UM1816
User manual

Description of STM32L1 HAL and low-layer drivers

Introduction

STMCube™ is an STMicroelectronics original initiative to make developers' lives easier by reducing development effort, time and cost. STM32Cube covers the whole STM32 portfolio.

STM32Cube Version 1.x includes:

- The 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 STM32CubeL1 for STM32L1 Series)
  - The STM32Cube HAL, STM32 abstraction layer embedded software ensuring maximized portability across the STM32 portfolio.
  - The 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, TCP/IP and Graphics.
  - All embedded software delivered with a full set of examples.

The HAL driver layer provides a generic multi-instance simple 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 which simplify the user application implementation. As an 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.

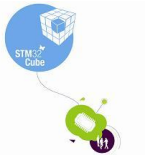
The HAL drivers are feature-oriented instead of IP-oriented. As an example, the timer APIs are split into several categories following the IP functions: basic timer, capture, pulse width modulation (PWM), and so on. The HAL driver layer implements run-time failure detection by checking the input values of all functions. Such dynamic checking contributes to enhance 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 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 associated peripheral registers content. Contrary to the HAL, the 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 complex upper level stack (such as USB).

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

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

The source code of HAL and LL drivers is developed in Strict ANSI-C which makes it independent from the development tools. It is checked with CodeSonar™ static analysis tool. It is fully documented and is MISRA-C 2004 compliant.



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1 Acronyms and definitions

Table 1: Acronyms and definitions

Acronym	Definition
ADC	Analog-to-digital converter
ANSI	American National Standards Institute
API	Application Programming Interface
BSP	Board Support Package
COMP	Comparator
CMSIS	Cortex Microcontroller Software Interface Standard
CPU	Central Processing Unit
CRYP	Cryptographic processor unit
CRC	CRC calculation unit
DAC	Digital to analog converter
DMA	Direct Memory Access
EXTI	External interrupt/event controller
FLASH	Flash memory
GPIO	General purpose I/Os
HAL	Hardware abstraction layer
I2C	Inter-integrated circuit
I2S	Inter-integrated sound
IRDA	InfraRed Data Association
IWDG	Independent watchdog
LCD	Liquid Crystal Display Controller
MSP	MCU Specific Package
NVIC	Nested Vectored Interrupt Controller
PCD	USB Peripheral Controller Driver
PWR	Power controller
RCC	Reset and clock controller
RNG	Random Number Generator
RTC	Real-time clock
SD	Secure Digital
SRAM	SRAM external memory
SMARTCARD	Smartcard IC
SPI	Serial Peripheral interface
SysTick	System tick timer
TIM	Advanced-control, general-purpose or basic timer
TSC	Touch Sensing Controller

Acronym	Definition
UART	Universal asynchronous receiver/transmitter
USART	Universal synchronous receiver/transmitter
WWDG	Window watchdog
USB	Universal Serial Bus
PPP	STM32 peripheral or block

2 Overview of HAL drivers

The HAL drivers were 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.

2.1 HAL and user-application files

2.1.1 HAL driver files

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

Table 2: HAL driver files

File	Description
stm32l1xx_hal_ppp.c	Main peripheral/module driver file. It includes the APIs that are common to all STM32 devices. *Example: stm32l1xx_hal_adc.c, stm32l1xx_hal_irda.c, …*
stm32lxx_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: stm32lxx_hal_adc.h, stm32lxx_hal_irda.h, …*

File	Description
stm32lxx_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: stm32lxx_hal_adc_ex.c, stm32lxx_hal_dma_ex.c, …*
stm32lxx_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 *Example: stm32lxx_hal_adc_ex.h, stm32lxx_hal_dma_ex.h, …*
stm32lxx_hal.c	This file is used for HAL initialization and contains DBGMCU, Remap and Time Delay based on systick APIs.
stm32lxx_hal.h	*stm32l*xx_hal.c header file
stm32lxx_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.
stm32lxx_hal_conf_template.h	Template file allowing to customize the drivers for a given application.
stm32lxx_hal_def.h	Common HAL resources such as common define statements, enumerations, structures and macros.

2.1.2 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_stm32l1xx.c	This file contains SystemInit() which 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_stm32l1xx.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.
stm32l1xx_flash.icf (optional)	Linker file for EWARM toolchain allowing mainly to adapt the stack/heap size to fit the application requirements.
stm32l1xx_hal_msp.c	This file contains the MSP initialization and de-initialization (main routine and callbacks) of the peripheral used in the user application.
stm32l1xx_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.

File	Description
stm32l1xx_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 *stm32l1x*x_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: • the call to HAL_Init() • assert_failed() implementation • system clock configuration • peripheral HAL initialization and user application code.

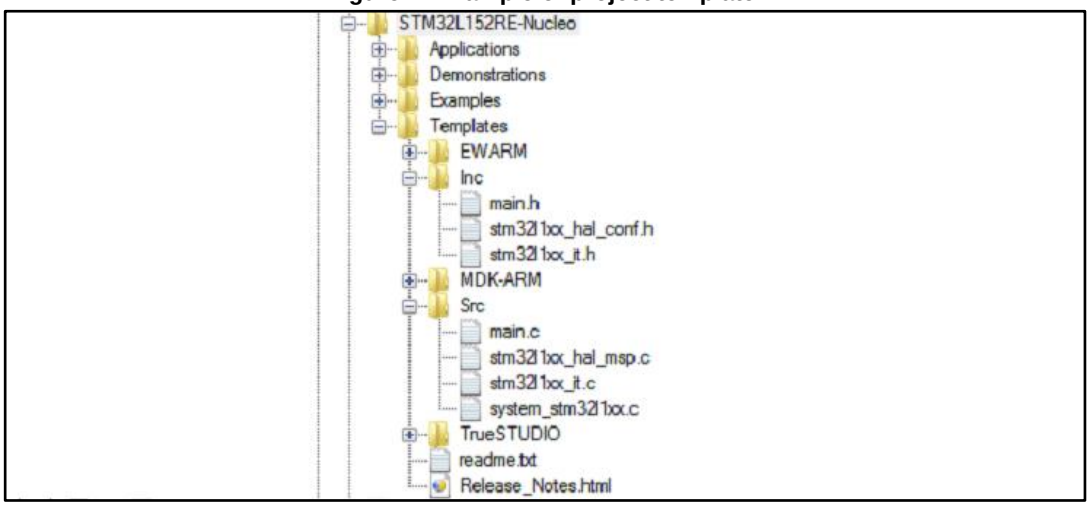
The STM32Cube package comes with ready-to-use project templates, one for each supported board. Each project contains the files listed above and a preconfigured project for the supported toolchains.

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_Delay()
  - System clock configured with the maximum frequency of the device

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

Figure 1: Example of project template



2.2 HAL data structures

Each HAL driver can contain the following data structures:

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

2.2.1 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;
```

1) The multi-instance feature implies that all the APIs used in the application are re-entrant and avoid using global variables because subroutines can fail to be re-entrant 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:

- Re-entrant code does not hold any static (or global) non-constant data: re-entrant functions can work with global data. For example, a re-entrant 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.

2.2.2 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 frame.*/
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 disabled.*/
uint32 t OverSampling; /*!< Specifies wether the Over sampling 8 is enabled or
disabled,
to achieve higher speed (up to fPCLK/8).*/
}UART_InitTypeDef;
```

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)
```

2.2.3 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)
```

2.3 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
SingleDiff);
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(STM32L100xBA) || defined (STM32L151xBA) || defined (STM32L152xBA) || \
defined(STM32L100xC) || defined (STM32L151xC) || defined (STM32L152xC) || defined
(STM32L162xC) || \
defined(STM32L151xCA) || defined (STM32L151xD) || defined (STM32L152xCA) || defined
(STM32L152xD) || defined (STM32L162xCA) || defined (STM32L162xD) || \
defined(STM32L151xE) || defined (STM32L152xE) || defined (STM32L162xE)
void HAL_RCCEx_EnableLSECSS(void);
void HAL RCCEx DisableLSECSS(void);
#endif /* STM32L100xBA || ….. STM32L162xE*/
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 (1)
Family specific APIs		X
Device specific APIs		X

Notes:

(1)In some cases, the implementation for a specific device part number may change . In this case the generic API is declared as weak function in the extension file. The API is implemented again to overwrite the default function

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.

