IsActiveFlag_PROCEND
	RAMERRF	LL_PKA_IsActiveFlag_RAMERR

108.19 PWR

Table 44. **Correspondence between PWR registers and PWR low-layer driver functions**

Register	Field	Function
CR1	DBP	LL_PWR_DisableBkUpAccess
		LL_PWR_EnableBkUpAccess
		LL_PWR_IsEnabledBkUpAccess
	LPMS	LL_PWR_GetPowerMode
		LL_PWR_SetPowerMode
	LPR	LL_PWR_DisableLowPowerRunMode
		LL_PWR_EnableLowPowerRunMode
		LL_PWR_EnterLowPowerRunMode
		LL_PWR_ExitLowPowerRunMode
		LL_PWR_IsEnabledLowPowerRunMode
	RRSTP	LL_PWR_DisableSRAM3Retention
		LL_PWR_EnableSRAM3Retention
		LL_PWR_IsEnabledSRAM3Retention
	VOS	LL_PWR_GetRegulVoltageScaling
		LL_PWR_SetRegulVoltageScaling
CR2	IOSV	LL_PWR_DisableVddIO2
		LL_PWR_EnableVddIO2
		LL_PWR_IsEnabledVddIO2
	PLS	LL_PWR_GetPVDLevel
		LL_PWR_SetPVDLevel
	PVDE	LL_PWR_DisablePVD
		LL_PWR_EnablePVD
		LL_PWR_IsEnabledPVD
	PVME1	LL_PWR_DisablePVM
		LL_PWR_EnablePVM
		LL_PWR_IsEnabledPVM
	PVME2	LL_PWR_DisablePVM
		LL_PWR_EnablePVM
		LL_PWR_IsEnabledPVM
	PVME3	LL_PWR_DisablePVM
		LL_PWR_EnablePVM
		LL_PWR_IsEnabledPVM
	PVME4	LL_PWR_DisablePVM
		LL_PWR_EnablePVM
		LL_PWR_IsEnabledPVM

Register	Field	Function
CR2	USV	LL_PWR_DisableVddUSB
		LL_PWR_EnableVddUSB
		LL_PWR_IsEnabledVddUSB
CR3	APC	LL_PWR_DisablePUPDCfg
		LL_PWR_EnablePUPDCfg
		LL_PWR_IsEnabledPUPDCfg
	DSIPDEN	LL_PWR_DisableDSIPinsPDActivation
		LL_PWR_DisableDSIPullDown
		LL_PWR_EnableDSIPinsPDActivation
		LL_PWR_EnableDSIPullDown
		LL_PWR_IsEnabledDSIPinsPDActivation
		LL_PWR_IsEnabledDSIPullDown
	EIWF	LL_PWR_DisableInternWU
		LL_PWR_EnableInternWU
		LL_PWR_IsEnabledInternWU
	EWUP1	LL_PWR_DisableWakeUpPin
		LL_PWR_EnableWakeUpPin
		LL_PWR_IsEnabledWakeUpPin
	EWUP2	LL_PWR_DisableWakeUpPin
		LL_PWR_EnableWakeUpPin
		LL_PWR_IsEnabledWakeUpPin
	EWUP3	LL_PWR_DisableWakeUpPin
		LL_PWR_EnableWakeUpPin
		LL_PWR_IsEnabledWakeUpPin
	EWUP4	LL_PWR_DisableWakeUpPin
		LL_PWR_EnableWakeUpPin
		LL_PWR_IsEnabledWakeUpPin
	EWUP5	LL_PWR_DisableWakeUpPin
		LL_PWR_EnableWakeUpPin
		LL_PWR_IsEnabledWakeUpPin
	RRS	LL_PWR_DisableSRAM2Retention
		LL_PWR_EnableSRAM2Retention
		LL_PWR_GetSRAM2ContentRetention
		LL_PWR_IsEnabledSRAM2Retention
		LL_PWR_SetSRAM2ContentRetention
CR4	VBE	LL_PWR_DisableBatteryCharging
		LL_PWR_EnableBatteryCharging
		LL_PWR_IsEnabledBatteryCharging

Register	Field	Function
CR4	VBRS	LL_PWR_GetBattChargResistor
		LL_PWR_SetBattChargResistor
	WP1	LL_PWR_IsWakeUpPinPolarityLow
		LL_PWR_SetWakeUpPinPolarityHigh
		LL_PWR_SetWakeUpPinPolarityLow
	WP2	LL_PWR_IsWakeUpPinPolarityLow
		LL_PWR_SetWakeUpPinPolarityHigh
		LL_PWR_SetWakeUpPinPolarityLow
	WP3	LL_PWR_IsWakeUpPinPolarityLow
		LL_PWR_SetWakeUpPinPolarityHigh
		LL_PWR_SetWakeUpPinPolarityLow
	WP4	LL_PWR_IsWakeUpPinPolarityLow
		LL_PWR_SetWakeUpPinPolarityHigh
		LL_PWR_SetWakeUpPinPolarityLow
	WP5	LL_PWR_IsWakeUpPinPolarityLow
		LL_PWR_SetWakeUpPinPolarityHigh
		LL_PWR_SetWakeUpPinPolarityLow
CR5	R1MODE	LL_PWR_DisableRange1BoostMode
		LL_PWR_EnableRange1BoostMode
		LL_PWR_IsEnabledRange1BoostMode
PDCRA	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRB	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRC	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRD	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRE	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRF	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown

Register	Field	Function
PDCRG	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRH	PD0-15	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PDCRI	PD0-11	LL_PWR_DisableGPIOPullDown
		LL_PWR_EnableGPIOPullDown
		LL_PWR_IsEnabledGPIOPullDown
PUCRA	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRB	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRC	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRD	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRE	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRF	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRG	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRH	PU0-15	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
PUCRI	PU0-11	LL_PWR_DisableGPIOPullUp
		LL_PWR_EnableGPIOPullUp
		LL_PWR_IsEnabledGPIOPullUp
SCR	CSBF	LL_PWR_ClearFlag_SB
	CWUF	LL_PWR_ClearFlag_WU

Register	Field	Function
SCR	CWUF1	LL_PWR_ClearFlag_WU1
	CWUF2	LL_PWR_ClearFlag_WU2
	CWUF3	LL_PWR_ClearFlag_WU3
	CWUF4	LL_PWR_ClearFlag_WU4
	CWUF5	LL_PWR_ClearFlag_WU5
SR1	SBF	LL_PWR_IsActiveFlag_SB
	WUF1	LL_PWR_IsActiveFlag_WU1
	WUF2	LL_PWR_IsActiveFlag_WU2
	WUF3	LL_PWR_IsActiveFlag_WU3
	WUF4	LL_PWR_IsActiveFlag_WU4
	WUF5	LL_PWR_IsActiveFlag_WU5
	WUFI	LL_PWR_IsActiveFlag_InternWU
SR2	PVDO	LL_PWR_IsActiveFlag_PVDO
	PVMO1	LL_PWR_IsActiveFlag_PVMO1
	PVMO2	LL_PWR_IsActiveFlag_PVMO2
	PVMO3	LL_PWR_IsActiveFlag_PVMO3
	PVMO4	LL_PWR_IsActiveFlag_PVMO4
	REGLPF	LL_PWR_IsActiveFlag_REGLPF
	REGLPS	LL_PWR_IsActiveFlag_REGLPS
	VOSF	LL_PWR_IsActiveFlag_VOS

108.20 RCC

Table 45. Correspondence between RCC registers and RCC low-layer driver functions

Register	Field	Function
BDCR	BDRST	LL_RCC_ForceBackupDomainReset
		LL_RCC_ReleaseBackupDomainReset
	LSCOEN	LL_RCC_LSCO_Disable
		LL_RCC_LSCO_Enable
	LSCOSEL	LL_RCC_LSCO_GetSource
		LL_RCC_LSCO_SetSource
	LSEBYP	LL_RCC_LSE_DisableBypass
		LL_RCC_LSE_EnableBypass
	LSECSSD	LL_RCC_LSE_IsCSSDetected
	LSECSSON	LL_RCC_LSE_DisableCSS
		LL_RCC_LSE_EnableCSS
	LSEDRV	LL_RCC_LSE_GetDriveCapability
		LL_RCC_LSE_SetDriveCapability

Register	Field	Function
BDCR	LSEON	LL_RCC_LSE_Disable
		LL_RCC_LSE_Enable
	LSERDY	LL_RCC_LSE_IsReady
	RTCEN	LL_RCC_DisableRTC
		LL_RCC_EnableRTC
		LL_RCC_IsEnabledRTC
	RTCSEL	LL_RCC_GetRTCClockSource
		LL_RCC_SetRTCClockSource
CCIPR	ADCSEL	LL_RCC_GetADCClockSource
		LL_RCC_SetADCClockSource
	CLK48SEL	LL_RCC_GetRNGClockSource
		LL_RCC_GetSDMMCClockSource
		LL_RCC_GetUSBClockSource
		LL_RCC_SetRNGClockSource
		LL_RCC_SetSDMMCClockSource
		LL_RCC_SetUSBClockSource
	I2CxSEL	LL_RCC_GetI2CClockSource
		LL_RCC_SetI2CClockSource
	LPTIMxSEL	LL_RCC_GetLPTIMClockSource
		LL_RCC_SetLPTIMClockSource
	LPUART1SEL	LL_RCC_GetLPUARTClockSource
		LL_RCC_SetLPUARTClockSource
	UARTxSEL	LL_RCC_GetUARTClockSource
		LL_RCC_SetUARTClockSource
	USARTxSEL	LL_RCC_GetUSARTClockSource
		LL_RCC_SetUSARTClockSource
CCIPR2	ADFSDM1SEL	LL_RCC_GetDFSDMAudioClockSource
		LL_RCC_SetDFSDMAudioClockSource
	DFSDM1SEL	LL_RCC_GetDFSDMClockSource
		LL_RCC_SetDFSDMClockSource
	DSISEL	LL_RCC_GetDSIClockSource
		LL_RCC_SetDSIClockSource
	OSPISEL	LL_RCC_GetOCTOSPIClockSource
		LL_RCC_SetOCTOSPIClockSource
	PLLSAI2DIVR	LL_RCC_GetLTDCClockSource
		LL_RCC_PLLSAI2_ConfigDomain_LTDC
		LL_RCC_PLLSAI2_GetDIVR
		LL_RCC_SetLTDCClockSource

Register	Field	Function
CCIPR2	SAIxSEL	LL_RCC_GetSAIClockSource
		LL_RCC_SetSAIClockSource
	SDMMCSEL	LL_RCC_GetSDMMCKernelClockSource
		LL_RCC_SetSDMMCKernelClockSource
CFGR	HPRE	LL_RCC_GetAHBPrescaler
		LL_RCC_SetAHBPrescaler
	MCOPRE	LL_RCC_ConfigMCO
	MCOSEL	LL_RCC_ConfigMCO
	PPRE1	LL_RCC_GetAPB1Prescaler
		LL_RCC_SetAPB1Prescaler
	PPRE2	LL_RCC_GetAPB2Prescaler
		LL_RCC_SetAPB2Prescaler
	STOPWUCK	LL_RCC_GetClkAfterWakeFromStop
		LL_RCC_SetClkAfterWakeFromStop
	SW	LL_RCC_SetSysClkSource
	SWS	LL_RCC_GetSysClkSource
CICR	CSSC	LL_RCC_ClearFlag_HSECSS
	HSERDYC	LL_RCC_ClearFlag_HSERDY
	HSI48RDYC	LL_RCC_ClearFlag_HSI48RDY
	HSIRDYC	LL_RCC_ClearFlag_HSIRDY
	LSECSSC	LL_RCC_ClearFlag_LSECSS
	LSERDYC	LL_RCC_ClearFlag_LSERDY
	LSIRDYC	LL_RCC_ClearFlag_LSIRDY
	MSIRDYC	LL_RCC_ClearFlag_MSIRDY
	PLLRDYC	LL_RCC_ClearFlag_PLLRDY
	PLLSAI1RDYC	LL_RCC_ClearFlag_PLLSAI1RDY
	PLLSAI2RDYC	LL_RCC_ClearFlag_PLLSAI2RDY
CIER	HSERDYIE	LL_RCC_DisableIT_HSERDY
		LL_RCC_EnableIT_HSERDY
		LL_RCC_IsEnabledIT_HSERDY
	HSI48RDYIE	LL_RCC_DisableIT_HSI48RDY
		LL_RCC_EnableIT_HSI48RDY
		LL_RCC_IsEnabledIT_HSI48RDY
	HSIRDYIE	LL_RCC_DisableIT_HSIRDY
		LL_RCC_EnableIT_HSIRDY
		LL_RCC_IsEnabledIT_HSIRDY
	LSECSSIE	LL_RCC_DisableIT_LSECSS
		LL_RCC_EnableIT_LSECSS