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

2.4 Devices supported by HAL drivers

Table 5: List of devices supported by HAL drivers

Files	VALUE LINE			ACCESS LINE							LCD LINE w/o AES							LCD Line w/ AES				
	STM32L100xB	STM32L100xBA	STM32L100xC	STM32L151xB	STM32L151xBA	STM32L151xC	STM32L151xCA	STM32L151xD	STM32L151xDX	STM32L151xE	STM32L152xB	STM32L152xBA	STM32L152xC	STM32L152xCA	STM32L152xD	STM32L152xDX	STM32L152xE	STM32L162xC	STM32L162xCA	STM32L162xD	STM32L162xDX	STM32L162xE
stm32l1xx_hal.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_adc.c stm32l1xx_hal_adc.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_adc_ex.c stm32l1xx_hal_adc_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_comp.c stm32l1xx_hal_comp.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_cortex.c stm32l1xx_hal_cortex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_crc.c stm32l1xx_hal_crc.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_cryp.c stm32l1xx_hal_cryp.h	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_dac.c stm32l1xx_hal_dac.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_dac_ex.c stm32l1xx_hal_dac_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_dma.c stm32l1xx_hal_dma.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_flash.c stm32l1xx_hal_flash.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_flash_ramfunc.c stm32l1xx_hal_flash_ramfunc.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_flash_ex.c stm32l1xx_hal_flash_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Files	VALUE LINE			ACCESS LINE							LCD LINE w/o AES							LCD Line w/ AES				
	STM32L100xB	STM32L100xBA	STM32L100xC	STM32L151xB	STM32L151xBA	STM32L151xC	STM32L151xCA	STM32L151xD	STM32L151xDX	STM32L151xE	STM32L152xB	STM32L152xBA	STM32L152xC	STM32L152xCA	STM32L152xD	STM32L152xDX	STM32L152xE	STM32L162xC	STM32L162xCA	STM32L162xD	STM32L162xDX	STM32L162xE
stm32l1xx_hal_gpio.c stm32l1xx_hal_gpio.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_i2c.c stm32l1xx_hal_i2c.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_i2c_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_i2s.c stm32l1xx_hal_i2s.h	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_irda.c stm32l1xx_hal_irda.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_iwdg.c stm32l1xx_hal_iwdg.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_lcd.c stm32l1xx_hal_lcd.h	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_msp_template.c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
stm32l1xx_hal_nor.c stm32l1xx_hal_nor.h	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No
stm32l1xx_hal_opamp.c stm32l1xx_hal_opamp.h	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_opamp_ex.c stm32l1xx_hal_opamp_ex.h	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_pcd.c stm32l1xx_hal_pcd.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_pcd_ex.c stm32l1xx_hal_pcd_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_pwr.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_pwr_ex.c stm32l1xx_hal_pwr_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_rcc.c stm32l1xx_hal_rcc.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Files	VALUE LINE			ACCESS LINE							LCD LINE w/o AES							LCD Line w/ AES				
	STM32L100xB	STM32L100xBA	STM32L100xC	STM32L151xB	STM32L151xBA	STM32L151xC	STM32L151xCA	STM32L151xD	STM32L151xDX	STM32L151xE	STM32L152xB	STM32L152xBA	STM32L152xC	STM32L152xCA	STM32L152xD	STM32L152xDX	STM32L152xE	STM32L162xC	STM32L162xCA	STM32L162xD	STM32L162xDX	STM32L162xE
stm32l1xx_hal_rcc_ex.c stm32l1xx_hal_rcc_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_rtc.c stm32l1xx_hal_rtc.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_rtc_ex.c stm32l1xx_hal_rtc_ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_sd.c stm32l1xx_hal_sd.h	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No
stm32l1xx_hal_smartcard.c stm32l1xx_hal_smartcard.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_spi.c stm32l1xx_hal_spi.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_spi_ex.c	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_sram.c stm32l1xx_hal_sram.h	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No
stm32l1xx_hal_tim.c stm32l1xx_hal_tim.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_tim_ex.cstm32l1xx_hal_tim _ex.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_uart.c stm32l1xx_hal_uart.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_usart.c stm32l1xx_hal_usart.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_hal_wwdg.c stm32l1xx_hal_wwdg.h	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
stm32l1xx_ll_fsmc.c stm32l1xx_ll_fsmc.h	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No
stm32l1xx_ll_sdmmc.c stm32l1xx_ll_sdmmc.h	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No

2.5 HAL driver rules

2.5.1 HAL API naming rules

The following naming rules are used in HAL drivers:

Table 6: HAL API naming rules

	Generic	Family specific	Device specific
File names	*stm32l1xx_hal_ppp (c/h)*	*stm32l1xx_hal_ppp_ex (c/h)*	*stm32l1xx_ 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 STM32L1xx reference manuals.
- Peripheral registers are declared in the PPP_TypeDef structure (e.g. ADC_TypeDef) in stm32l1xxx.h header file. stm32l1xxx.h corresponds to stm32l100xb.h, stm32l100xba.h, stm32l100xc.h, stm32l151xb.h, stm32l151xba.h, stm32l151xc.h, stm32l151xca.h, stm32l151xd.h, stm32l151xe.h, stm32l151xdx.h, stm32l152xb.h, stm32l152xba.h, stm32l152xc.h, stm32l152xca.h, stm32l152xd.h, stm32l152xe.h, stm32l152xdx.h, stm32l162xc.h, stm32l162xca.h, stm32l162xd.h or stm32l162xe.h, stm32l162xdx.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 PPP_DeInit, e.g. 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_ADC_Start*() refers to the injection mode

2.5.2 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: 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 7: 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 stm32l1xx_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)
```

2.5.3 HAL interrupt handler and callback functions

Besides the APIs, HAL peripheral drivers include:

- HAL_PPP_IRQHandler() peripheral interrupt handler that should be called from stm32l1xx_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 8: Callback functions

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

2.6 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 runtime 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 9: 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
	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

Function group	Common API name	Description
	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 runtime the peripheral and the data flow states.
	HAL_ADC_GetError()	This fuction allows getting in runtime the error that occurred during IT routine

2.7 HAL extension APIs

2.7.1 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, stm32l1xx_hal_ppp_ex.c, that includes all the specific functions and define statements (stm32l1xx_hal_ppp_ex.h) for a given part number.

Below an example based on the ADC peripheral:

Table 10: HAL extension APIs

Function Group	Common API Name
HAL_ADCEx_CalibrationStart()	This function is used to start the automatic ADC calibration
HAL_ADCEx_Calibration_GetValue()	This function is used to get the ADC calibration factor
HAL_ADCEx_Calibration_SetValue()	This function is used to set the calibration factor to overwrite automatic conversion result

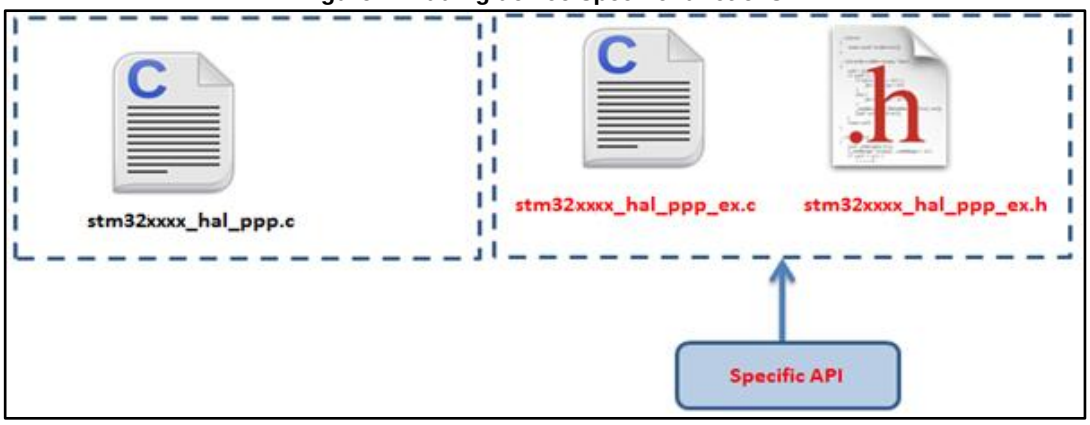
2.7.2 HAL extension model cases

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

Case 1: Adding a part number-specific function

When a new feature specific to a given device is required, the new APIs are added in the stm32l1xx_hal_ppp_ex.c extension file. They are named HAL_PPPEx_Function().

Figure 2: Adding device-specific functions



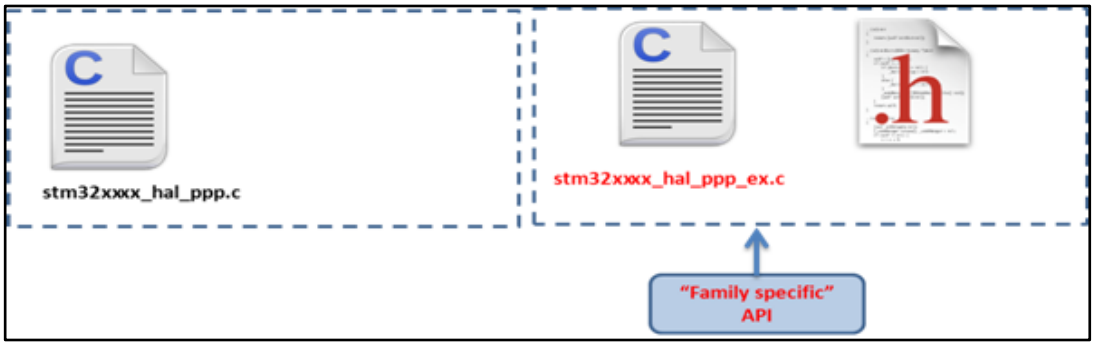
Example: stm32l1xx_hal_rcc_ex.c/h

```
#if defined(STM32L100xBA) || defined (STM32L151xBA) || defined (STM32L152xBA) || \
defined(STM32L100xC) || defined (STM32L151xC) || defined (STM32L152xC) || defined
STM32L162xC) || \
defined(STM32L151xCA) || defined (STM32L151xD) || defined (STM32L152xCA) || defined
(STM32L152xD) || defined (STM32L162xCA) || defined (STM32L162xD) ||\
defined(STM32L151xE) || defined (STM32L152xE) || defined (STM32L162xE)
void HAL RCCEx EnableLSECSS(void);
void HAL RCCEx DisableLSECSS(void);
#endif /* STM32L100xBA || ….. STM32L162xE*/
```

Case 2: 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

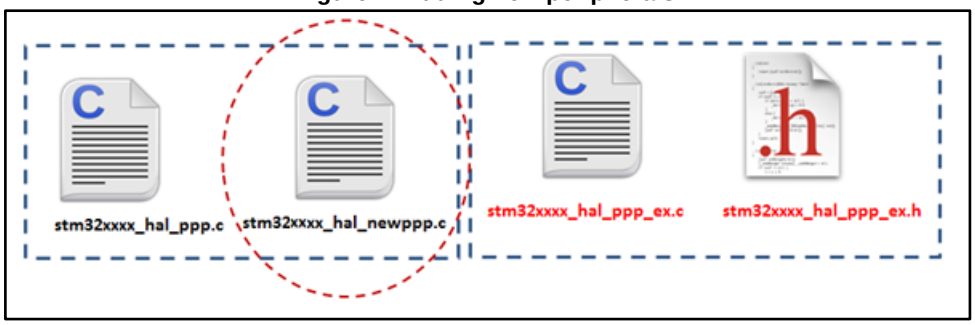


Case 3: Adding a new peripheral (specific to a device belonging to a given family)

When a peripheral which is available only in a specific device is required, the APIs corresponding to this new peripheral/module are added in stm32l1xx_hal_newppp.c. However the inclusion of this file is selected in the stm32lxx_hal_conf.h using the macro:

```
#define HAL_NEWPPP_MODULE_ENABLED
```

Figure 4: Adding new peripherals

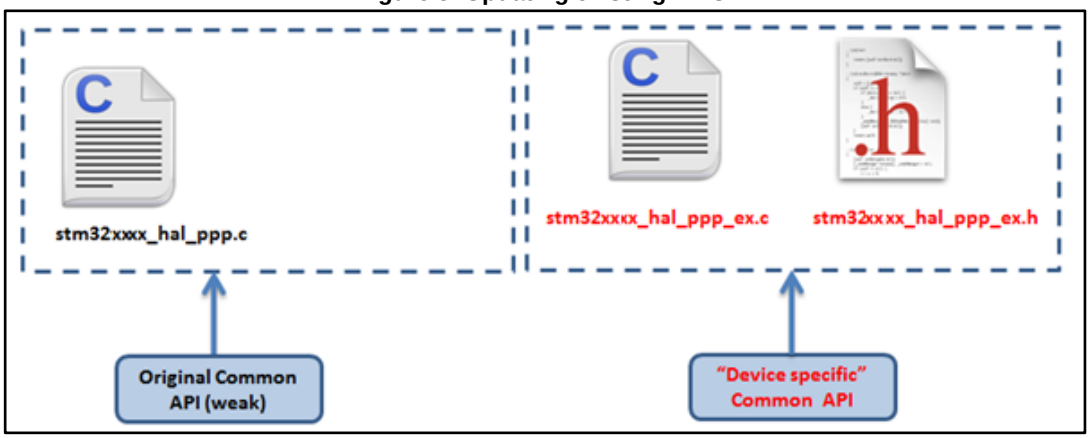


Example: stm32l1xx_hal_lcd.c/h

Case 4: Updating existing common APIs

In this case, the routines are defined with the same names in the stm32l1xx_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



Case 5: Updating existing data structures

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

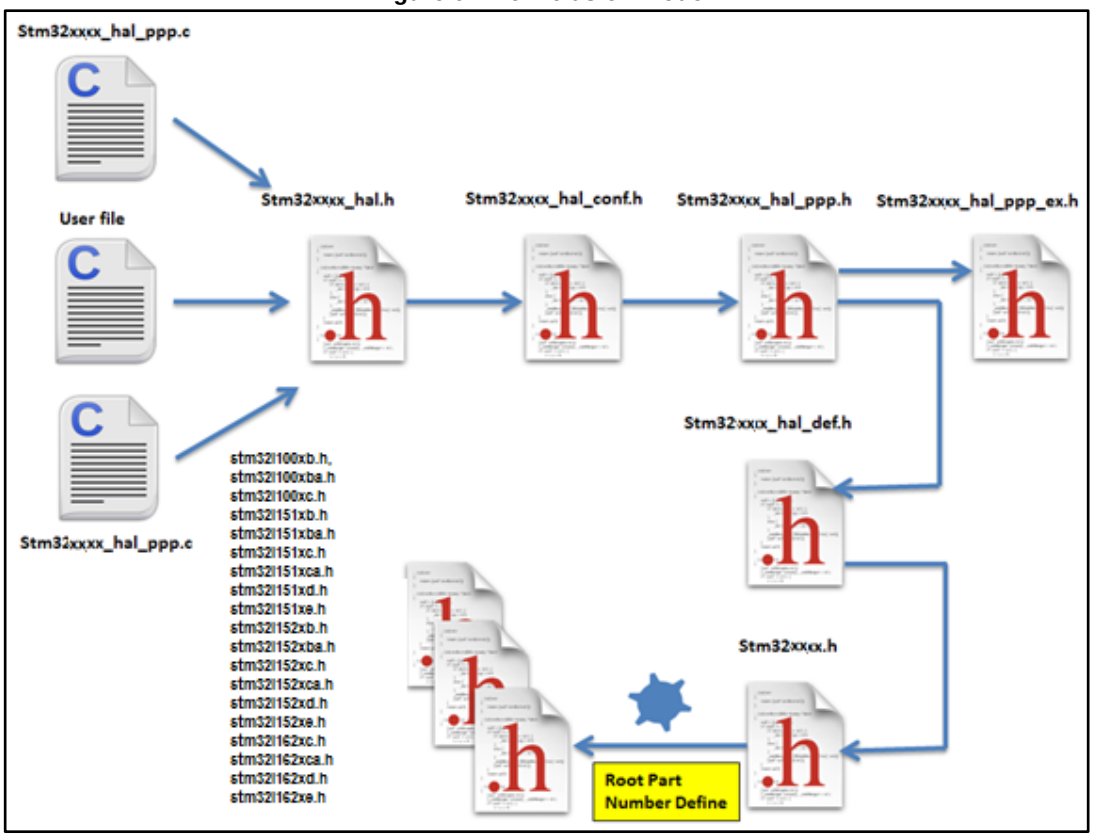
Example:

```
#if defined (STM32L100xB)
typedef struct
{
(…)
}PPP InitTypeDef;
#endif /* STM32L100xB */
```

2.8 File inclusion model

The header of the common HAL driver file (stm32l1xx_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 stm32l1xx 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 USE_HAL_USART_MODULE
#define USE_HAL_IRDA_MODULE
#define USE HAL DMA MODULE
#define USE HAL RCC MODULE
(…)
```

2.9 HAL common resources

The common HAL resources, such as common define enumerations, structures and macros, are defined in stm32l1*xx_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 stm32l1xx_hal_def.h file
calls the stm32l1xx.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: *__HAL_LINKDMA();*

```
#define   HAL LINKDMA(  HANDLE  ,   PPP DMA FIELD ,   DMA HANDLE ) \
do{ \
(__HANDLE__)->__PPP_DMA_FIELD_ = &(__DMA_HANDLE_); \
(__DMA_HANDLE_).Parent = (__HANDLE__); \
} while(0)
```

2.10 HAL configuration

The configuration file, *stm32l1xx_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 11: 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	5000
HSI_VALUE	Defines the value of the internal oscillator (HSI) expressed in Hz.	16 000 000 (Hz)
MSI_VALUE	Defines the Internal Multiple Speed oscillator (MSI) value expressed in Hz.	2 097 000 (Hz)
LSE_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.	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)

Configuration item	Description	Default Value
PREFETCH_ENABLE	Enables prefetch feature	TRUE
BUFFER_CACHE_ENABLE	Enables buffer cache	FALSE

The stm32l1xx_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.

By default, the values defined in the stm32l1xx_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.

2.11 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.

2.11.1 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, 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 (RTC, USB…). In this case, the clock configuration is performed by an extended API defined in stm32l1xx_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 stm32l1xx_hal_rcc.h and stm32l1xx_hal_rcc_ex.h. They allow executing elementary operations on RCC block registers, such as peripherals clock gating/reset control:

- __PPP_CLK_ENABLE/__PPP_CLK_DISABLE to enable/disable the peripheral clock
- __PPP_FORCE_RESET/__PPP_RELEASE_RESET to force/release peripheral reset
- __PPP_CLK_SLEEP_ENABLE/__PPP_CLK_SLEEP_DISABLE to enable/disable the peripheral clock during low power (Sleep) mode.

2.11.2 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 stm32l1xx_it.c and implement HAL_GPIO_EXTI_Callback()

The table below describes the GPIO_InitTypeDef structure field.

Table 12: 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 • 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_VERY_LOW GPIO_SPEED_LOW GPIO_SPEED_MEDIUM GPIO_SPEED_HIGH

Structure field	Description
Alternate	Peripheral to be connected to the selected pins. Possible values: GPIO_AFx_PPP, where AFx: is the alternate function index PPP: is the peripheral instance Example: use GPIO_AF1_TIM2 to connect TIM2 IOs on AF1. These values are defined in the GPIO extended driver, since the AF mapping may change between product lines.  Refer to the “Alternate function mapping” table in the datasheets for the detailed description of the system and peripheral I/O alternate functions.

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_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);
```

- Configuring USART1 Tx (PA9, mapped on AF4) as alternate function:

```
GPIO_InitStruct.Pin = GPIO_PIN_9;
GPIO_InitStruct.Mode = GPIO_MODE_AF_PP;
GPIO_InitStruct.Pull = GPIO_PULLUP;
GPIO_InitStruct.Speed = GPIO_SPEED_FAST;
GPIO_InitStruct.Alternate = GPIO_AF4_USART1;
HAL_GPIO_Init(GPIOA, &GPIO_InitStruct);
```

2.11.3 Cortex NVIC and SysTick timer

The Cortex HAL driver, stm32l1xx_hal_cortex.c, provides APIs to handle NVIC and SysTick. The supported APIs include:

- HAL_NVIC_SetPriority()
- HAL_NVIC_EnableIRQ()/HAL_NVIC_DisableIRQ()
- HAL_NVIC_SystemReset()
- HAL_SYSTICK_IRQHandler()
- HAL_NVIC_GetPendingIRQ() / HAL_NVIC_SetPendingIRQ () / HAL_NVIC_ClearPendingIRQ()
- HAL_SYSTICK_Config()
- HAL_SYSTICK_CLKSourceConfig()
- HAL_SYSTICK_Callback()

2.11.4 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_PVDConfig()
  - 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()
  - HAL_PWR_EnterSTANDBYMode()

Depending on the STM32 Series, extension functions are available in stm32l1xx_hal_pwr_ex. Here are a few examples (the list is not exhaustive)

- Ultralow power mode control
  - HAL_PWREx_EnableUltraLowPower() / HAL_PWREx_DisableUltraLowPower()
  - HAL_PWREx_EnableLowPowerRunMode() / HAL_PWREx_DisableLowPowerRunMode()

2.11.5 EXTI

The EXTI is not considered as a standalone peripheral but rather as a service used by other peripheral. As a result there are no EXTI APIs but each peripheral HAL driver implements the associated EXTI configuration and EXTI function are implemented 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 COMP 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 13: Description of EXTI configuration macros

Macros	Description
PPP_EXTI_LINE_FUNCTION	Defines the EXTI line connected to the internal peripheral. Example: #define PWR_EXTI_LINE_PVD ((uint32_t)0x00010000) /*!<External interrupt line 16 Connected to the PVD EXTI Line */
__HAL_PPP_EXTI_ENABLE_IT(__EXTI_ LINE__)	Enables a given EXTI line Example: __HAL_PVD_EXTI_ENABLE_IT(PWR_EXTI_LINE_ PVD)
__HAL_PPP_EXTI_DISABLE_IT(__EXTI_ LINE__)	Disables a given EXTI line. Example: __HAL_PVD_EXTI_DISABLE_IT(PWR_EXTI_LINE_ PVD)

Macros	Description
__HAL_PPP_EXTI_GET_FLAG(__EXTI_ LINE__)	Gets a given EXTI line interrupt flag pending bit status. Example: __HAL_PVD_EXTI_GET_FLAG(PWR_EXTI_LINE_PVD)
__HAL_PPP_EXTI_CLEAR_FLAG(__EXTI_ LINE__)	Clears a given EXTI line interrupt flag pending bit. Example; __HAL_PVD_EXTI_CLEAR_FLAG(PWR_EXTI_LINE_PVD)
__HAL_PPP_EXTI_GENERATE_SWIT (__EXTI_LINE__)	Generates a software interrupt for a given EXTI line. Example: __HAL_PVD_EXTI_ GENERATE_SWIT (PWR_EXTI_LINE_PVD)

If the EXTI interrupt mode is selected, the user application must call HAL_PPP_FUNCTION_IRQHandler() (for example HAL_PWR_PVD_IRQHandler()), from stm32l1xx_it.c file, and implement HAL_PPP_FUNCTIONCallback() callback function (for example HAL_PWR_PVDCallback().

2.11.6 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 or peripheral flow control mode
- Channels Priority level
- Source and Destination Increment mode

Two operating modes are available:

- Polling mode I/O operation
  a. 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.
  b. 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
  a. Configure the DMA interrupt priority using HAL_NVIC_SetPriority()
  b. Enable the DMA IRQ handler using HAL_NVIC_EnableIRQ()
  c. 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.
  d. Use HAL_DMA_IRQHandler() called under DMA_IRQHandler() Interrupt subroutine
  e. 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: enablse the specified DMA Channels.
- __HAL_DMA_DISABLE: disables the specified DMA Channels.
- __HAL_DMA_GET_FLAG: gets the DMA Channels pending flags.
- __HAL_DMA_CLEAR_FLAG: clears the DMA Channels pending flags.
- __HAL_DMA_ENABLE_IT: enables the specified DMA Channels interrupts.
- __HAL_DMA_DISABLE_IT: disables the specified DMA Channels interrupts.
- __HAL_DMA_GET_IT_SOURCE: checks whether the specified DMA stream interrupt has occurred or not.

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”).

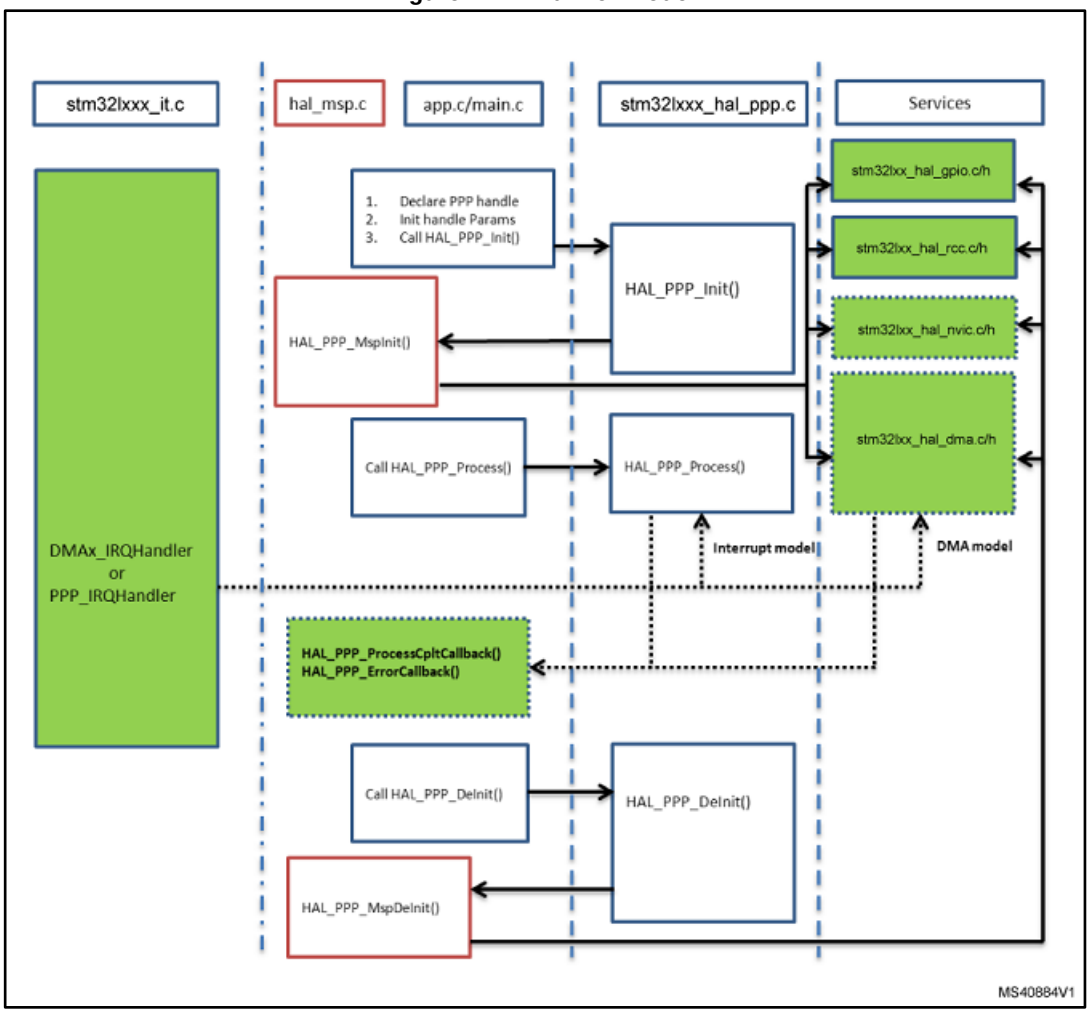
DMA channel callbacks need to be initialized by the user application only in case of memory-to-memory transfer. However when peripheral-to-memory transfers are used, these callbacks are automatically initialized by calling a process API function that uses the DMA.

2.12 How to use HAL drivers

2.12.1 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



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.

2.12.2 HAL initialization

2.12.2.1 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 stm32l1xx_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.

2.12.2.2 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:

```
static void SystemClock Config(void)
{
RCC_ClkInitTypeDef RCC_ClkInitStruct;
RCC_OscInitTypeDef RCC_OscInitStruct;
/* Enable MSI with range 5, PLL is OFF */
RCC OscInitStruct.OscillatorType = RCC OSCILLATORTYPE MSI;
RCC_OscInitStruct.MSIState = RCC_MSIRANGE_5;
RCC_OscInitStruct.MSICalibrationValue=0x00;
RCC_OscInitStruct.PLL.PLLState = RCC_PLL_NONE;
HAL_RCC_OscConfig(&RCC_OscInitStruct);
/* Select MSI as system clock source and configure the HCLK, PCLK1 and PCLK2 clocks
dividers */
RCC_ClkInitStruct.ClockType = (RCC_CLOCKTYPE_SYSCLK | RCC_CLOCKTYPE_HCLK |
RCC_CLOCKTYPE_PCLK1 | RCC_CLOCKTYPE_PCLK2);
RCC ClkInitStruct.SYSCLKSource = RCC SYSCLKSOURCE MSI;
RCC ClkInitStruct.AHBCLKDivider = RCC SYSCLK DIV1;
RCC ClkInitStruct.APB1CLKDivider = RCC HCLK DIV1;
RCC ClkInitStruct.APB2CLKDivider = RCC HCLK DIV1;
HAL_RCC_ClockConfig(&RCC_ClkInitStruct, FLASH_LATENCY_0);
}
```

2.12.2.3 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 *stm32l1xx_hal_msp.c* file in the user folders. An *stm32l1xx_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.

stm32l1xx_hal_msp.c file contains the following functions:

Table 14: 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.

2.12.3 HAL IO 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

2.12.3.1 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 HELIAC; }
```

2.12.3.2 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 *stm32l1xx_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)
{
}
```

*stm32l1xx_it.c*file:

```
extern UART_HandleTypeDef UartHandle;
void USART1_IRQHandler(void)
{
HAL UART IRQHandler(&UartHandle);
}
```

2.12.3.3 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 *stm32l1xx_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)
{
}
```

stm32l1xx_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 ;
(…)
}
```

2.12.4 Timeout and error management

2.12.4.1 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, uint32_t Timeout)
```

The timeout possible value are the following:

Table 15: 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

Notes:

(1)HAL_MAX_DELAY is defined in the stm32l1xx_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;
}
}
(…)
}
```

2.12.4.2 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 */
}
```