Register	Field	Function
CIER	LSECSSIE	LL_RCC_IsEnabledIT_LSECSS
	LSERDYIE	LL_RCC_DisableIT_LSERDY
		LL_RCC_EnableIT_LSERDY
		LL_RCC_IsEnabledIT_LSERDY
	LSIRDYIE	LL_RCC_DisableIT_LSIRDY
		LL_RCC_EnableIT_LSIRDY
		LL_RCC_IsEnabledIT_LSIRDY
	MSIRDYIE	LL_RCC_DisableIT_MSIRDY
		LL_RCC_EnableIT_MSIRDY
		LL_RCC_IsEnabledIT_MSIRDY
	PLLRDYIE	LL_RCC_DisableIT_PLLRDY
		LL_RCC_EnableIT_PLLRDY
		LL_RCC_IsEnabledIT_PLLRDY
	PLLSAI1RDYIE	LL_RCC_DisableIT_PLLSAI1RDY
		LL_RCC_EnableIT_PLLSAI1RDY
		LL_RCC_IsEnabledIT_PLLSAI1RDY
	PLLSAI2RDYIE	LL_RCC_DisableIT_PLLSAI2RDY
		LL_RCC_EnableIT_PLLSAI2RDY
		LL_RCC_IsEnabledIT_PLLSAI2RDY
CIFR	CSSF	LL_RCC_IsActiveFlag_HSECSS
	HSERDYF	LL_RCC_IsActiveFlag_HSERDY
	HSIRDYF	LL_RCC_IsActiveFlag_HSIRDY
	LSECSSF	LL_RCC_IsActiveFlag_LSECSS
	LSERDYF	LL_RCC_IsActiveFlag_LSERDY
	LSIRDYF	LL_RCC_IsActiveFlag_LSIRDY
	MSIRDYF	LL_RCC_IsActiveFlag_MSIRDY
	PLLRDYF	LL_RCC_IsActiveFlag_PLLRDY
	PLLSAI1RDYF	LL_RCC_IsActiveFlag_PLLSAI1RDY
	PLLSAI2RDYF	LL_RCC_IsActiveFlag_PLLSAI2RDY
CIR	HSI48RDYF	LL_RCC_IsActiveFlag_HSI48RDY
CR	CSSON	LL_RCC_HSE_EnableCSS
	HSEBYP	LL_RCC_HSE_DisableBypass
		LL_RCC_HSE_EnableBypass
	HSEON	LL_RCC_HSE_Disable
		LL_RCC_HSE_Enable
	HSERDY	LL_RCC_HSE_IsReady
	HSIASFS	LL_RCC_HSI_DisableAutoFromStop
		LL_RCC_HSI_EnableAutoFromStop

Register	Field	Function
CR	HSIKERON	LL_RCC_HSI_DisableInStopMode
		LL_RCC_HSI_EnableInStopMode
		LL_RCC_HSI_IsEnabledInStopMode
	HSION	LL_RCC_HSI_Disable
		LL_RCC_HSI_Enable
	HSIRDY	LL_RCC_HSI_IsReady
	MSION	LL_RCC_MSI_Disable
		LL_RCC_MSI_Enable
	MSIPLLEN	LL_RCC_MSI_DisablePLLMode
		LL_RCC_MSI_EnablePLLMode
	MSIRANGE	LL_RCC_MSI_GetRange
		LL_RCC_MSI_SetRange
	MSIRDY	LL_RCC_MSI_IsReady
	MSIRGSEL	LL_RCC_MSI_EnableRangeSelection
		LL_RCC_MSI_IsEnabledRangeSelect
	PLLON	LL_RCC_PLL_Disable
		LL_RCC_PLL_Enable
	PLLRDY	LL_RCC_PLL_IsReady
	PLLSAI1ON	LL_RCC_PLLSAI1_Disable
		LL_RCC_PLLSAI1_Enable
	PLLSAI1RDY	LL_RCC_PLLSAI1_IsReady
	PLLSAI2ON	LL_RCC_PLLSAI2_Disable
		LL_RCC_PLLSAI2_Enable
	PLLSAI2RDY	LL_RCC_PLLSAI2_IsReady
CRRCR	HSI48CAL	LL_RCC_HSI48_GetCalibration
	HSI48ON	LL_RCC_HSI48_Disable
		LL_RCC_HSI48_Enable
	HSI48RDY	LL_RCC_HSI48_IsReady
CSR	BORRSTF	LL_RCC_IsActiveFlag_BORRST
	FWRSTF	LL_RCC_IsActiveFlag_FWRST
	IWDGRSTF	LL_RCC_IsActiveFlag_IWDGRST
	LPWRRSTF	LL_RCC_IsActiveFlag_LPWRRST
	LSION	LL_RCC_LSI_Disable
		LL_RCC_LSI_Enable
	LSIRDY	LL_RCC_LSI_IsReady
	MSISRANGE	LL_RCC_MSI_GetRangeAfterStandby
		LL_RCC_MSI_SetRangeAfterStandby
	OBLRSTF	LL_RCC_IsActiveFlag_OBLRST

Register	Field	Function
CSR	PINRSTF	LL_RCC_IsActiveFlag_PINRST
	RMVF	LL_RCC_ClearResetFlags
	SFTRSTF	LL_RCC_IsActiveFlag_SFTRST
	WWDGRSTF	LL_RCC_IsActiveFlag_WWDGRST
DLYCFGR	OCTOSPI1_DLY	LL_RCC_OCTOSPI1_DelayConfig
	OCTOSPI2_DLY	LL_RCC_OCTOSPI2_DelayConfig
ICSCR	HSICAL	LL_RCC_HSI_GetCalibration
	HSITRIM	LL_RCC_HSI_GetCalibTrimming
		LL_RCC_HSI_SetCalibTrimming
	MSICAL	LL_RCC_MSI_GetCalibration
	MSITRIM	LL_RCC_MSI_GetCalibTrimming
		LL_RCC_MSI_SetCalibTrimming
PLLCFGR	PLLM	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_ConfigDomain_SAI
		LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetDivider
	PLLN	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_ConfigDomain_SAI
		LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetN
	PLLPDIV	LL_RCC_PLL_ConfigDomain_SAI
		LL_RCC_PLL_GetP
	PLLPEN	LL_RCC_PLL_DisableDomain_SAI
		LL_RCC_PLL_EnableDomain_SAI
	PLLQ	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_GetQ
	PLLQEN	LL_RCC_PLL_DisableDomain_48M
		LL_RCC_PLL_EnableDomain_48M
	PLLR	LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetR
	PLLREN	LL_RCC_PLL_DisableDomain_SYS
		LL_RCC_PLL_EnableDomain_SYS
	PLLSRC	LL_RCC_PLLSAI1_ConfigDomain_48M
		LL_RCC_PLLSAI1_ConfigDomain_ADC
		LL_RCC_PLLSAI1_ConfigDomain_SAI
		LL_RCC_PLLSAI2_ConfigDomain_DSI
		LL_RCC_PLLSAI2_ConfigDomain_LTDC
		LL_RCC_PLLSAI2_ConfigDomain_SAI

Register	Field	Function
PLLCFGR	PLLSRC	LL_RCC_PLL_ConfigDomain_48M
		LL_RCC_PLL_ConfigDomain_SAI
		LL_RCC_PLL_ConfigDomain_SYS
		LL_RCC_PLL_GetMainSource
		LL_RCC_PLL_SetMainSource
PLLSAI1CFGR	PLLSAI1M	LL_RCC_PLLSAI1_ConfigDomain_48M
		LL_RCC_PLLSAI1_ConfigDomain_ADC
		LL_RCC_PLLSAI1_ConfigDomain_SAI
		LL_RCC_PLLSAI1_GetDivider
	PLLSAI1N	LL_RCC_PLLSAI1_ConfigDomain_48M
		LL_RCC_PLLSAI1_ConfigDomain_ADC
		LL_RCC_PLLSAI1_ConfigDomain_SAI
		LL_RCC_PLLSAI1_GetN
	PLLSAI1PDIV	LL_RCC_PLLSAI1_ConfigDomain_SAI
		LL_RCC_PLLSAI1_GetP
	PLLSAI1PEN	LL_RCC_PLLSAI1_DisableDomain_SAI
		LL_RCC_PLLSAI1_EnableDomain_SAI
	PLLSAI1Q	LL_RCC_PLLSAI1_ConfigDomain_48M
		LL_RCC_PLLSAI1_GetQ
	PLLSAI1QEN	LL_RCC_PLLSAI1_DisableDomain_48M
		LL_RCC_PLLSAI1_EnableDomain_48M
	PLLSAI1R	LL_RCC_PLLSAI1_ConfigDomain_ADC
		LL_RCC_PLLSAI1_GetR
	PLLSAI1REN	LL_RCC_PLLSAI1_DisableDomain_ADC
		LL_RCC_PLLSAI1_EnableDomain_ADC
PLLSAI2CFGR	PLLSAI2M	LL_RCC_PLLSAI2_ConfigDomain_DSI
		LL_RCC_PLLSAI2_ConfigDomain_LTDC
		LL_RCC_PLLSAI2_ConfigDomain_SAI
		LL_RCC_PLLSAI2_GetDivider
	PLLSAI2N	LL_RCC_PLLSAI2_ConfigDomain_DSI
		LL_RCC_PLLSAI2_ConfigDomain_LTDC
		LL_RCC_PLLSAI2_ConfigDomain_SAI
		LL_RCC_PLLSAI2_GetN
	PLLSAI2PDIV	LL_RCC_PLLSAI2_ConfigDomain_SAI
		LL_RCC_PLLSAI2_GetP
	PLLSAI2PEN	LL_RCC_PLLSAI2_DisableDomain_SAI
		LL_RCC_PLLSAI2_EnableDomain_SAI
	PLLSAI2Q	LL_RCC_PLLSAI2_ConfigDomain_DSI

Register	Field	Function
PLLSAI2CFGR	PLLSAI2Q	LL_RCC_PLLSAI2_GetQ
	PLLSAI2QEN	LL_RCC_PLLSAI2_DisableDomain_DSI
		LL_RCC_PLLSAI2_EnableDomain_DSI
	PLLSAI2R	LL_RCC_PLLSAI2_ConfigDomain_LTDC
		LL_RCC_PLLSAI2_GetR
	PLLSAI2REN	LL_RCC_PLLSAI2_DisableDomain_LTDC
		LL_RCC_PLLSAI2_EnableDomain_LTDC

108.21 RNG

Table 46. Correspondence between RNG registers and RNG low-layer driver functions

Register	Field	Function
CR	CED	LL_RNG_DisableClkErrorDetect
		LL_RNG_EnableClkErrorDetect
		LL_RNG_IsEnabledClkErrorDetect
	CLKDIV	LL_RNG_GetClockDivider
		LL_RNG_SetClockDivider
	CONDRST	LL_RNG_IsResetConditioningBitSet
		LL_RNG_ResetConditioningResetBit
		LL_RNG_SetConditioningResetBit
	CONFIGLOCK	LL_RNG_ConfigLock
		LL_RNG_IsConfigLocked
	IE	LL_RNG_DisableIT
		LL_RNG_EnableIT
		LL_RNG_IsEnabledIT
	NISTC	LL_RNG_DisableNistCompliance
		LL_RNG_EnableNistCompliance
		LL_RNG_IsNistComplianceEnabled
	RNGEN	LL_RNG_Disable
		LL_RNG_Enable
		LL_RNG_IsEnabled
	RNG_CONFIG1	LL_RNG_GetConfig1
		LL_RNG_SetConfig1
	RNG_CONFIG2	LL_RNG_GetConfig2
		LL_RNG_SetConfig2
	RNG_CONFIG3	LL_RNG_GetConfig3
		LL_RNG_SetConfig3
DR	RNDATA	LL_RNG_ReadRandData32

Register	Field	Function
HTCR	HTCFG	LL_RNG_GetHealthconfiguration
		LL_RNG_SetHealthconfiguration
SR	CECS	LL_RNG_IsActiveFlag_CECS
	CEIS	LL_RNG_ClearFlag_CEIS
		LL_RNG_IsActiveFlag_CEIS
	DRDY	LL_RNG_IsActiveFlag_DRDY
	SECS	LL_RNG_IsActiveFlag_SECS
	SEIS	LL_RNG_ClearFlag_SEIS
		LL_RNG_IsActiveFlag_SEIS

108.22 RTC

Table 47. Correspondence between RTC registers and RTC low-layer driver functions

Register	Field	Function
BKPxR	BKP	LL_RTC_BAK_GetRegister
		LL_RTC_BAK_SetRegister
CR	ALRAIE	LL_RTC_IsEnabledIT_ALRA
	ALRBIE	LL_RTC_IsEnabledIT_ALRB
	TSIE	LL_RTC_IsEnabledIT_TS
	WUTIE	LL_RTC_IsEnabledIT_WUT
ISR	ALRAF	LL_RTC_ClearFlag_ALRA
		LL_RTC_IsActiveFlag_ALRA
	ALRAWF	LL_RTC_IsActiveFlag_ALRAW
	ALRBF	LL_RTC_ClearFlag_ALRB
		LL_RTC_IsActiveFlag_ALRB
	ALRBWF	LL_RTC_IsActiveFlag_ALRBW
	INIT	LL_RTC_DisableInitMode
		LL_RTC_EnableInitMode
	INITF	LL_RTC_IsActiveFlag_INIT
	INITS	LL_RTC_IsActiveFlag_INITS
	ITSF	LL_RTC_ClearFlag_ITS
	RECALPF	LL_RTC_IsActiveFlag_RECALP
	RSF	LL_RTC_ClearFlag_RS
		LL_RTC_IsActiveFlag_RS
	SHPF	LL_RTC_IsActiveFlag_SHP
	TAMP1F	LL_RTC_ClearFlag_TAMP1
		LL_RTC_IsActiveFlag_TAMP1
	TAMP2F	LL_RTC_ClearFlag_TAMP2

Register	Field	Function
ISR	TAMP2F	LL_RTC_IsActiveFlag_TAMP2
	TAMP3F	LL_RTC_ClearFlag_TAMP3
		LL_RTC_IsActiveFlag_TAMP3
	TSF	LL_RTC_ClearFlag_TS
		LL_RTC_IsActiveFlag_TS
	TSOVF	LL_RTC_ClearFlag_TSOV
		LL_RTC_IsActiveFlag_TSOV
	WUTF	LL_RTC_ClearFlag_WUT
		LL_RTC_IsActiveFlag_WUT
	WUTWF	LL_RTC_IsActiveFlag_WUTW
OR	ALARMOUTTYPE	LL_RTC_GetAlarmOutputType
		LL_RTC_SetAlarmOutputType
	OUT_RMP	LL_RTC_DisableOutRemap
		LL_RTC_EnableOutRemap
RCT_ALRMASSR	SS	LL_RTC_ALMA_GetSubSecond
		LL_RTC_ALMA_SetSubSecond
RTC_ALRMAR	DT	LL_RTC_ALMA_GetDay
		LL_RTC_ALMA_SetDay
	DU	LL_RTC_ALMA_GetDay
		LL_RTC_ALMA_GetWeekDay
		LL_RTC_ALMA_SetDay
		LL_RTC_ALMA_SetWeekDay
	HT	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetHour
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetHour
	HU	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetHour
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetHour
	MNT	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetMinute
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetMinute
	MNU	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetMinute
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetMinute

Register	Field	Function
RTC_ALRMAR	MSK1	LL_RTC_ALMA_GetMask
		LL_RTC_ALMA_SetMask
	MSK2	LL_RTC_ALMA_GetMask
		LL_RTC_ALMA_SetMask
	MSK3	LL_RTC_ALMA_GetMask
		LL_RTC_ALMA_SetMask
	MSK4	LL_RTC_ALMA_GetMask
		LL_RTC_ALMA_SetMask
	PM	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetTimeFormat
		LL_RTC_ALMA_SetTimeFormat
	ST	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetSecond
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetSecond
	SU	LL_RTC_ALMA_ConfigTime
		LL_RTC_ALMA_GetSecond
		LL_RTC_ALMA_GetTime
		LL_RTC_ALMA_SetSecond
	WDSEL	LL_RTC_ALMA_DisableWeekday
		LL_RTC_ALMA_EnableWeekday
RTC_ALRMASSR	MASKSS	LL_RTC_ALMA_GetSubSecondMask
		LL_RTC_ALMA_SetSubSecondMask
RTC_ALRMBR	DT	LL_RTC_ALMB_GetDay
		LL_RTC_ALMB_SetDay
	DU	LL_RTC_ALMB_GetDay
		LL_RTC_ALMB_GetWeekDay
		LL_RTC_ALMB_SetDay
		LL_RTC_ALMB_SetWeekDay
	HT	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetHour
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetHour
	HU	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetHour
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetHour
	MNT	LL_RTC_ALMB_ConfigTime

Register	Field	Function
RTC_ALRMBR	MNT	LL_RTC_ALMB_GetMinute
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetMinute
	MNU	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetMinute
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetMinute
	MSK1	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	MSK2	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	MSK3	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	MSK4	LL_RTC_ALMB_GetMask
		LL_RTC_ALMB_SetMask
	PM	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetTimeFormat
		LL_RTC_ALMB_SetTimeFormat
	ST	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetSecond
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetSecond
	SU	LL_RTC_ALMB_ConfigTime
		LL_RTC_ALMB_GetSecond
		LL_RTC_ALMB_GetTime
		LL_RTC_ALMB_SetSecond
	WDSEL	LL_RTC_ALMB_DisableWeekday
		LL_RTC_ALMB_EnableWeekday
RTC_ALRMBSSR	MASKSS	LL_RTC_ALMB_GetSubSecondMask
		LL_RTC_ALMB_SetSubSecondMask
	SS	LL_RTC_ALMB_GetSubSecond
		LL_RTC_ALMB_SetSubSecond
RTC_CALR	CALM	LL_RTC_CAL_GetMinus
		LL_RTC_CAL_SetMinus
	CALP	LL_RTC_CAL_IsPulseInserted
		LL_RTC_CAL_SetPulse
	CALW16	LL_RTC_CAL_GetPeriod
		LL_RTC_CAL_SetPeriod

Register	Field	Function
RTC_CALR	CALW8	LL_RTC_CAL_GetPeriod
		LL_RTC_CAL_SetPeriod
RTC_CR	ADD1H	LL_RTC_TIME_IncHour
	ALRAE	LL_RTC_ALMA_Disable
		LL_RTC_ALMA_Enable
	ALRAIE	LL_RTC_DisableIT_ALRA
		LL_RTC_EnableIT_ALRA
	ALRBE	LL_RTC_ALMB_Disable
		LL_RTC_ALMB_Enable
	ALRBIE	LL_RTC_DisableIT_ALRB
		LL_RTC_EnableIT_ALRB
	BKP	LL_RTC_TIME_DisableDayLightStore
		LL_RTC_TIME_EnableDayLightStore
		LL_RTC_TIME_IsDayLightStoreEnabled
	BYPSHAD	LL_RTC_DisableShadowRegBypass
		LL_RTC_EnableShadowRegBypass
		LL_RTC_IsShadowRegBypassEnabled
	COE	LL_RTC_CAL_GetOutputFreq
		LL_RTC_CAL_SetOutputFreq
	COSEL	LL_RTC_CAL_GetOutputFreq
		LL_RTC_CAL_SetOutputFreq
	FMT	LL_RTC_GetHourFormat
		LL_RTC_SetHourFormat
	ITSE	LL_RTC_TS_Disable
		LL_RTC_TS_DisableInternalEvent
		LL_RTC_TS_Enable
		LL_RTC_TS_EnableInternalEvent
	ITSEDGE	LL_RTC_TS_GetActiveEdge
		LL_RTC_TS_SetActiveEdge
	OSEL	LL_RTC_GetAlarmOutEvent
		LL_RTC_SetAlarmOutEvent
	POL	LL_RTC_GetOutputPolarity
		LL_RTC_SetOutputPolarity
	REFCKON	LL_RTC_DisableRefClock
		LL_RTC_EnableRefClock
	SUB1H	LL_RTC_TIME_DecHour
	TSIE	LL_RTC_DisableIT_TS
		LL_RTC_EnableIT_TS

Register	Field	Function
RTC_CR	WUCKSEL	LL_RTC_WAKEUP_GetClock
		LL_RTC_WAKEUP_SetClock
	WUTE	LL_RTC_WAKEUP_Disable
		LL_RTC_WAKEUP_Enable
		LL_RTC_WAKEUP_IsEnabled
	WUTIE	LL_RTC_DisableIT_WUT
		LL_RTC_EnableIT_WUT
RTC_DR	DT	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetDay
		LL_RTC_DATE_SetDay
	DU	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetDay
		LL_RTC_DATE_SetDay
	MT	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetMonth
		LL_RTC_DATE_SetMonth
	MU	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetMonth
		LL_RTC_DATE_SetMonth
	WDU	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetWeekDay
		LL_RTC_DATE_SetWeekDay
	YT	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetYear
		LL_RTC_DATE_SetYear
	YU	LL_RTC_DATE_Config
		LL_RTC_DATE_Get
		LL_RTC_DATE_GetYear
		LL_RTC_DATE_SetYear
RTC_PRER	PREDIV_A	LL_RTC_GetAsynchPrescaler
		LL_RTC_SetAsynchPrescaler
	PREDIV_S	LL_RTC_GetSynchPrescaler

Register	Field	Function
RTC_PRER	PREDIV_S	LL_RTC_SetSynchPrescaler
RTC_SHIFTR	ADD1S	LL_RTC_TIME_Synchronize
	SUBFS	LL_RTC_TIME_Synchronize
RTC_SR	ITSF	LL_RTC_IsActiveFlag_ITS
RTC_SSR	SS	LL_RTC_TIME_GetSubSecond
RTC_TR	HT	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetHour
		LL_RTC_TIME_SetHour
	HU	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetHour
		LL_RTC_TIME_SetHour
	MNT	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetMinute
		LL_RTC_TIME_SetMinute
	MNU	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetMinute
		LL_RTC_TIME_SetMinute
	PM	LL_RTC_TIME_Config
		LL_RTC_TIME_GetFormat
		LL_RTC_TIME_SetFormat
	ST	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetSecond
		LL_RTC_TIME_SetSecond
	SU	LL_RTC_TIME_Config
		LL_RTC_TIME_Get
		LL_RTC_TIME_GetSecond
		LL_RTC_TIME_SetSecond
RTC_TSDR	DT	LL_RTC_TS_GetDate
		LL_RTC_TS_GetDay
	DU	LL_RTC_TS_GetDate
		LL_RTC_TS_GetDay
	MT	LL_RTC_TS_GetDate
		LL_RTC_TS_GetMonth