2.12.4.3 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 *stm32l1xx_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 stm32l1xx_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)
{
}
}
```

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.

3 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 FSMC, USB or SDMMC).

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.

3.1 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 16: LL driver files

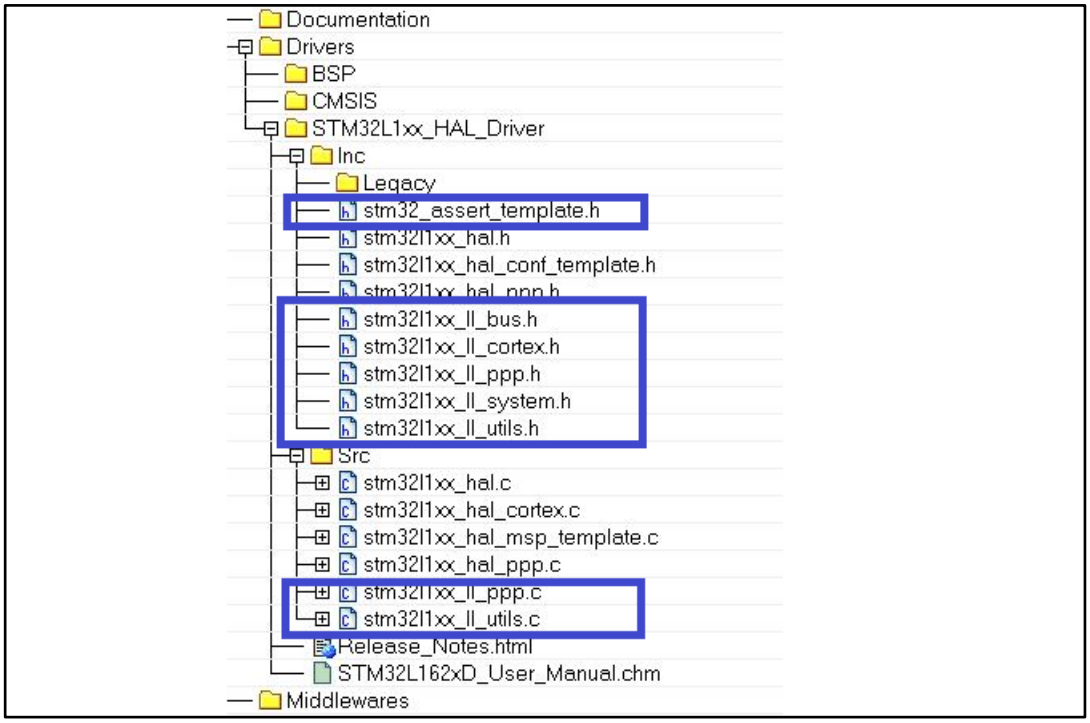
File	Description
stm32l1xx_ll_bus.h	This is the h-source file for core bus control and peripheral clock activation and deactivation *Example: LL_AHB1_GRP1_EnableClock*
stm32l1xx_ll_ppp.h/.c	stm32l1xx_ll_ppp.c provides peripheral initialization functions such as LL_PPP_Init(), LL_PPP_StructInit(), LL_PPP_DeInit(). All the other APIs are definined within stm32l1xx_ll_ppp.h file. The Low Layer PPP driver is a standalone module. To use it, the application must include it in thevxx_ll_ppp.h file.
stm32l1xx_ll_cortex.h	Cortex-M related register operation APIs including the Systick, Low power (LL_SYSTICK_xxxxx, LL_LPM_xxxxx "Low Power Mode" ...)
stm32l1xx_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.
stm32l1xx_ll_system.h	System related operations (LL_SYSCFG_xxx, LL_DBGMCU_xxx and LL_FLASH_xxx and LL_RI_xxx)

File	Description
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.

There is no configuration file for the LL drivers.

The Low Layer files are located in the same HAL driver folder.

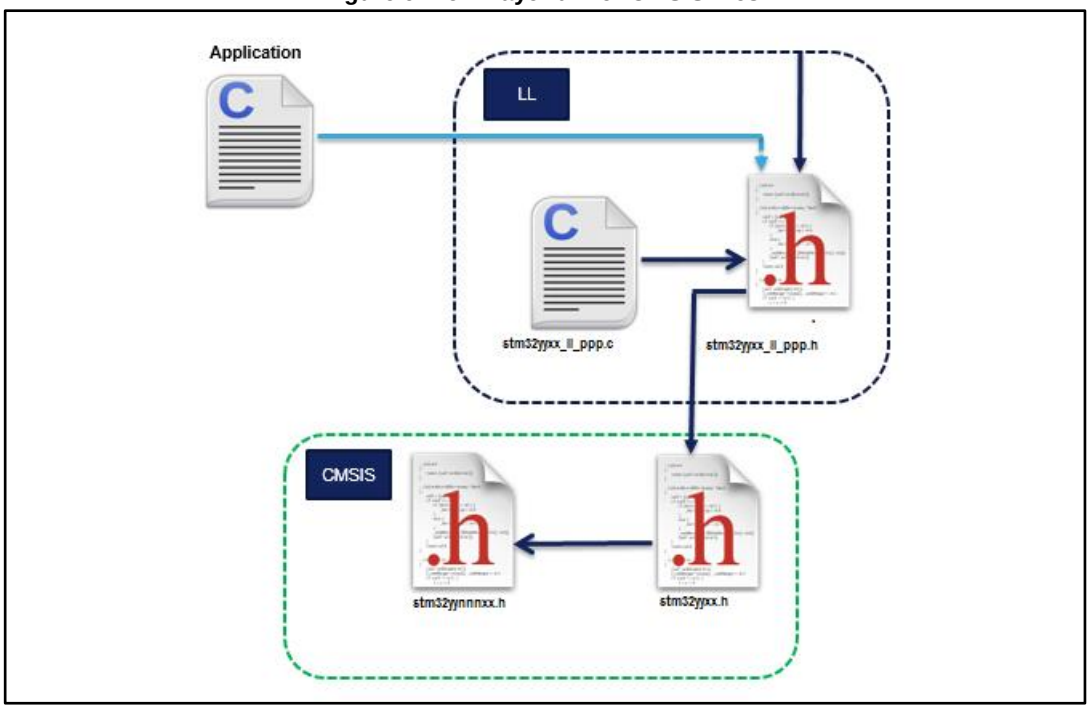
Figure 8: Low Layer driver folders



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 drivers header files.

3.2 Overview of Low Layer APIs and naming rules

3.2.1 Peripheral initialization functions

The LL drivers offer three sets of initialization functions. They are defined in stm32l1xx_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 17: 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)

Functions	Return Type	Parameters	Description
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)
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 18: "Optional peripheral initialization functions"*):

Table 18: Optional peripheral initialization functions

Functions	Return Type	Parameters	Examples
LL_PPP{_CATEGORY }_Init	*Error Status*	• *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_Init TypeDef *ADC_INJ_InitStruct)

Functions	Return Type	Parameters	Examples
LL_PPP_CommonInit	*Error Status*	• *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)

3.2.1.1 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 2.12.4.3: "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.

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

3.2.2 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 19: 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 20: 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*

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 21: Peripheral clock activation/deactivation management

Name	Examples
LL_bus_GRPx_ActionClock{Mode}	• *LL_AHB1_GRP1_EnableClock (LL_AHB1_GRP1_PERIPH_GPIOA|LL_AHB1_GRP1_PERIPH_GPIOB)* • *LL_APB1_GRP1_EnableClockSleep (LL_APB1_GRP1_PERIPH_DAC1)*

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

'bus' refers to the bus name (eg APB1).

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

Table 22: 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 23: Peripheral configuration management

Name	Examples
LL_PPP{_CATEGORY}_Set{ or Get}ConfigItem	*LL_USART_SetBaudRate (USART2, 16000000, LL_USART_OVERSAMPLING_16, 9600)*

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

Table 24: 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})*

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

4 Cohabiting of HAL and LL

The Low Layer is designed to be used in standalone mode or combined with the HAL. It 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 might overwrite some registers which content is mirrored in the HAL handles.

4.1 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 stm32l1xx_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 STM32CubeL1 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.

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.

4.2 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 STM32L1 firmware package (refer to Examples_MIX projects).

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.

5 HAL System Driver

5.1 HAL Firmware driver API description

5.1.1 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

5.1.2 Initialization and de-initialization functions

This section provides functions allowing to:

- Initializes the Flash interface, the NVIC allocation and initial clock configuration. It initializes the source of time base also when timeout is needed and the backup domain when enabled.
- de-Initializes 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()***

5.1.3 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
- Enable/Disable Debug module during Sleep mode
- Enable/Disable Debug module during STOP mode
- Enable/Disable Debug module during STANDBY mode

This section contains the following APIs:

- ***HAL_IncTick()***
- ***HAL_GetTick()***
- ***HAL_Delay()***
- ***HAL_SuspendTick()***
- ***HAL_ResumeTick()***
- ***HAL_GetHalVersion()***
- ***HAL_GetREVID()***
- ***HAL_GetDEVID()***
- ***HAL_DBGMCU_EnableDBGSleepMode()***
- ***HAL_DBGMCU_DisableDBGSleepMode()***
- ***HAL_DBGMCU_EnableDBGStopMode()***
- ***HAL_DBGMCU_DisableDBGStopMode()***
- ***HAL_DBGMCU_EnableDBGStandbyMode()***
- ***HAL_DBGMCU_DisableDBGStandbyMode()***

5.1.4 Detailed description of functions

HAL_Init

Function name	**HAL_StatusTypeDef HAL_Init (void)**
Function description	This function configures the Flash prefetch, Configures time base source, NVIC and Low level hardware.
Return values	• **HAL:** status
Notes	• This function is called at the beginning of program after reset and before the clock configuration • The time base configuration is based on MSI clock when exiting from Reset. Once done, time base tick start incrementing. In the default implementation,Systick is used as source of time base. the tick variable is incremented each 1ms in its ISR.

HAL_DeInit

Function name	**HAL_StatusTypeDef HAL_DeInit (void)**
Function description	This function de-Initializes common part of the HAL and stops the source of time base.
Return values	• **HAL:** status
Notes	• This function is optional.

HAL_MspInit

Function name	**void HAL_MspInit (void)**
Function description	Initializes the MSP.

Return values
- **None:**

HAL_MspDeInit

Function name **void HAL_MspDeInit (void)**

Function description DeInitializes 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.

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 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 (__IO uint32_t Delay)**

Function description This function provides accurate 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	Provides 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_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 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 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	Returns 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	Returns the device revision identifier.
Return values	• **Device:** revision identifier

HAL_GetDEVID

Function name	**uint32_t HAL_GetDEVID (void)**
Function description	Returns the device identifier.
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 STOP mode.
Return values	• **None:**

HAL_DBGMCU_DisableDBGStopMode

Function name	**void HAL_DBGMCU_DisableDBGStopMode (void)**
Function description	Disable the Debug Module during STOP mode.
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:**

5.2 HAL Firmware driver defines

5.2.1 HAL

Freeze Unfreeze Peripherals in Debug mode

__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_TIM9

__HAL_DBGMCU_UNFREEZE_TIM9

__HAL_DBGMCU_FREEZE_TIM10

__HAL_DBGMCU_UNFREEZE_TIM10

__HAL_DBGMCU_FREEZE_TIM11

__HAL_DBGMCU_UNFREEZE_TIM11

Boot Mode

SYSCFG_BOOT_MAINFLASH

SYSCFG_BOOT_SYSTEMFLASH

SYSCFG_BOOT_FSMC

SYSCFG_BOOT_SRAM

Boot Mode Configuration

__HAL_SYSCFG_REMAPMEMORY_FLASH

__HAL_SYSCFG_REMAPMEMORY_SYSTEMFLASH

__HAL_SYSCFG_REMAPMEMORY_SRAM

__HAL_SYSCFG_REMAPMEMORY_FSMC

__HAL_SYSCFG_GET_BOOT_MODE

Description:

- Returns 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_FSMC (available only for STM32L151xD, STM32L152xD & STM32L162xD)
  - SYSCFG_BOOT_SRAM

USB DP line Configuration

__HAL_SYSCFG_USBPULLUP_ENABLE

__HAL_SYSCFG_USBPULLUP_DISABLE

VREFINT configuration

__HAL_SYSCFG_VREFINT_OUT_ENABLE

The VREFINT output can be routed to any I/O in group 3:

__HAL_SYSCFG_VREFINT_OUT_DISABLE

6 HAL ADC Generic Driver

6.1 ADC Firmware driver registers structures

6.1.1 ADC_InitTypeDef

Data Fields

- ***uint32_t ClockPrescaler***
- ***uint32_t Resolution***
- ***uint32_t DataAlign***
- ***uint32_t ScanConvMode***
- ***uint32_t EOCSelection***
- ***uint32_t LowPowerAutoWait***
- ***uint32_t LowPowerAutoPowerOff***
- ***uint32_t ChannelsBank***
- ***uint32_t ContinuousConvMode***
- ***uint32_t NbrOfConversion***
- ***uint32_t DiscontinuousConvMode***
- ***uint32_t NbrOfDiscConversion***
- ***uint32_t ExternalTrigConv***
- ***uint32_t ExternalTrigConvEdge***
- ***uint32_t DMAContinuousRequests***

Field Documentation

- ***uint32_t ADC_InitTypeDef::ClockPrescaler***
  Select ADC clock source (asynchronous clock derived from HSI RC oscillator) and clock prescaler. This parameter can be a value of ***ADC_ClockPrescaler*** 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: HSI RC oscillator must be preliminarily enabled at RCC top level.
- ***uint32_t ADC_InitTypeDef::Resolution***
  Configures the ADC resolution. This parameter can be a value of ***ADC_Resolution***
- ***uint32_t ADC_InitTypeDef::DataAlign***
  Specifies ADC data alignment to right (MSB on register bit 11 and LSB on register bit 0) (default setting) or to left (if regular group: MSB on register bit 15 and LSB on register bit 4, if injected group (MSB kept as signed value due to potential negative value after offset application): MSB on register bit 14 and LSB on register bit 3). This parameter can be a value of ***ADC_Data_align***
- ***uint32_t ADC_InitTypeDef::ScanConvMode***
  Configures the sequencer of regular and injected groups. 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'/'InjectedNbrOfConversion' and each channel rank). Scan direction is upward: from rank1 to rank 'n'. This parameter can be a value of ***ADC_Scan_mode***
- ***uint32_t ADC_InitTypeDef::EOCSelection***
  Specifies what EOC (End Of Conversion) flag is used for conversion by polling and interruption: end of conversion of each rank or complete sequence. This parameter

can be a value of ***ADC_EOCSelection***. Note: For injected group, end of conversion (flag&IT) is raised only at the end of the sequence. Therefore, if end of conversion is set to end of each conversion, injected group should not be used with interruption (HAL_ADCEx_InjectedStart_IT) or polling (HAL_ADCEx_InjectedStart and HAL_ADCEx_InjectedPollForConversion). By the way, polling is still possible since driver will use an estimated timing for end of injected conversion. Note: If overrun feature is intended to be used, use ADC in mode 'interruption' (function **HAL_ADC_Start_IT()**) with parameter EOCSelection set to end of each conversion or in mode 'transfer by DMA' (function **HAL_ADC_Start_DMA()**). If overrun feature is intended to be bypassed, use ADC in mode 'polling' or 'interruption' with parameter EOCSelection must be set to end of sequence

- ***uint32_t ADC_InitTypeDef::LowPowerAutoWait***
  Selects the dynamic low power Auto Delay: new conversion start only when the previous conversion (for regular group) or previous sequence (for injected group) has been treated by user software, using function **HAL_ADC_GetValue()** or **HAL_ADCEx_InjectedGetValue()**. This feature automatically adapts the speed of ADC to the speed of the system that reads the data. Moreover, this avoids risk of overrun for low frequency applications. This parameter can be a value of ***ADC_LowPowerAutoWait***. Note: Do not use with interruption or DMA (**HAL_ADC_Start_IT()**, **HAL_ADC_Start_DMA()**) since they have to 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 conversion data is needed: use **HAL_ADC_PollForConversion()** to ensure that conversion is completed and use **HAL_ADC_GetValue()** to retrieve conversion result and trig another conversion (in case of usage of injected group, use the equivalent functions HAL_ADCExInjected_Start(), **HAL_ADCEx_InjectedGetValue()**, ...). Note: ADC clock latency and some timing constraints depending on clock prescaler have to be taken into account: refer to reference manual (register ADC_CR2 bit DELS description).
- ***uint32_t ADC_InitTypeDef::LowPowerAutoPowerOff***
  Selects the auto-off mode: 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 automatic wait mode (parameter 'LowPowerAutoWait'). This parameter can be a value of ***ADC_LowPowerAutoPowerOff***.
- ***uint32_t ADC_InitTypeDef::ChannelsBank***
  Selects the ADC channels bank. This parameter can be a value of ***ADC_ChannelsBank***. Note: Banks availability depends on devices categories. Note: To change bank selection on the fly, without going through execution of '**HAL_ADC_Init()**', macro '**__HAL_ADC_CHANNELS_BANK()**' can be used directly.
- ***uint32_t ADC_InitTypeDef::ContinuousConvMode***
  Specifies whether the conversion is performed in single mode (one conversion) or continuous mode for regular group, after the selected trigger occurred (software start or external trigger). This parameter can be set to ENABLE or DISABLE.
- ***uint32_t ADC_InitTypeDef::NbrOfConversion***
  Specifies the number of ranks that will be converted within the regular group sequencer. To use 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 = 28.
- ***uint32_t ADC_InitTypeDef::DiscontinuousConvMode***
  Specifies whether the conversions sequence of regular group 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 regular group (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***
  Selects the external event used to trigger the conversion start of regular group. If set to ADC_SOFTWARE_START, external triggers are disabled. If set to external trigger source, triggering is on event rising edge by default. This parameter can be a value of ***ADC_External_trigger_source_Regular***
- ***uint32_t ADC_InitTypeDef::ExternalTrigConvEdge***
  Selects the external trigger edge of regular group. If trigger is set to ADC_SOFTWARE_START, this parameter is discarded. This parameter can be a value of ***ADC_External_trigger_edge_Regular***
- ***uint32_t ADC_InitTypeDef::DMAContinuousRequests***
  Specifies whether the DMA requests are performed in one shot mode (DMA transfer stop when number of conversions is reached) or in Continuous mode (DMA transfer unlimited, whatever number of conversions). Note: In continuous mode, DMA must be configured in circular mode. Otherwise an overrun will be triggered when DMA buffer maximum pointer is reached. 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). This parameter can be set to ENABLE or DISABLE.

6.1.2 ADC_ChannelConfTypeDef

Data Fields

- ***uint32_t Channel***
- ***uint32_t Rank***
- ***uint32_t SamplingTime***

Field Documentation

- ***uint32_t ADC_ChannelConfTypeDef::Channel***
  Specifies the channel to configure into ADC regular group. This parameter can be a value of ***ADC_channels*** Note: Depending on devices, some channels may not be available on package pins. Refer to device datasheet for channels availability. Maximum number of channels by device category (without taking in account each device package constraints): STM32L1 category 1, 2: 24 channels on external pins + 3 channels on internal measurement paths (VrefInt, Temp sensor, Vcomp): Channel 0 to channel 26. STM32L1 category 3: 25 channels on external pins + 3 channels on internal measurement paths (VrefInt, Temp sensor, Vcomp): Channel 0 to channel 26, 1 additional channel in bank B. Note: OPAMP1 and OPAMP2 are connected internally but not increasing internal channels number: they are sharing ADC input with external channels ADC_IN3 and ADC_IN8. STM32L1 category 4, 5: 40 channels on external pins + 3 channels on internal measurement paths (VrefInt, Temp sensor, Vcomp): Channel 0 to channel 31, 11 additional channels in bank B. Note: OPAMP1 and OPAMP2 are connected internally but not increasing internal channels number: they are sharing ADC input with external channels ADC_IN3 and ADC_IN8. Note: In case of peripherals OPAMPx not used: 3 channels (3, 8, 13) can be configured as direct channels (fast channels). Refer to macro ' **__HAL_ADC_CHANNEL_SPEED_FAST()** '. Note: In case of peripheral OPAMP3 and ADC channel OPAMP3 used (OPAMP3 available on STM32L1 devices Cat.4 only): the analog switch COMP1_SW1 must be

closed. Refer to macro: '
__HAL_OPAMP_OPAMP3OUT_CONNECT_ADC_COMP1() '.

- ***uint32_t ADC_ChannelConfTypeDef::Rank***
  Specifies the rank in the regular group sequencer. This parameter can be a value of ***ADC_regular_rank*** Note: In case of need 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 can be 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 ADC clock cycles at ADC resolution 12 bits, 11 cycles at 10 bits, 9 cycles at 8 bits, 7 cycles at 6 bits). This parameter can be a value of ***ADC_sampling_times*** Caution: This parameter updates the parameter property of the channel, that can be used into regular and/or injected groups. If this same channel has been previously configured in the other group (regular/injected), it will be updated to 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, parameters TS_vrefint, TS_temp (values rough order: 4us min).

6.1.3 ADC_AnalogWDGConfTypeDef

Data Fields

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

Field Documentation

- ***uint32_t ADC_AnalogWDGConfTypeDef::WatchdogMode***
  Configures the ADC analog watchdog mode: single/all channels, regular/injected group. This parameter can be a value of ***ADC_analog_watchdog_mode***.
- ***uint32_t ADC_AnalogWDGConfTypeDef::Channel***
  Selects which ADC channel to monitor by analog watchdog. This parameter has an effect only if watchdog mode is configured on single channel (parameter WatchdogMode) This parameter can be a value of ***ADC_channels***.
- ***uint32_t ADC_AnalogWDGConfTypeDef::ITMode***
  Specifies 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***
  Configures the ADC analog watchdog High threshold value. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF.
- ***uint32_t ADC_AnalogWDGConfTypeDef::LowThreshold***
  Configures the ADC analog watchdog High threshold value. This parameter must be a number between Min_Data = 0x000 and Max_Data = 0xFFF.
- ***uint32_t ADC_AnalogWDGConfTypeDef::WatchdogNumber***
  Reserved for future use, can be set to 0

6.1.4 ADC_HandleTypeDef

Data Fields