Register	Field	Function
RTC_TSDR	MU	LL_RTC_TS_GetDate
		LL_RTC_TS_GetMonth
	WDU	LL_RTC_TS_GetDate
		LL_RTC_TS_GetWeekDay
RTC_TSSSR	SS	LL_RTC_TS_GetSubSecond
RTC_TSTR	HT	LL_RTC_TS_GetHour
		LL_RTC_TS_GetTime
	HU	LL_RTC_TS_GetHour
		LL_RTC_TS_GetMinute
		LL_RTC_TS_GetSecond
		LL_RTC_TS_GetTime
	MNT	LL_RTC_TS_GetMinute
		LL_RTC_TS_GetTime
	MNU	LL_RTC_TS_GetTime
	PM	LL_RTC_TS_GetTimeFormat
	ST	LL_RTC_TS_GetSecond
		LL_RTC_TS_GetTime
	SU	LL_RTC_TS_GetTime
RTC_WPR	KEY	LL_RTC_DisableWriteProtection
		LL_RTC_EnableWriteProtection
RTC_WUTR	WUT	LL_RTC_WAKEUP_GetAutoReload
		LL_RTC_WAKEUP_SetAutoReload
TAMPCR	TAMP1E	LL_RTC_TAMPER_Disable
		LL_RTC_TAMPER_Enable
	TAMP1IE	LL_RTC_DisableIT_TAMP1
		LL_RTC_EnableIT_TAMP1
		LL_RTC_IsEnabledIT_TAMP1
	TAMP1MF	LL_RTC_TAMPER_DisableMask
		LL_RTC_TAMPER_EnableMask
	TAMP1NOERASE	LL_RTC_TAMPER_DisableEraseBKP
		LL_RTC_TAMPER_EnableEraseBKP
	TAMP1TRG	LL_RTC_TAMPER_DisableActiveLevel
		LL_RTC_TAMPER_EnableActiveLevel
	TAMP2E	LL_RTC_TAMPER_Disable
		LL_RTC_TAMPER_Enable
	TAMP2IE	LL_RTC_DisableIT_TAMP2
		LL_RTC_EnableIT_TAMP2
		LL_RTC_IsEnabledIT_TAMP2

Register	Field	Function
TAMPCR	TAMP2MF	LL_RTC_TAMPER_DisableMask
		LL_RTC_TAMPER_EnableMask
	TAMP2NOERASE	LL_RTC_TAMPER_DisableEraseBKP
		LL_RTC_TAMPER_EnableEraseBKP
	TAMP2TRG	LL_RTC_TAMPER_DisableActiveLevel
		LL_RTC_TAMPER_EnableActiveLevel
	TAMP3E	LL_RTC_TAMPER_Disable
		LL_RTC_TAMPER_Enable
	TAMP3IE	LL_RTC_DisableIT_TAMP3
		LL_RTC_EnableIT_TAMP3
		LL_RTC_IsEnabledIT_TAMP3
	TAMP3MF	LL_RTC_TAMPER_DisableMask
		LL_RTC_TAMPER_EnableMask
	TAMP3NOERASE	LL_RTC_TAMPER_DisableEraseBKP
		LL_RTC_TAMPER_EnableEraseBKP
	TAMP3TRG	LL_RTC_TAMPER_DisableActiveLevel
		LL_RTC_TAMPER_EnableActiveLevel
	TAMPFLT	LL_RTC_TAMPER_GetFilterCount
		LL_RTC_TAMPER_SetFilterCount
	TAMPFREQ	LL_RTC_TAMPER_GetSamplingFreq
		LL_RTC_TAMPER_SetSamplingFreq
	TAMPIE	LL_RTC_DisableIT_TAMP
		LL_RTC_EnableIT_TAMP
		LL_RTC_IsEnabledIT_TAMP
	TAMPPRCH	LL_RTC_TAMPER_GetPrecharge
		LL_RTC_TAMPER_SetPrecharge
	TAMPPUDIS	LL_RTC_TAMPER_DisablePullUp
		LL_RTC_TAMPER_EnablePullUp

108.23 SPI

Table 48. Correspondence between SPI registers and SPI low-layer driver functions

Register	Field	Function
CR1	BIDIMODE	LL_SPI_GetTransferDirection
		LL_SPI_SetTransferDirection
	BIDIOE	LL_SPI_GetTransferDirection
		LL_SPI_SetTransferDirection
	BR	LL_SPI_GetBaudRatePrescaler

Register	Field	Function
CR1	BR	LL_SPI_SetBaudRatePrescaler
	CPHA	LL_SPI_GetClockPhase
		LL_SPI_SetClockPhase
	CPOL	LL_SPI_GetClockPolarity
		LL_SPI_SetClockPolarity
	CRCEN	LL_SPI_DisableCRC
		LL_SPI_EnableCRC
		LL_SPI_IsEnabledCRC
	CRCL	LL_SPI_GetCRCWidth
		LL_SPI_SetCRCWidth
	CRCNEXT	LL_SPI_SetCRCNext
	LSBFIRST	LL_SPI_GetTransferBitOrder
		LL_SPI_SetTransferBitOrder
	MSTR	LL_SPI_GetMode
		LL_SPI_SetMode
	RXONLY	LL_SPI_GetTransferDirection
		LL_SPI_SetTransferDirection
	SPE	LL_SPI_Disable
		LL_SPI_Enable
		LL_SPI_IsEnabled
	SSI	LL_SPI_GetMode
		LL_SPI_SetMode
	SSM	LL_SPI_GetNSSMode
		LL_SPI_SetNSSMode
CR2	DS	LL_SPI_GetDataWidth
		LL_SPI_SetDataWidth
	ERRIE	LL_SPI_DisableIT_ERR
		LL_SPI_EnableIT_ERR
		LL_SPI_IsEnabledIT_ERR
	FRF	LL_SPI_GetStandard
		LL_SPI_SetStandard
	FRXTH	LL_SPI_GetRxFIFOThreshold
		LL_SPI_SetRxFIFOThreshold
	LDMARX	LL_SPI_GetDMAParity_RX
		LL_SPI_SetDMAParity_RX
	LDMATX	LL_SPI_GetDMAParity_TX
		LL_SPI_SetDMAParity_TX
	NSSP	LL_SPI_DisableNSSPulseMgt

Register	Field	Function
CR2	NSSP	LL_SPI_EnableNSSPulseMgt
		LL_SPI_IsEnabledNSSPulse
	RXDMAEN	LL_SPI_DisableDMAReq_RX
		LL_SPI_EnableDMAReq_RX
		LL_SPI_IsEnabledDMAReq_RX
	RXNEIE	LL_SPI_DisableIT_RXNE
		LL_SPI_EnableIT_RXNE
		LL_SPI_IsEnabledIT_RXNE
	SSOE	LL_SPI_GetNSSMode
		LL_SPI_SetNSSMode
	TXDMAEN	LL_SPI_DisableDMAReq_TX
		LL_SPI_EnableDMAReq_TX
		LL_SPI_IsEnabledDMAReq_TX
	TXEIE	LL_SPI_DisableIT_TXE
		LL_SPI_EnableIT_TXE
		LL_SPI_IsEnabledIT_TXE
CRCPR	CRCPOLY	LL_SPI_GetCRCPolynomial
		LL_SPI_SetCRCPolynomial
DR	DR	LL_SPI_DMA_GetRegAddr
		LL_SPI_ReceiveData16
		LL_SPI_ReceiveData8
		LL_SPI_TransmitData16
		LL_SPI_TransmitData8
RXCRCR	RXCRC	LL_SPI_GetRxCRC
SR	BSY	LL_SPI_IsActiveFlag_BSY
	CRCERR	LL_SPI_ClearFlag_CRCERR
		LL_SPI_IsActiveFlag_CRCERR
	FRE	LL_SPI_ClearFlag_FRE
		LL_SPI_IsActiveFlag_FRE
	FRLVL	LL_SPI_GetRxFIFOLevel
	FTLVL	LL_SPI_GetTxFIFOLevel
	MODF	LL_SPI_ClearFlag_MODF
		LL_SPI_IsActiveFlag_MODF
	OVR	LL_SPI_ClearFlag_OVR
		LL_SPI_IsActiveFlag_OVR
	RXNE	LL_SPI_IsActiveFlag_RXNE
	TXE	LL_SPI_IsActiveFlag_TXE
TXCRCR	TXCRC	LL_SPI_GetTxCRC

108.24 SYSTEM

Table 49. Correspondence between SYSTEM registers and SYSTEM low-layer driver functions

Register	Field	Function
DBGMCU_APB1FZR1	DBG_xxxx_STOP	LL_DBGMCU_APB1_GRP1_FreezePeriph
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
DBGMCU_APB1FZR2	DBG_xxxx_STOP	LL_DBGMCU_APB1_GRP2_FreezePeriph
		LL_DBGMCU_APB1_GRP2_UnFreezePeriph
DBGMCU_APB2FZ	DBG_TIMx_STOP	LL_DBGMCU_APB2_GRP1_FreezePeriph
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph
DBGMCU_CR	DBG_SLEEP	LL_DBGMCU_DisableDBGSleepMode
		LL_DBGMCU_EnableDBGSleepMode
	DBG_STANDBY	LL_DBGMCU_DisableDBGStandbyMode
		LL_DBGMCU_EnableDBGStandbyMode
	DBG_STOP	LL_DBGMCU_DisableDBGStopMode
		LL_DBGMCU_EnableDBGStopMode
	TRACE_IOEN	LL_DBGMCU_GetTracePinAssignment
		LL_DBGMCU_SetTracePinAssignment
	TRACE_MODE	LL_DBGMCU_GetTracePinAssignment
		LL_DBGMCU_SetTracePinAssignment
DBGMCU_IDCODE	DEV_ID	LL_DBGMCU_GetDeviceID
	REV_ID	LL_DBGMCU_GetRevisionID
FLASH_ACR	DCEN	LL_FLASH_DisableDataCache
		LL_FLASH_EnableDataCache
	DCRST	LL_FLASH_DisableDataCacheReset
		LL_FLASH_EnableDataCacheReset
	ICEN	LL_FLASH_DisableInstCache
		LL_FLASH_EnableInstCache
	ICRST	LL_FLASH_DisableInstCacheReset
		LL_FLASH_EnableInstCacheReset
	LATENCY	LL_FLASH_GetLatency
		LL_FLASH_SetLatency
	PRFTEN	LL_FLASH_DisablePrefetch
		LL_FLASH_EnablePrefetch
		LL_FLASH_IsPrefetchEnabled
	RUN_PD	LL_FLASH_DisableRunPowerDown
		LL_FLASH_EnableRunPowerDown
	SLEEP_PD	LL_FLASH_DisableSleepPowerDown
		LL_FLASH_EnableSleepPowerDown

Register	Field	Function
FLASH_PDKEYR	PDKEY1	LL_FLASH_DisableRunPowerDown
		LL_FLASH_EnableRunPowerDown
	PDKEY2	LL_FLASH_DisableRunPowerDown
		LL_FLASH_EnableRunPowerDown
SYSCFG_CFGR1	BOOSTEN	LL_SYSCFG_DisableAnalogBooster
		LL_SYSCFG_EnableAnalogBooster
	FPU_IE_0	LL_SYSCFG_DisableIT_FPU_IOC
		LL_SYSCFG_EnableIT_FPU_IOC
		LL_SYSCFG_IsEnabledIT_FPU_IOC
	FPU_IE_1	LL_SYSCFG_DisableIT_FPU_DZC
		LL_SYSCFG_EnableIT_FPU_DZC
		LL_SYSCFG_IsEnabledIT_FPU_DZC
	FPU_IE_2	LL_SYSCFG_DisableIT_FPU_UFC
		LL_SYSCFG_EnableIT_FPU_UFC
		LL_SYSCFG_IsEnabledIT_FPU_UFC
	FPU_IE_3	LL_SYSCFG_DisableIT_FPU_OFC
		LL_SYSCFG_EnableIT_FPU_OFC
		LL_SYSCFG_IsEnabledIT_FPU_OFC
	FPU_IE_4	LL_SYSCFG_DisableIT_FPU_IDC
		LL_SYSCFG_EnableIT_FPU_IDC
		LL_SYSCFG_IsEnabledIT_FPU_IDC
	FPU_IE_5	LL_SYSCFG_DisableIT_FPU_IXC
		LL_SYSCFG_EnableIT_FPU_IXC
		LL_SYSCFG_IsEnabledIT_FPU_IXC
	FWDIS	LL_SYSCFG_EnableFirewall
		LL_SYSCFG_IsEnabledFirewall
	I2C_PBx_FMP	LL_SYSCFG_DisableFastModePlus
		LL_SYSCFG_EnableFastModePlus
	I2Cx_FMP	LL_SYSCFG_DisableFastModePlus
		LL_SYSCFG_EnableFastModePlus
SYSCFG_CFGR2	CLL	LL_SYSCFG_GetTIMBreakInputs
		LL_SYSCFG_SetTIMBreakInputs
	ECCL	LL_SYSCFG_GetTIMBreakInputs
		LL_SYSCFG_SetTIMBreakInputs
	PVDL	LL_SYSCFG_GetTIMBreakInputs
		LL_SYSCFG_SetTIMBreakInputs
	SPF	LL_SYSCFG_ClearFlag_SP
		LL_SYSCFG_IsActiveFlag_SP

Register	Field	Function
SYSCFG_CFGR2	SPL	LL_SYSCFG_GetTIMBreakInputs
		LL_SYSCFG_SetTIMBreakInputs
SYSCFG_EXTICR1	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR2	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR3	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR4	EXTIx	LL_SYSCFG_GetEXTISource
		LL_SYSCFG_SetEXTISource
SYSCFG_MEMRMP	FB_MODE	LL_SYSCFG_GetFlashBankMode
		LL_SYSCFG_SetFlashBankMode
	MEM_MODE	LL_SYSCFG_GetRemapMemory
		LL_SYSCFG_SetRemapMemory
SYSCFG_SCSR	SRAM2BSY	LL_SYSCFG_IsSRAM2EraseOngoing
	SRAM2ER	LL_SYSCFG_EnableSRAM2Erase
SYSCFG_SKR	KEY	LL_SYSCFG_LockSRAM2WRP
		LL_SYSCFG_UnlockSRAM2WRP
SYSCFG_SWPR	PxWP	LL_SYSCFG_EnableSRAM2PageWRP_0_31
SYSCFG_SWPR2	PxWP	LL_SYSCFG_EnableSRAM2PageWRP_32_63
VREFBUF_CCR	TRIM	LL_VREFBUF_GetTrimming
		LL_VREFBUF_SetTrimming
VREFBUF_CSR	ENVR	LL_VREFBUF_Disable
		LL_VREFBUF_Enable
	HIZ	LL_VREFBUF_DisableHIZ
		LL_VREFBUF_EnableHIZ
	VRR	LL_VREFBUF_IsVREFReady
	VRS	LL_VREFBUF_GetVoltageScaling
		LL_VREFBUF_SetVoltageScaling

108.25 TIM

Table 50. Correspondence between TIM registers and TIM low-layer driver functions

Register	Field	Function
ARR	ARR	LL_TIM_GetAutoReload
		LL_TIM_SetAutoReload
BDTR	AOE	LL_TIM_DisableAutomaticOutput
		LL_TIM_EnableAutomaticOutput

Register	Field	Function
BDTR	AOE	LL_TIM_IsEnabledAutomaticOutput
	BK2E	LL_TIM_DisableBRK2
		LL_TIM_EnableBRK2
	BK2F	LL_TIM_ConfigBRK2
	BK2P	LL_TIM_ConfigBRK2
	BKE	LL_TIM_DisableBRK
		LL_TIM_EnableBRK
	BKF	LL_TIM_ConfigBRK
	BKP	LL_TIM_ConfigBRK
	DTG	LL_TIM_OC_SetDeadTime
	LOCK	LL_TIM_CC_SetLockLevel
	MOE	LL_TIM_DisableAllOutputs
		LL_TIM_EnableAllOutputs
		LL_TIM_IsEnabledAllOutputs
	OSSI	LL_TIM_SetOffStates
	OSSR	LL_TIM_SetOffStates
CCER	CC1E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC1NE	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC1NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC1P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC2E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC2NE	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel

Register	Field	Function
CCER	CC2NE	LL_TIM_CC_IsEnabledChannel
	CC2NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC2P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC3E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC3NE	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC3NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC3P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
		LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC4E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC4NP	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
	CC4P	LL_TIM_IC_Config
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity

Register	Field	Function
CCER	CC4P	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC5E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC5P	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
	CC6E	LL_TIM_CC_DisableChannel
		LL_TIM_CC_EnableChannel
		LL_TIM_CC_IsEnabledChannel
	CC6P	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetPolarity
		LL_TIM_OC_SetPolarity
CCMR1	CC1S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	CC2S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	IC1F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC1PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	IC2F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC2PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	OC1CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear

Register	Field	Function
CCMR1	OC1FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC1M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC1PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
	OC2CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC2FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC2M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC2PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
CCMR2	CC3S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	CC4S	LL_TIM_IC_Config
		LL_TIM_IC_GetActiveInput
		LL_TIM_IC_SetActiveInput
		LL_TIM_OC_ConfigOutput
	IC3F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC3PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler
		LL_TIM_IC_SetPrescaler
	IC4F	LL_TIM_IC_Config
		LL_TIM_IC_GetFilter
		LL_TIM_IC_SetFilter
	IC4PSC	LL_TIM_IC_Config
		LL_TIM_IC_GetPrescaler

Register	Field	Function
CCMR2	IC4PSC	LL_TIM_IC_SetPrescaler
	OC3CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC3FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC3M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC3PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
	OC4CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC4FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC4M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC4PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
CCMR3	CC5S	LL_TIM_OC_ConfigOutput
	CC6S	LL_TIM_OC_ConfigOutput
	OC5CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear
		LL_TIM_OC_IsEnabledClear
	OC5FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC5M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC5PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
	OC6CE	LL_TIM_OC_DisableClear
		LL_TIM_OC_EnableClear

Register	Field	Function
CCMR3	OC6CE	LL_TIM_OC_IsEnabledClear
	OC6FE	LL_TIM_OC_DisableFast
		LL_TIM_OC_EnableFast
		LL_TIM_OC_IsEnabledFast
	OC6M	LL_TIM_OC_GetMode
		LL_TIM_OC_SetMode
	OC6PE	LL_TIM_OC_DisablePreload
		LL_TIM_OC_EnablePreload
		LL_TIM_OC_IsEnabledPreload
CCR1	CCR1	LL_TIM_IC_GetCaptureCH1
		LL_TIM_OC_GetCompareCH1
		LL_TIM_OC_SetCompareCH1
CCR2	CCR2	LL_TIM_IC_GetCaptureCH2
		LL_TIM_OC_GetCompareCH2
		LL_TIM_OC_SetCompareCH2
CCR3	CCR3	LL_TIM_IC_GetCaptureCH3
		LL_TIM_OC_GetCompareCH3
		LL_TIM_OC_SetCompareCH3
CCR4	CCR4	LL_TIM_IC_GetCaptureCH4
		LL_TIM_OC_GetCompareCH4
		LL_TIM_OC_SetCompareCH4
CCR5	CCR5	LL_TIM_OC_GetCompareCH5
		LL_TIM_OC_SetCompareCH5
	GC5C1	LL_TIM_SetCH5CombinedChannels
	GC5C2	LL_TIM_SetCH5CombinedChannels
	GC5C3	LL_TIM_SetCH5CombinedChannels
CCR6	CCR6	LL_TIM_OC_GetCompareCH6
		LL_TIM_OC_SetCompareCH6
CNT	CNT	LL_TIM_GetCounter
		LL_TIM_SetCounter
CR1	ARPE	LL_TIM_DisableARRPreload
		LL_TIM_EnableARRPreload
		LL_TIM_IsEnabledARRPreload
	CEN	LL_TIM_DisableCounter
		LL_TIM_EnableCounter
		LL_TIM_IsEnabledCounter
	CKD	LL_TIM_GetClockDivision
		LL_TIM_SetClockDivision

Register	Field	Function
CR1	CMS	LL_TIM_GetCounterMode
		LL_TIM_SetCounterMode
	DIR	LL_TIM_GetCounterMode
		LL_TIM_GetDirection
		LL_TIM_SetCounterMode
	OPM	LL_TIM_GetOnePulseMode
		LL_TIM_SetOnePulseMode
	UDIS	LL_TIM_DisableUpdateEvent
		LL_TIM_EnableUpdateEvent
		LL_TIM_IsEnabledUpdateEvent
	UIFREMAP	LL_TIM_DisableUIFRemap
		LL_TIM_EnableUIFRemap
	URS	LL_TIM_GetUpdateSource
		LL_TIM_SetUpdateSource
CR2	CCDS	LL_TIM_CC_GetDMAReqTrigger
		LL_TIM_CC_SetDMAReqTrigger
	CCPC	LL_TIM_CC_DisablePreload
		LL_TIM_CC_EnablePreload
	CCUS	LL_TIM_CC_SetUpdate
	MMS	LL_TIM_SetTriggerOutput
	MMS2	LL_TIM_SetTriggerOutput2
	OIS1	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS2	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS2N	LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS3	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS3N	LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS4	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS5	LL_TIM_OC_ConfigOutput

Register	Field	Function
CR2	OIS5	LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	OIS6	LL_TIM_OC_ConfigOutput
		LL_TIM_OC_GetIdleState
		LL_TIM_OC_SetIdleState
	TI1S	LL_TIM_IC_DisableXORCombination
		LL_TIM_IC_EnableXORCombination
		LL_TIM_IC_IsEnabledXORCombination
DCR	DBA	LL_TIM_ConfigDMABurst
	DBL	LL_TIM_ConfigDMABurst
DIER	BIE	LL_TIM_DisableIT_BRK
		LL_TIM_EnableIT_BRK
		LL_TIM_IsEnabledIT_BRK
	CC1DE	LL_TIM_DisableDMAReq_CC1
		LL_TIM_EnableDMAReq_CC1
		LL_TIM_IsEnabledDMAReq_CC1
	CC1IE	LL_TIM_DisableIT_CC1
		LL_TIM_EnableIT_CC1
		LL_TIM_IsEnabledIT_CC1
	CC2DE	LL_TIM_DisableDMAReq_CC2
		LL_TIM_EnableDMAReq_CC2
		LL_TIM_IsEnabledDMAReq_CC2
	CC2IE	LL_TIM_DisableIT_CC2
		LL_TIM_EnableIT_CC2
		LL_TIM_IsEnabledIT_CC2
	CC3DE	LL_TIM_DisableDMAReq_CC3
		LL_TIM_EnableDMAReq_CC3
		LL_TIM_IsEnabledDMAReq_CC3
	CC3IE	LL_TIM_DisableIT_CC3
		LL_TIM_EnableIT_CC3
		LL_TIM_IsEnabledIT_CC3
	CC4DE	LL_TIM_DisableDMAReq_CC4
		LL_TIM_EnableDMAReq_CC4
		LL_TIM_IsEnabledDMAReq_CC4
	CC4IE	LL_TIM_DisableIT_CC4
		LL_TIM_EnableIT_CC4
		LL_TIM_IsEnabledIT_CC4
	COMDE	LL_TIM_DisableDMAReq_COM