- ***ADC_TypeDef * Instance***

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

Field Documentation

- ***ADC_TypeDef* ADC_HandleTypeDef::Instance***
  Register base address
- ***ADC_InitTypeDef ADC_HandleTypeDef::Init***
  ADC required parameters
- ***__IO uint32_t ADC_HandleTypeDef::NbrOfConversionRank***
  ADC conversion rank counter
- ***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

6.2 ADC Firmware driver API description

6.2.1 ADC peripheral features

- 12-bit, 10-bit, 8-bit or 6-bit configurable resolution
- Interrupt generation at the end of regular conversion, end of injected 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)
- ADC conversion of regular group and injected group.
- External trigger (timer or EXTI) with configurable polarity for both regular and injected groups.
- DMA request generation for transfer of conversions data of regular group.
- ADC offset on injected channels
- ADC supply requirements: 2.4 V to 3.6 V at full speed and down to 1.8 V at slower speed.
- ADC input range: from Vref- (connected to Vssa) to Vref+ (connected to Vdda or to an external voltage reference).

6.2.2 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. Caution: On STM32L1, ADC clock frequency max is 16MHz (refer to device datasheet). Therefore, ADC clock prescaler must be configured in function of ADC clock source frequency to remain below this maximum frequency.

  - Two clock settings are mandatory:
    - ADC clock (core clock).
    - ADC clock (conversions clock). Only one possible clock source: derived from HSI RC 16MHz oscillator (HSI). ADC is connected directly to HSI RC 16MHz oscillator. Therefore, RCC PLL setting has no impact on ADC. PLL can be disabled (".PLL.PLLState = RCC_PLL_NONE") or enabled with HSI16 as clock source (".PLL.PLLSource = RCC_PLLSOURCE_HSI") to be used as device main clock source SYSCLK. The only mandatory setting is ".HSIState = RCC_HSI_ON"
    - Example: Into HAL_ADC_MspInit() (recommended code location) or with other device clock parameters configuration:
    - __HAL_RCC_ADC1_CLK_ENABLE();
    - HAL_RCC_GetOscConfig(&RCC_OscInitStructure);
    - RCC_OscInitStructure.OscillatorType = (... | RCC_OSCILLATORTYPE_HSI);
    - RCC_OscInitStructure.HSIState = RCC_HSI_ON;
    - RCC_OscInitStructure.HSICalibrationValue = RCC_HSICALIBRATION_DEFAULT;
    - RCC_OscInitStructure.PLL.PLLState = RCC_PLL_NONE;
    - RCC_OscInitStructure.PLL.PLLSource = ...
    - RCC_OscInitStructure.PLL...
    - HAL_RCC_OscConfig(&RCC_OscInitStructure);
  - ADC clock prescaler is 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, groups regular/injected, 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 injected group parameters (conversion trigger, sequencer, ..., of injected group) and the channels for injected group parameters (channel number, channel rank into sequencer, ..., into injected group) using function HAL_ADCEx_InjectedConfigChannel().
4. Optionally, configure the analog watchdog parameters (channels monitored, thresholds, ...) using function HAL_ADC_AnalogWDGConfig().
5. Optionally, for devices with several ADC instances: configure the multimode parameters using function HAL_ADCEx_MultiModeConfigChannel().

Execution of ADC conversions

1. 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() (or for injected group: HAL_ADCEx_InjectedPollForConversion())
     - Retrieve conversion results using function HAL_ADC_GetValue() (or for injected group: HAL_ADCEx_InjectedGetValue())
     - 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) (or for injected group: HAL_ADCEx_InjectedConvCpltCallback())
     - Retrieve conversion results using function HAL_ADC_GetValue() (or for injected group: HAL_ADCEx_InjectedGetValue())
     - 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()
   - For devices with several ADCs: ADC multimode conversion with transfer by DMA:
     - Activate the ADC peripheral (slave) and start conversions using function HAL_ADC_Start()
     - Activate the ADC peripheral (master) and start conversions using function HAL_ADCEx_MultiModeStart_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 (master) using function HAL_ADCEx_MultiModeStop_DMA()
     - Stop conversion and disable the ADC peripheral (slave) using function HAL_ADC_Stop_IT()

Callback functions must be implemented in user program:

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

- HAL_ADC_ConvHalfCpltCallback
- HAL_ADCEx_InjectedConvCpltCallback()

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:
     - HAL_RCC_GetOscConfig(&RCC_OscInitStructure);
     - RCC_OscInitStructure.OscillatorType = RCC_OSCILLATORTYPE_HSI;
     - RCC_OscInitStructure.HSIState = RCC_HSI_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)

6.2.3 Initialization and de-initialization functions

This section provides functions allowing to:

- Initialize and configure the ADC.
- De-initialize the ADC.

This section contains the following APIs:

- ***HAL_ADC_Init()***
- ***HAL_ADC_DeInit()***
- ***HAL_ADC_MspInit()***
- ***HAL_ADC_MspDeInit()***

6.2.4 IO operation functions

This section provides functions allowing to:

- Start conversion of regular group.
- Stop conversion of regular group.
- Poll for conversion complete on regular group.
- Poll for conversion event.
- Get result of regular channel conversion.
- Start conversion of regular group and enable interruptions.
- Stop conversion of regular group and disable interruptions.
- Handle ADC interrupt request
- Start conversion of regular group and enable DMA transfer.

- Stop conversion of regular group and disable ADC DMA transfer.

This section contains the following APIs:

- ***HAL_ADC_Start()***
- ***HAL_ADC_Stop()***
- ***HAL_ADC_PollForConversion()***
- ***HAL_ADC_PollForEvent()***
- ***HAL_ADC_Start_IT()***
- ***HAL_ADC_Stop_IT()***
- ***HAL_ADC_Start_DMA()***
- ***HAL_ADC_Stop_DMA()***
- ***HAL_ADC_GetValue()***
- ***HAL_ADC_IRQHandler()***
- ***HAL_ADC_ConvCpltCallback()***
- ***HAL_ADC_ConvHalfCpltCallback()***
- ***HAL_ADC_LevelOutOfWindowCallback()***
- ***HAL_ADC_ErrorCallback()***

6.2.5 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()***

6.2.6 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()***

6.2.7 Detailed description of functions

HAL_ADC_Init

Function name	**HAL_StatusTypeDef HAL_ADC_Init (ADC_HandleTypeDef * hadc)**
Function description	Initializes 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 (clock source APB2). See commented example code below that can be copied and uncommented into HAL_ADC_MspInit().

- 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".

HAL_ADC_DeInit

Function name	**HAL_StatusTypeDef HAL_ADC_DeInit (ADC_HandleTypeDef * hadc)**
Function description	Deinitialize the ADC peripheral registers to its default reset values.
Parameters	• **hadc:** ADC handle
Return values	• **HAL:** status
Notes	• To not impact other ADCs, reset of common ADC registers have been left commented below. If needed, the example code can be copied and uncommented into function HAL_ADC_MspDeInit().

HAL_ADC_MspInit

Function name	**void HAL_ADC_MspInit (ADC_HandleTypeDef * hadc)**
Function description	Initializes the ADC MSP.
Parameters	• **hadc:** ADC handle
Return values	• **None:**

HAL_ADC_MspDeInit

Function name	**void HAL_ADC_MspDeInit (ADC_HandleTypeDef * hadc)**
Function description	DeInitializes the ADC MSP.
Parameters	• **hadc:** ADC handle
Return values	• **None:**

HAL_ADC_Start

Function name	**HAL_StatusTypeDef HAL_ADC_Start (ADC_HandleTypeDef * hadc)**
Function description	Enables ADC, starts conversion of regular group.
Parameters	• **hadc:** ADC handle
Return values	• **HAL:** status

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 conversion event.

Parameters
- **hadc:** ADC handle
- **EventType:** the ADC event type. This parameter can be one of the following values:
  - ADC_AWD_EVENT: ADC Analog watchdog event.
  - ADC_OVR_EVENT: ADC Overrun event.
- **Timeout:** Timeout value in millisecond.

Return values
- **HAL:** status

HAL_ADC_Start_IT

Function name	**HAL_StatusTypeDef HAL_ADC_Start_IT (ADC_HandleTypeDef * hadc)**
Function description	Enables ADC, starts conversion of regular group with interruption.

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	• **None:**

HAL_ADC_Start_DMA

Function name	**HAL_StatusTypeDef HAL_ADC_Start_DMA (ADC_HandleTypeDef * hadc, uint32_t * pData, uint32_t Length)**
Function description	Enables ADC, starts conversion of regular group and transfers result through DMA.

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 injected group. If injected group is under use, it should be preliminarily stopped using HAL_ADCEx_InjectedStop function.

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	Handles 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 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 paramater "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 Configures the the selected channel to be linked to the regular group.

Parameters
- **hadc:** ADC handle
- **sConfig:** Structure of ADC channel for regular group.

Return values
- **HAL:** status

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

HAL_ADC_AnalogWDGConfig

Function name **HAL_StatusTypeDef HAL_ADC_AnalogWDGConfig (ADC_HandleTypeDef * hadc, ADC_AnalogWDGConfTypeDef * AnalogWDGConfig)**

Function description Configures the analog watchdog.

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

Return values
- **HAL:** status

Notes