Register	Field	Function
DIER	COMDE	LL_TIM_EnableDMAReq_COM
		LL_TIM_IsEnabledDMAReq_COM
	COMIE	LL_TIM_DisableIT_COM
		LL_TIM_EnableIT_COM
		LL_TIM_IsEnabledIT_COM
	TDE	LL_TIM_DisableDMAReq_TRIG
		LL_TIM_EnableDMAReq_TRIG
		LL_TIM_IsEnabledDMAReq_TRIG
	TIE	LL_TIM_DisableIT_TRIG
		LL_TIM_EnableIT_TRIG
		LL_TIM_IsEnabledIT_TRIG
	UDE	LL_TIM_DisableDMAReq_UPDATE
		LL_TIM_EnableDMAReq_UPDATE
		LL_TIM_IsEnabledDMAReq_UPDATE
	UIE	LL_TIM_DisableIT_UPDATE
		LL_TIM_EnableIT_UPDATE
		LL_TIM_IsEnabledIT_UPDATE
EGR	B2G	LL_TIM_GenerateEvent_BRK2
	BG	LL_TIM_GenerateEvent_BRK
	CC1G	LL_TIM_GenerateEvent_CC1
	CC2G	LL_TIM_GenerateEvent_CC2
	CC3G	LL_TIM_GenerateEvent_CC3
	CC4G	LL_TIM_GenerateEvent_CC4
	COMG	LL_TIM_GenerateEvent_COM
	TG	LL_TIM_GenerateEvent_TRIG
	UG	LL_TIM_GenerateEvent_UPDATE
OR2	BKCMP1E	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BKCMP1P	LL_TIM_SetBreakInputSourcePolarity
	BKCMP2E	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BKCMP2P	LL_TIM_SetBreakInputSourcePolarity
	BKDF1BK0E	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BKINE	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BKINP	LL_TIM_SetBreakInputSourcePolarity
	ETRSEL	LL_TIM_SetETRSource

Register	Field	Function
OR3	BK2CMP1E	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BK2CMP1P	LL_TIM_SetBreakInputSourcePolarity
	BK2CMP2E	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BK2CMP2P	LL_TIM_SetBreakInputSourcePolarity
	BK2DF1BK1E	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BK2INE	LL_TIM_DisableBreakInputSource
		LL_TIM_EnableBreakInputSource
	BK2INP	LL_TIM_SetBreakInputSourcePolarity
PSC	PSC	LL_TIM_GetPrescaler
		LL_TIM_SetPrescaler
RCR	REP	LL_TIM_GetRepetitionCounter
		LL_TIM_SetRepetitionCounter
SMCR	ECE	LL_TIM_DisableExternalClock
		LL_TIM_EnableExternalClock
		LL_TIM_IsEnabledExternalClock
		LL_TIM_SetClockSource
	ETF	LL_TIM_ConfigETR
	ETP	LL_TIM_ConfigETR
	ETPS	LL_TIM_ConfigETR
	MSM	LL_TIM_DisableMasterSlaveMode
		LL_TIM_EnableMasterSlaveMode
		LL_TIM_IsEnabledMasterSlaveMode
	OCCS	LL_TIM_SetOCRefClearInputSource
	SMS	LL_TIM_SetClockSource
		LL_TIM_SetEncoderMode
		LL_TIM_SetSlaveMode
	TS	LL_TIM_SetTriggerInput
SR	B2IF	LL_TIM_ClearFlag_BRK2
		LL_TIM_IsActiveFlag_BRK2
	BIF	LL_TIM_ClearFlag_BRK
		LL_TIM_IsActiveFlag_BRK
	CC1IF	LL_TIM_ClearFlag_CC1
		LL_TIM_IsActiveFlag_CC1
	CC1OF	LL_TIM_ClearFlag_CC1OVR
		LL_TIM_IsActiveFlag_CC1OVR

Register	Field	Function
SR	CC2IF	LL_TIM_ClearFlag_CC2
		LL_TIM_IsActiveFlag_CC2
	CC2OF	LL_TIM_ClearFlag_CC2OVR
		LL_TIM_IsActiveFlag_CC2OVR
	CC3IF	LL_TIM_ClearFlag_CC3
		LL_TIM_IsActiveFlag_CC3
	CC3OF	LL_TIM_ClearFlag_CC3OVR
		LL_TIM_IsActiveFlag_CC3OVR
	CC4IF	LL_TIM_ClearFlag_CC4
		LL_TIM_IsActiveFlag_CC4
	CC4OF	LL_TIM_ClearFlag_CC4OVR
		LL_TIM_IsActiveFlag_CC4OVR
	CC5IF	LL_TIM_ClearFlag_CC5
		LL_TIM_IsActiveFlag_CC5
	CC6IF	LL_TIM_ClearFlag_CC6
		LL_TIM_IsActiveFlag_CC6
	COMIF	LL_TIM_ClearFlag_COM
		LL_TIM_IsActiveFlag_COM
	SBIF	LL_TIM_ClearFlag_SYSBRK
		LL_TIM_IsActiveFlag_SYSBRK
	TIF	LL_TIM_ClearFlag_TRIG
		LL_TIM_IsActiveFlag_TRIG
	UIF	LL_TIM_ClearFlag_UPDATE
		LL_TIM_IsActiveFlag_UPDATE

108.26 USART

Table 51. Correspondence between USART registers and USART low-layer driver functions

Register	Field	Function
BRR	BRR	LL_USART_GetBaudRate
		LL_USART_SetBaudRate
CR1	CMIE	LL_USART_DisableIT_CM
		LL_USART_EnableIT_CM
		LL_USART_IsEnabledIT_CM
	DEAT	LL_USART_GetDEAssertionTime
		LL_USART_SetDEAssertionTime
	DEDT	LL_USART_GetDEDeassertionTime
		LL_USART_SetDEDeassertionTime

Register	Field	Function
CR1	EOBIE	LL_USART_DisableIT_EOB
		LL_USART_EnableIT_EOB
		LL_USART_IsEnabledIT_EOB
	FIFOEN	LL_USART_DisableFIFO
		LL_USART_EnableFIFO
		LL_USART_IsEnabledFIFO
	IDLEIE	LL_USART_DisableIT_IDLE
		LL_USART_EnableIT_IDLE
		LL_USART_IsEnabledIT_IDLE
	M0	LL_USART_ConfigCharacter
		LL_USART_GetDataWidth
		LL_USART_SetDataWidth
	M1	LL_USART_ConfigCharacter
		LL_USART_GetDataWidth
		LL_USART_SetDataWidth
	MME	LL_USART_DisableMuteMode
		LL_USART_EnableMuteMode
		LL_USART_IsEnabledMuteMode
	OVER8	LL_USART_GetOverSampling
		LL_USART_SetOverSampling
	PCE	LL_USART_ConfigCharacter
		LL_USART_GetParity
		LL_USART_SetParity
	PEIE	LL_USART_DisableIT_PE
		LL_USART_EnableIT_PE
		LL_USART_IsEnabledIT_PE
	PS	LL_USART_ConfigCharacter
		LL_USART_GetParity
		LL_USART_SetParity
	RE	LL_USART_DisableDirectionRx
		LL_USART_EnableDirectionRx
		LL_USART_GetTransferDirection
		LL_USART_SetTransferDirection
	RTOIE	LL_USART_DisableIT_RTO
		LL_USART_EnableIT_RTO
		LL_USART_IsEnabledIT_RTO
	RXFFIE	LL_USART_DisableIT_RXFF
		LL_USART_EnableIT_RXFF

Register	Field	Function
CR1	RXFFIE	LL_USART_IsEnabledIT_RXFF
	RXNEIE_RXFNEIE	LL_USART_DisableIT_RXNE_RXFNE
		LL_USART_EnableIT_RXNE_RXFNE
		LL_USART_IsEnabledIT_RXNE_RXFNE
	TCIE	LL_USART_DisableIT_TC
		LL_USART_EnableIT_TC
		LL_USART_IsEnabledIT_TC
	TE	LL_USART_DisableDirectionTx
		LL_USART_EnableDirectionTx
		LL_USART_GetTransferDirection
		LL_USART_SetTransferDirection
	TXEIE_TXFNFIE	LL_USART_DisableIT_TXE_TXFNF
		LL_USART_EnableIT_TXE_TXFNF
		LL_USART_IsEnabledIT_TXE_TXFNF
	TXFEIE	LL_USART_DisableIT_TXFE
		LL_USART_EnableIT_TXFE
		LL_USART_IsEnabledIT_TXFE
	UE	LL_USART_Disable
		LL_USART_Enable
		LL_USART_IsEnabled
	UESM	LL_USART_DisableInStopMode
		LL_USART_EnableInStopMode
		LL_USART_IsEnabledInStopMode
	WAKE	LL_USART_GetWakeUpMethod
		LL_USART_SetWakeUpMethod
CR2	ABREN	LL_USART_DisableAutoBaudRate
		LL_USART_EnableAutoBaudRate
		LL_USART_IsEnabledAutoBaud
	ABRMODE	LL_USART_GetAutoBaudRateMode
		LL_USART_SetAutoBaudRateMode
	ADD	LL_USART_ConfigNodeAddress
		LL_USART_GetNodeAddress
	ADDM7	LL_USART_ConfigNodeAddress
		LL_USART_GetNodeAddressLen
	CLKEN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode

Register	Field	Function
CR2	CLKEN	LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableSCLKOutput
		LL_USART_EnableSCLKOutput
		LL_USART_IsEnabledSCLKOutput
	CPHA	LL_USART_ConfigClock
		LL_USART_GetClockPhase
		LL_USART_SetClockPhase
	CPOL	LL_USART_ConfigClock
		LL_USART_GetClockPolarity
		LL_USART_SetClockPolarity
	DATAINV	LL_USART_GetBinaryDataLogic
		LL_USART_SetBinaryDataLogic
	DIS_NSS	LL_USART_DisableSPISlaveSelect
		LL_USART_EnableSPISlaveSelect
		LL_USART_IsEnabledSPISlaveSelect
	LBCL	LL_USART_ConfigClock
		LL_USART_GetLastClkPulseOutput
		LL_USART_SetLastClkPulseOutput
	LBDIE	LL_USART_DisableIT_LBD
		LL_USART_EnableIT_LBD
		LL_USART_IsEnabledIT_LBD
	LBDL	LL_USART_GetLINBrkDetectionLen
		LL_USART_SetLINBrkDetectionLen
	LINEN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableLIN
		LL_USART_EnableLIN
		LL_USART_IsEnabledLIN
	MSBFIRST	LL_USART_GetTransferBitOrder
		LL_USART_SetTransferBitOrder
	RTOEN	LL_USART_DisableRxTimeout

Register	Field	Function
CR2	RTOEN	LL_USART_EnableRxTimeout
		LL_USART_IsEnabledRxTimeout
	RXINV	LL_USART_GetRXPinLevel
		LL_USART_SetRXPinLevel
	SLVEN	LL_USART_DisableSPISlave
		LL_USART_EnableSPISlave
		LL_USART_IsEnabledSPISlave
	STOP	LL_USART_ConfigCharacter
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigSmartcardMode
		LL_USART_GetStopBitsLength
		LL_USART_SetStopBitsLength
	SWAP	LL_USART_GetTXRXSwap
		LL_USART_SetTXRXSwap
	TXINV	LL_USART_GetTXPinLevel
		LL_USART_SetTXPinLevel
CR3	CTSE	LL_USART_DisableCTSHWFlowCtrl
		LL_USART_EnableCTSHWFlowCtrl
		LL_USART_GetHWFlowCtrl
		LL_USART_SetHWFlowCtrl
	CTSIE	LL_USART_DisableIT_CTS
		LL_USART_EnableIT_CTS
		LL_USART_IsEnabledIT_CTS
	DDRE	LL_USART_DisableDMADeactOnRxErr
		LL_USART_EnableDMADeactOnRxErr
		LL_USART_IsEnabledDMADeactOnRxErr
	DEM	LL_USART_DisableDEMode
		LL_USART_EnableDEMode
		LL_USART_IsEnabledDEMode
	DEP	LL_USART_GetDESignalPolarity
		LL_USART_SetDESignalPolarity
	DMAR	LL_USART_DisableDMAReq_RX
		LL_USART_EnableDMAReq_RX
		LL_USART_IsEnabledDMAReq_RX
	DMAT	LL_USART_DisableDMAReq_TX
		LL_USART_EnableDMAReq_TX
		LL_USART_IsEnabledDMAReq_TX

Register	Field	Function
CR3	EIE	LL_USART_DisableIT_ERROR
		LL_USART_EnableIT_ERROR
		LL_USART_IsEnabledIT_ERROR
	HDSEL	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableHalfDuplex
		LL_USART_EnableHalfDuplex
		LL_USART_IsEnabledHalfDuplex
	IREN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableIrda
		LL_USART_EnableIrda
		LL_USART_IsEnabledIrda
	IRLP	LL_USART_GetIrdaPowerMode
		LL_USART_SetIrdaPowerMode
	NACK	LL_USART_DisableSmartcardNACK
		LL_USART_EnableSmartcardNACK
		LL_USART_IsEnabledSmartcardNACK
	ONEBIT	LL_USART_DisableOneBitSamp
		LL_USART_EnableOneBitSamp
		LL_USART_IsEnabledOneBitSamp
	OVRDIS	LL_USART_DisableOverrunDetect
		LL_USART_EnableOverrunDetect
		LL_USART_IsEnabledOverrunDetect
	RTSE	LL_USART_DisableRTSHWFlowCtrl
		LL_USART_EnableRTSHWFlowCtrl
		LL_USART_GetHWFlowCtrl
		LL_USART_SetHWFlowCtrl
	RXFTCFG	LL_USART_ConfigFIFOsThreshold

Register	Field	Function
CR3	RXFTCFG	LL_USART_GetRXFIFOThreshold
		LL_USART_SetRXFIFOThreshold
	RXFTIE	LL_USART_DisableIT_RXFT
		LL_USART_EnableIT_RXFT
		LL_USART_IsEnabledIT_RXFT
	SCARCNT	LL_USART_GetSmartcardAutoRetryCount
		LL_USART_SetSmartcardAutoRetryCount
	SCEN	LL_USART_ConfigAsyncMode
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigMultiProcessMode
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableSmartcard
		LL_USART_EnableSmartcard
		LL_USART_IsEnabledSmartcard
	TCBGTIE	LL_USART_DisableIT_TCBGT
		LL_USART_EnableIT_TCBGT
		LL_USART_IsEnabledIT_TCBGT
	TXFTCFG	LL_USART_ConfigFIFOsThreshold
		LL_USART_GetTXFIFOThreshold
		LL_USART_SetTXFIFOThreshold
	TXFTIE	LL_USART_DisableIT_TXFT
		LL_USART_EnableIT_TXFT
		LL_USART_IsEnabledIT_TXFT
	WUFIE	LL_USART_DisableIT_WKUP
		LL_USART_EnableIT_WKUP
		LL_USART_IsEnabledIT_WKUP
	WUS	LL_USART_GetWKUPType
		LL_USART_SetWKUPType
GTPR	GT	LL_USART_GetSmartcardGuardTime
		LL_USART_SetSmartcardGuardTime
	PSC	LL_USART_GetIrdaPrescaler
		LL_USART_GetSmartcardPrescaler
		LL_USART_SetIrdaPrescaler
		LL_USART_SetSmartcardPrescaler
ICR	CMCF	LL_USART_ClearFlag_CM

Register	Field	Function
ICR	CTSCF	LL_USART_ClearFlag_nCTS
	EOBCF	LL_USART_ClearFlag_EOB
	FECF	LL_USART_ClearFlag_FE
	IDLECF	LL_USART_ClearFlag_IDLE
	LBDCF	LL_USART_ClearFlag_LBD
	NECF	LL_USART_ClearFlag_NE
	ORECF	LL_USART_ClearFlag_ORE
	PECF	LL_USART_ClearFlag_PE
	RTOCF	LL_USART_ClearFlag_RTO
	TCBGTCF	LL_USART_ClearFlag_TCBGT
	TCCF	LL_USART_ClearFlag_TC
	TXFECF	LL_USART_ClearFlag_TXFE
	UDRCF	LL_USART_ClearFlag_UDR
	WUCF	LL_USART_ClearFlag_WKUP
ISR	ABRE	LL_USART_IsActiveFlag_ABRE
	ABRF	LL_USART_IsActiveFlag_ABR
	BUSY	LL_USART_IsActiveFlag_BUSY
	CMF	LL_USART_IsActiveFlag_CM
	CTS	LL_USART_IsActiveFlag_CTS
	CTSIF	LL_USART_IsActiveFlag_nCTS
	EOBF	LL_USART_IsActiveFlag_EOB
	FE	LL_USART_IsActiveFlag_FE
	IDLE	LL_USART_IsActiveFlag_IDLE
	LBDF	LL_USART_IsActiveFlag_LBD
	NE	LL_USART_IsActiveFlag_NE
	ORE	LL_USART_IsActiveFlag_ORE
	PE	LL_USART_IsActiveFlag_PE
	REACK	LL_USART_IsActiveFlag_REACK
	RTOF	LL_USART_IsActiveFlag_RTO
	RWU	LL_USART_IsActiveFlag_RWU
	RXFF	LL_USART_IsActiveFlag_RXFF
	RXFT	LL_USART_IsActiveFlag_RXFT
	RXNE_RXFNE	LL_USART_IsActiveFlag_RXNE_RXFNE
	SBKF	LL_USART_IsActiveFlag_SBK
	TC	LL_USART_IsActiveFlag_TC
	TCBGT	LL_USART_IsActiveFlag_TCBGT
	TEACK	LL_USART_IsActiveFlag_TEACK
	TXE_TXFNF	LL_USART_IsActiveFlag_TXE_TXFNF

Register	Field	Function
ISR	TXFE	LL_USART_IsActiveFlag_TXFE
	TXFT	LL_USART_IsActiveFlag_TXFT
	UDR	LL_USART_IsActiveFlag_UDR
	WUF	LL_USART_IsActiveFlag_WKUP
PRESC	PRESCALER	LL_USART_GetPrescaler
		LL_USART_SetPrescaler
RDR	RDR	LL_USART_DMA_GetRegAddr
		LL_USART_ReceiveData8
		LL_USART_ReceiveData9
RQR	ABRRQ	LL_USART_RequestAutoBaudRate
	MMRQ	LL_USART_RequestEnterMuteMode
	RXFRQ	LL_USART_RequestRxDataFlush
	SBKRQ	LL_USART_RequestBreakSending
	TXFRQ	LL_USART_RequestTxDataFlush
RTOR	BLEN	LL_USART_GetBlockLength
		LL_USART_SetBlockLength
	RTO	LL_USART_GetRxTimeout
		LL_USART_SetRxTimeout
TDR	TDR	LL_USART_DMA_GetRegAddr
		LL_USART_TransmitData8
		LL_USART_TransmitData9

108.27 WWDG

Table 52. Correspondence between WWDG registers and WWDG low-layer driver functions

Register	Field	Function
CFR	EWI	LL_WWDG_EnableIT_EWKUP
		LL_WWDG_IsEnabledIT_EWKUP
	W	LL_WWDG_GetWindow
		LL_WWDG_SetWindow
	WDGTB	LL_WWDG_GetPrescaler
		LL_WWDG_SetPrescaler
CR	T	LL_WWDG_GetCounter
		LL_WWDG_SetCounter
	WDGA	LL_WWDG_Enable
		LL_WWDG_IsEnabled
SR	EWIF	LL_WWDG_ClearFlag_EWKUP
		LL_WWDG_IsActiveFlag_EWKUP

109 FAQs

General subjects

Why should I use the HAL drivers?

There are many advantages in using the HAL drivers:

- Ease of use: you can use the HAL drivers to configure and control any peripheral embedded within your STM32 MCU without prior in-depth knowledge of the product.
- HAL drivers provide intuitive and ready-to-use APIs to configure the peripherals and support polling, interrupt and DMA programming model to accommodate all application requirements, thus allowing the end-user to build a complete application by calling a few APIs.
- Higher level of abstraction than a standard peripheral library allowing to transparently manage:
  - Data transfers and processing using blocking mode (polling) or non-blocking mode (interrupt or DMA)
  - Error management through peripheral error detection and timeout mechanism.
- Generic architecture speeding up initialization and porting, thus allowing customers to focus on innovation.
- Generic set of APIs with full compatibility across the STM32 Series/lines, to ease the porting task between STM32 MCUs.
- The APIs provided within the HAL drivers are feature-oriented and do not require in-depth knowledge of peripheral operation.
- The APIs provided are modular. They include initialization, IO operation and control functions. The end-user has to call init function, then start the process by calling one IO operation functions (write, read, transmit, receive, …). Most of the peripherals have the same architecture.
- The number of functions required to build a complete and useful application is very reduced. As an example, to build a UART communication process, the user only has to call HAL_UART_Init() then HAL_UART_Transmit() or HAL_UART_Receive().

Which devices are supported by the HAL drivers?

The HAL drivers are developed to support all STM32L4 and STM32L4+ devices. To ensure compatibility between all devices and portability with others Series and lines, the API is split into the generic and the extension APIs . For more details, please refer to *section **Devices supported by the HAL drivers***.

What is the cost of using HAL drivers in term of code size and performance?

Like generic architecture drivers, the HAL drivers may induce firmware overhead.

This is due to the high abstraction level and ready-to-use APIs which allow data transfers, errors management and offloads the user application from implementation details.

Architecture

How many files should I modify to configure the HAL drivers?

Only one file needs to be modified: stm32l4xx_hal_conf.h. You can modify this file by disabling unused modules, or adjusting some parameters (i.e. HSE value, System configuration…)

A template is provided in the HAL drivers folders (stm32l4xx_hal_conf_template.c).

Which header files should I include in my application to use the HAL drivers?

Only stm32l4xx_hal.h file has to be included.

What is the difference between xx_hal_ppp.c/.h and xx_hal_ppp_ *ex* .c/.h?

The HAL driver architecture supports common features across STM32 Series/lines. To support specific features, the drivers are split into two groups.

- The generic APIs (stm32l4xx_hal_ppp.c): It includes the common set of APIs across all the STM32 product lines

- The extension APIs (stm32l4xx_hal_ppp_ex.c): It includes the specific APIs for specific device part number or family.

Initialization and I/O operation functions

How do I configure the system clock?

Unlike the standard library, the system clock configuration is not performed in CMSIS drivers file (system_stm32l4xx.c) but in the main user application by calling the two main functions, HAL_RCC_OscConfig() and HAL_RCC_ClockConfig(). It can be modified in any user application section.

What is the purpose of the *PPP_HandleTypeDef *pHandle* structure located in each driver in addition to the Initialization structure

PPP_HandleTypeDef *pHandle is the main structure implemented in the HAL drivers. It handles the peripheral configuration and registers, and embeds all the structures and variables required to follow the peripheral device flow (pointer to buffer, Error code, State,...)

However, this structure is not required to service peripherals such as GPIO, SYSTICK, PWR, and RCC.

What is the purpose of HAL_PPP_MspInit() and HAL_PPP_MspDeInit() functions?

These function are called within HAL_PPP_Init() and HAL_PPP_DeInit(), respectively. They are used to perform the low level Initialization/de-initialization related to the additional hardware resources (RCC, GPIO, NVIC and DMA).

These functions are declared in stm32l4xx_hal_msp.c. A template is provided in the HAL driver folders (stm32l4xx_hal_msp_template.c).

When and how should I use callbacks functions (functions declared with the attribute *__weak*)?

Use callback functions for the I/O operations used in DMA or interrupt mode. The PPP process complete callbacks are called to inform the user about process completion in real-time event mode (interrupts).

The Errors callbacks are called when a processing error occurs in DMA or interrupt mode. These callbacks are customized by the user to add user proprietary code. They can be declared in the application. Note that the same process completion callbacks are used for DMA and interrupt mode.

Is it mandatory to use HAL_Init() function at the beginning of the user application?

It is mandatory to use HAL_Init() function to enable the system configuration (Prefetch, Data instruction cache,…), configure the systTick and the NVIC priority grouping and the hardware low level initialization.

The SysTick configuration shall be adjusted by calling ***HAL_RCC_ClockConfig()*** function, to obtain 1 ms whatever the system clock.

Why do I need to configure the SysTick timer to use the HAL drivers?

The SysTick timer is configured to be used to generate variable increments by calling *HAL_IncTick()* function in SysTick ISR and retrieve the value of this variable by calling *HAL_GetTick()* function.

The call HAL_GetTick() function is mandatory when using HAL drivers with Polling Process or when using HAL_Delay().

Why is the SysTick timer configured to have 1 ms?

This is mandatory to ensure correct IO operation in particular for polling mode operation where the 1 ms is required as timebase.

Could HAL_Delay() function block my application under certain conditions?

Care must be taken when using HAL_Delay() since this function provides accurate delay based on a variable incremented in SysTick ISR. This implies that if HAL_Delay() is called from a peripheral ISR process, then the SysTick interrupt must have higher priority (numerically lower) than the peripheral interrupt, otherwise the caller ISR process will be blocked. Use HAL_NVIC_SetPriority() function to change the SysTick interrupt priority.

What programming model sequence should I follow to use HAL drivers ?

Follow the sequence below to use the APIs provided in the HAL drivers:

1. Call HAL_Init() function to initialize the system (data cache, NVIC priority,…).
2. Initialize the system clock by calling HAL_RCC_OscConfig() followed by HAL_RCC_ClockConfig().
3. Add HAL_IncTick() function under SysTick_Handler() ISR function to enable polling process when using HAL_Delay() function
4. Start initializing your peripheral by calling HAL_PPP_Init().
5. Implement the hardware low level initialization (Peripheral clock, GPIO, DMA,..) by calling HAL_PPP_MspInit() instm32l4xx_hal_msp.c
6. Start your process operation by calling IO operation functions.

What is the purpose of HAL_PPP_IRQHandler() function and when should I use it?

HAL_PPP_IRQHandler() is used to handle interrupt process. It is called under PPP_IRQHandler() function in stm32l4xx_it.c. In this case, the end-user has to implement only the callbacks functions (prefixed by __weak) to perform the appropriate action when an interrupt is detected. Advanced users can implement their own code in PPP_IRQHandler() without calling HAL_PPP_IRQHandler().

Can I use directly the macros defined in xx_hal_ppp.h ?

Yes, you can: a set of macros is provided with the APIs. They allow accessing directly some specific features using peripheral flags.

Where must PPP_HandleTypedef structure peripheral handler be declared?

PPP_HandleTypedef structure peripheral handler must be declared as a global variable, so that all the structure fields are set to 0 by default. In this way, the peripheral handler default state are set to HAL_PPP_STATE_RESET, which is the default state for each peripheral after a system reset.

When should I use HAL versus LL drivers?

HAL drivers offer high-level and function-oriented APIs, with a high level of portability. Product/IPs complexity is hidden for end users. LL drivers offer low-level APIs at registers level, with a better optimization but less portability. They require a deep knowledge of product/IPs specifications.

How can I include LL drivers in my environment? Is there any LL configuration file as for HAL?

There is no configuration file. Source code shall directly include the necessary stm32l4xx_ll_ppp.h file(s).

Can I use HAL and LL drivers together? If yes, what are the constraints?

It is possible to use both HAL and LL drivers. One can handle the IP initialization phase with HAL and then manage the I/O operations with LL drivers. The major difference between HAL and LL is that HAL drivers require to create and use handles for operation management while LL drivers operates directly on peripheral registers. Mixing HAL and LL is illustrated in Examples_MIX example.

Is there any LL APIs which are not available with HAL?

Yes, there are. A few Cortex® APIs have been added in stm32l4xx_ll_cortex.h e.g. for accessing SCB or SysTick registers.

Why are SysTick interrupts not enabled on LL drivers?

When using LL drivers in standalone mode, you do not need to enable SysTick interrupts because they are not used in LL APIs, while HAL functions requires SysTick interrupts to manage timeouts.

Revision history

Table 53. **Document revision history**

Date	Revision	Changes
10-Jun-2015	1	Initial release.
07-Jul-2015	2	Document classification changed to public without content changes.
17-Sep-2015	3	Added LSI in Table *Define statements used for HAL configuration*. Updated Table *Description of GPIO_InitTypeDef_structure*. Added low-layer driver APIs. Updated STM32L4 new low-power management features in Section *PWR*. Section *HAL CRC Extension driver*: Added HAL_CRYPEX_ProcessSuspend() API. Section *HAL FLASH generic driver*: • Added FLASH_OB_USER_nRST_STANDBY parameter value for USERConfig field used in HAL_FLASHEx_OBProgram() and HAL_FLASHEx_OBGetConfig(). • Added RCC_MCO1SOURCE_NOCLOCK parameter value for HAL_RCC_MCOConfig(). • Added HAL_RCCEx_EnableLSECSS_IT(),HAL_RCCEx_LSECSS_IRQHandler() and HAL_RCCEx_LSECSS_Callback() APIs. • Updated HAL_RCCEx_GetPeriphCLKFreq() to support all peripherals with different clock sources.
07-Dec-2015	4	Section *PWR*: • Renamed 'STOP1 with main regulator on' into 'STOP0'. • Restricted STOP1' to low-power regulator on. Section *HAL_DBGMCU_DisableDBGStopMode* and *HAL_DBGMCU_EnableDBGStopMode*: added STOP0 mode in function description. Section *HAL PWR Extension driver*: • Added Section *HAL_PWREx_EnterSTOP0Mode* function. • Updated *HAL_PWREx_EnterSTOP1Mode* prototype (*Regulator* parameter removed) Updated SyncExt field in Section *SAI_InitTypeDef* structure: replaced SAI_SYNCHRONOUS_EXT value by SAI_SYNCHRONOUS_EXT_SAI1 and SAI_SYNCHRONOUS_EXT_SAI2. Section *IRDA Firmware driver defines*: corrected __HAL_IRDA_GET_IT_SOURCE() description. Section *SMARTCARD Firmware driver defines*: corrected __HAL_SMARTCARD_GET_IT_SOURCE() description. Updated Section *LL_PWR_SetPowerMode: LowPowerMode* parameter and changed *LL_PWR_GetPowerMode:* return value: • Renamed LL_PWR_MODE_STOP1_MAIN_REGU power mode into LL_PWR_MODE_STOP0. • Renamed LL_PWR_MODE_STOP1_LP_REGU power mode into LL_PWR_MODE_STOP1. Added Section *LL_RCC_LSE_DisableCSS* function. Added LL_RCC_LSE_DisableCSS() in Section *RCC*.
19-Feb-2016	5	Updated LL driver features in Section *Overview of low-layer drivers*. Updated Section *Low-layer files*. Added low-layers driver initialization and de-initialization APIs (when applicable) for LL ADC, LL COMP, LL DAC, LL DMA, LL EXTI, LL GPIO, LL I2C, LL LPTIM, LL LPUART, LL OPAMP, LL PWR, LL RCC, LL RTC, LL SPI, LL SWPMI, LL TIM and LL USART. **HAL I2C** Generic driver:

Date	Revision	Changes
		• The following new APIs now support repeated start feature: – HAL_I2C_Master_Sequential_Transmit_IT(), HAL_I2C_Master_Sequential_Receive_IT() and HAL_I2C_Master_Abort_IT(), – HAL_I2C_Slave_Sequential_Transmit_IT() and HAL_I2C_Slave_Sequential_Receive_IT() – HAL_I2C_EnableListen_IT() and HAL_I2C_DisableListen_IT() • New user callbacks HAL_I2C_ListenCpltCallback() and HAL_I2C_AddrCallback() • New API HAL_I2C_GetMode() to return HAL_I2C_MODE_MASTER, HAL_I2C_MODE_SLAVE or HAL_I2C_MODE_NONE **HAL IRDA** Generic driver: • Added missing IRDA_CLEAR_IDLEF definition for IDLE flag clear with __HAL_IRDA_CLEAR_FLAG(). **HAL SMARTCARD** Generic driver: • Added missing SMARTCARD_STOPBITS_0_5 definition for 0.5 stop bit frames. **HAL UART** Generic driver: • Added missing UART_STOPBITS_0_5 definition for 0.5 stop bit frames. **HAL USART** Generic driver: • Added missing USART_STOPBITS_0_5 definition for 0.5 stop bit frames. **LL COMP** driver: • LL_COMP_Set{/Get}InputNonInverting() renamed to LL_COMP_Set{/Get}InputMinus. • LL_COMP_Set{/Get}InputInverting() renamed to LL_COMP_Set{/Get}InputPlus. • LL_COMP_Set{/Get}WindowMode() renamed to LL_COMP_Set{/Get}CommonWindowMode(). **LL GPIO** driver: • To align with HAL GPIO, the following GPIO speed definitions have been added: LL_GPIO_SPEED_FREQ_LOW, LL_GPIO_SPEED_FREQ_MEDIUM, LL_GPIO_SPEED_FREQ_HIGH and LL_GPIO_SPEED_FREQ_VERY_HIGH. **LL I2C** driver: • Added new LL_I2C_ConfigFilters() function to configure noise filters. **LL LPTIM** driver: • Added the following new functions: – LL_LPTIM_IsEnabled() – LL_LPTIM_SetWaveform() – LL_LPTIM_SetPolarity() **LL OPAMP** driver: • LL_OPAMP_Get{/Set}PowerRange() renamed into LL_OPAMP_Get{/Set}CommonPowerRange(). **LL SPI** driver: • Removed LL_SPI_Set{/Get}HalfDuplexDirection() functions: this is managed through the TransferDirection parameter in LL_SPI_Set{/Get}TransferDirection(). **LL SWPMI** driver: • Added new LL_SWPMI_IsActivated() function. **LL TIM** driver: • Added the following new functions: – LL_TIM_CC_IsEnabledChannel() – LL_TIM_OC_IsEnabledFast(), LL_TIM_OC_IsEnabledPreload() and LL_TIM_OC_IsEnabledClear() – LL_TIM_IsEnabledMasterSlaveMode() – LL_TIM_EnableExternalClock(), LL_TIM_DisableExternalClock() and LL_TIM_IsEnabledExternalClock() **LL USART** driver: • Added LL_USART_STOPBITS_0_5 definition for usage in LL_USART_Set{/Get}StopBitsLength() and LL_USART_ConfigCharacter();

Date	Revision	Changes
07-Mar-2017	6	• Added HAL drivers for DCMI interface, supported by USB+LCD line STM32L496xx and USB +LCD+AES line STM32L4A6xx. • Added HAL drivers for HASH, supported by USB+LCD+AES line STM32L4A6xx. • Added HAL and LL drivers for DMA2D controller, supported by USB+LCD line STM32L496xx and USB+LCD+AES line STM32L4A6xx.
27-Sep-2017	7	• Added HAL driver for the OctoSPI interface supported by STM32L4+ Series. • Added HAL driver for GFXMMU and LTDC interfaces supported by STM32L4+ Series: STM32L4R7xx (USB_OTG and LCD-TFT Interface line), STM32L4S7xx (USB_OTG, LCD-TFT Interface and AES line), STM32L4R9xx (USB_OTG and MIPI DSIHOST line) and STM32L4S9xx (USB_OTG MPI DSIHOST and AES line). • Added HAL driver for the DSI interface supported by STM32L4+ Series: STM32L4R9xx (USB_OTG and MIPI DSIHOST line) and STM32L4S9xx (USB_OTG, MPI-DSI and AES line).
07-Feb-2020	8	Updated document introduction, in particular replaced STMCube™ by STM32Cube and updated STM32Cube logo with its latest version. Added HAL and LL drivers for the PKA peripheral supported by STM32L4Q5xx devices. Added HAL driver for the PSSI interface, supported by STM32L4P5xx and STM32L4Q5xx devices. Added HAL driver for MMC peripheral supported by STM32L4+ Series.

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