- Analog watchdog thresholds can be modified while ADC conversion is on going. In this case, some constraints must be taken into account: the programmed threshold values are effective from the next ADC EOC (end of unitary conversion). Considering that registers write delay may happen due to bus activity, this might cause an uncertainty on the effective timing of the new programmed threshold values.

HAL_ADC_GetState

Function name	**uint32_t HAL_ADC_GetState (ADC_HandleTypeDef * hadc)**
Function description	return the ADC state
Parameters	• **hadc:** ADC handle
Return values	• **HAL:** state

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

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()). • If low power mode AutoPowerOff is enabled, power-on/off phases are performed automatically by hardware. In this mode, this function is useless and must not be called because flag ADC_FLAG_RDY is not usable. Therefore, this function must be called under condition of "if (hadc->Init.LowPowerAutoPowerOff != ENABLE)".

ADC_ConversionStop_Disable

Function name	**HAL_StatusTypeDef ADC_ConversionStop_Disable (ADC_HandleTypeDef * hadc)**
Function description	Stop ADC conversion and disable the selected ADC.
Parameters	• **hadc:** ADC handle
Return values	• **HAL:** status.
Notes	• Prerequisite condition to use this function: ADC conversions must be stopped to disable the ADC.

6.3 ADC Firmware driver defines

6.3.1 ADC

ADC analog watchdog mode

ADC_ANALOGWATCHDOG_NONE

ADC_ANALOGWATCHDOG_SINGLE_REG

ADC_ANALOGWATCHDOG_SINGLE_INJEC

ADC_ANALOGWATCHDOG_SINGLE_REGINJEC

ADC_ANALOGWATCHDOG_ALL_REG

ADC_ANALOGWATCHDOG_ALL_INJEC

ADC_ANALOGWATCHDOG_ALL_REGINJEC

ADC channels

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

ADC_CHANNEL_19

ADC_CHANNEL_20

ADC_CHANNEL_21

ADC_CHANNEL_22

ADC_CHANNEL_23

ADC_CHANNEL_24

ADC_CHANNEL_25

ADC_CHANNEL_26

ADC_CHANNEL_27

ADC_CHANNEL_28

ADC_CHANNEL_29

ADC_CHANNEL_30

ADC_CHANNEL_31

ADC_CHANNEL_TEMPSENSOR

ADC_CHANNEL_VREFINT

ADC_CHANNEL_VCOMP

ADC_CHANNEL_VOPAMP1

ADC_CHANNEL_VOPAMP2

ADC_CHANNEL_VOPAMP3

ADC ChannelsBank

ADC_CHANNELS_BANK_A

ADC_CHANNELS_BANK_B

IS_ADC_CHANNELSBANK

IS_ADC_CHANNELSBANK

ADC ClockPrescaler

ADC_CLOCK_ASYNC_DIV1	ADC asynchronous clock derived from ADC dedicated HSI without prescaler
ADC_CLOCK_ASYNC_DIV2	ADC asynchronous clock derived from ADC dedicated HSI divided by a prescaler of 2
ADC_CLOCK_ASYNC_DIV4	ADC asynchronous clock derived from ADC dedicated HSI divided by a prescaler of 4

ADC conversion group

ADC_REGULAR_GROUP

ADC_INJECTED_GROUP

ADC_REGULAR_INJECTED_GROUP

ADC Data_align

ADC_DATAALIGN_RIGHT

ADC_DATAALIGN_LEFT

ADC EOCSelection

ADC_EOC_SEQ_CONV

ADC_EOC_SINGLE_CONV

ADC Error Code

HAL_ADC_ERROR_NONE	No error
HAL_ADC_ERROR_INTERNAL	ADC IP internal error: if problem of clocking, enable/disable, erroneous state
HAL_ADC_ERROR_OVR	Overrun error
HAL_ADC_ERROR_DMA	DMA transfer error

ADC Event type

ADC_AWD_EVENT ADC Analog watchdog event

ADC_OVR_EVENT ADC overrun event

ADC Exported Macros

__HAL_ADC_ENABLE

Description:

- Enable the ADC peripheral.

Parameters:

- __HANDLE__: ADC handle

Return value:

- None

__HAL_ADC_DISABLE

Description:

- Disable the ADC peripheral.

Parameters:

- __HANDLE__: ADC handle

Return value:

- None

__HAL_ADC_ENABLE_IT

Description:

- Enable the ADC end of conversion interrupt.

Parameters:

- __HANDLE__: ADC handle
- __INTERRUPT__: ADC Interrupt This parameter can be any combination of the following values:
  - ADC_IT_EOC: ADC End of Regular Conversion interrupt source
  - ADC_IT_JEOC: ADC End of Injected Conversion interrupt source
  - ADC_IT_AWD: ADC Analog watchdog interrupt source
  - ADC_IT_OVR: ADC overrun interrupt source

Return value:

- None

__HAL_ADC_DISABLE_IT

Description:

- Disable the ADC end of conversion interrupt.

Parameters:

- __HANDLE__: ADC handle
- __INTERRUPT__: ADC Interrupt This parameter can be any combination of the following values:
  - ADC_IT_EOC: ADC End of Regular Conversion interrupt source
  - ADC_IT_JEOC: ADC End of Injected Conversion interrupt source

- ADC_IT_AWD: ADC Analog watchdog interrupt source
- ADC_IT_OVR: ADC overrun 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 any combination of the following values:
  - ADC_IT_EOC: ADC End of Regular Conversion interrupt source
  - ADC_IT_JEOC: ADC End of Injected Conversion interrupt source
  - ADC_IT_AWD: ADC Analog watchdog interrupt source
  - ADC_IT_OVR: ADC overrun interrupt source

Return value:

- State: of interruption (SET or RESET)

__HAL_ADC_GET_FLAG

Description:

- Get the selected ADC's flag status.

Parameters:

- __HANDLE__: ADC handle
- __FLAG__: ADC flag This parameter can be any combination of the following values:
  - ADC_FLAG_STRT: ADC Regular group start flag
  - ADC_FLAG_JSTRT: ADC Injected group start flag
  - ADC_FLAG_EOC: ADC End of Regular conversion flag
  - ADC_FLAG_JEOC: ADC End of Injected conversion flag
  - ADC_FLAG_AWD: ADC Analog watchdog flag
  - ADC_FLAG_OVR: ADC overrun flag
  - ADC_FLAG_ADONS: ADC ready status flag
  - ADC_FLAG_RCNR: ADC Regular group ready status flag
  - ADC_FLAG_JCNR: ADC Injected group ready status flag

Return value:

- None

__HAL_ADC_CLEAR_FLAG

Description:

- Clear the ADC's pending flags.

Parameters:

- __HANDLE__: ADC handle
- __FLAG__: ADC flag
  - ADC_FLAG_STRT: ADC Regular group start flag
  - ADC_FLAG_JSTRT: ADC Injected group start flag
  - ADC_FLAG_EOC: ADC End of Regular conversion flag
  - ADC_FLAG_JEOC: ADC End of Injected conversion flag
  - ADC_FLAG_AWD: ADC Analog watchdog flag
  - ADC_FLAG_OVR: ADC overrun flag
  - ADC_FLAG_ADONS: ADC ready status flag
  - ADC_FLAG_RCNR: ADC Regular group ready status flag
  - ADC_FLAG_JCNR: ADC Injected group ready status flag

Return value:

- None

__HAL_ADC_RESET_HANDLE_STATE

Description:

- Reset ADC handle state.

Parameters:

- __HANDLE__: ADC handle

Return value:

- None

ADC Exported Types

HAL_ADC_STATE_RESET	ADC not yet initialized or disabled
HAL_ADC_STATE_READY	ADC peripheral ready for use
HAL_ADC_STATE_BUSY_INTERNAL	ADC is busy to 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 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 STM32L1 device: End Of Sampling flag raised
HAL_ADC_STATE_INJ_BUSY	A conversion on 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	Not available on STM32L1 device: Injected queue overflow occurrence
HAL_ADC_STATE_AWD1	Out-of-window occurrence of analog watchdog 1
HAL_ADC_STATE_AWD2	Not available on STM32L1 device: Out-of-window occurrence of analog watchdog 2
HAL_ADC_STATE_AWD3	Not available on STM32L1 device: Out-of-window occurrence of analog watchdog 3
HAL_ADC_STATE_MULTIMODE_SLAVE	Not available on STM32L1 device: ADC in multimode slave state, controlled by another ADC master (

ADC external trigger enable for regular group

ADC_EXTERNALTRIGCONVEDGE_NONE

ADC_EXTERNALTRIGCONVEDGE_RISING

ADC_EXTERNALTRIGCONVEDGE_FALLING

ADC_EXTERNALTRIGCONVEDGE_RISINGFALLING

ADC External trigger source Regular

ADC_EXTERNALTRIGCONV_T2_CC3

ADC_EXTERNALTRIGCONV_T2_CC2

ADC_EXTERNALTRIGCONV_T2_TRGO

ADC_EXTERNALTRIGCONV_T3_CC1

ADC_EXTERNALTRIGCONV_T3_CC3

ADC_EXTERNALTRIGCONV_T3_TRGO

ADC_EXTERNALTRIGCONV_T4_CC4

ADC_EXTERNALTRIGCONV_T4_TRGO

ADC_EXTERNALTRIGCONV_T6_TRGO

ADC_EXTERNALTRIGCONV_T9_CC2

ADC_EXTERNALTRIGCONV_T9_TRGO

ADC_EXTERNALTRIGCONV_EXT_IT11

ADC_SOFTWARE_START

ADC flags definition

ADC_FLAG_AWD	ADC Analog watchdog flag
ADC_FLAG_EOC	ADC End of Regular conversion flag
ADC_FLAG_JEOC	ADC End of Injected conversion flag
ADC_FLAG_JSTRT	ADC Injected group start flag
ADC_FLAG_STRT	ADC Regular group start flag
ADC_FLAG_OVR	ADC overrun flag
ADC_FLAG_ADONS	ADC ready status flag
ADC_FLAG_RCNR	ADC Regular group ready status flag
ADC_FLAG_JCNR	ADC Injected group ready status flag

ADC interrupts definition

ADC_IT_EOC	ADC End of Regular Conversion interrupt source
ADC_IT_JEOC	ADC End of Injected Conversion interrupt source
ADC_IT_AWD	ADC Analog watchdog interrupt source
ADC_IT_OVR	ADC overrun interrupt source

ADC LowPowerAutoPowerOff

ADC_AUTOPOWEROFF_DISABLE	
ADC_AUTOPOWEROFF_IDLE_PHASE	ADC power off when ADC is not converting (idle phase)
ADC_AUTOPOWEROFF_DELAY_PHASE	ADC power off when a delay is inserted between conversions (see parameter ADC_LowPowerAutoWait)
ADC_AUTOPOWEROFF_IDLE_DELAY_PHASES	ADC power off when ADC is not converting (idle phase) and when a delay is inserted between conversions

ADC LowPowerAutoWait

ADC_AUTOWAIT_DISABLE	< Note : For compatibility with other STM32 devices with ADC autowait
ADC_AUTOWAIT_UNTIL_DATA_READ	Insert a delay between ADC conversions: infinite delay, until the result of previous conversion is read
ADC_AUTOWAIT_7_APBCLOCKCYCLES	Insert a delay between ADC conversions: 7 APB clock cycles
ADC_AUTOWAIT_15_APBCLOCKCYCLES	Insert a delay between ADC conversions: 15 APB clock cycles
ADC_AUTOWAIT_31_APBCLOCKCYCLES	Insert a delay between ADC conversions: 31 APB clock cycles
ADC_AUTOWAIT_63_APBCLOCKCYCLES	Insert a delay between ADC conversions: 63 APB clock cycles
ADC_AUTOWAIT_127_APBCLOCKCYCLES	Insert a delay between ADC conversions:

	127 APB clock cycles
ADC_AUTOWAIT_255_APBCLOCKCYCLES	Insert a delay between ADC conversions: 255 APB clock cycles

ADC rank into regular group

ADC_REGULAR_RANK_1
ADC_REGULAR_RANK_2
ADC_REGULAR_RANK_3
ADC_REGULAR_RANK_4
ADC_REGULAR_RANK_5
ADC_REGULAR_RANK_6
ADC_REGULAR_RANK_7
ADC_REGULAR_RANK_8
ADC_REGULAR_RANK_9
ADC_REGULAR_RANK_10
ADC_REGULAR_RANK_11
ADC_REGULAR_RANK_12
ADC_REGULAR_RANK_13
ADC_REGULAR_RANK_14
ADC_REGULAR_RANK_15
ADC_REGULAR_RANK_16
ADC_REGULAR_RANK_17
ADC_REGULAR_RANK_18
ADC_REGULAR_RANK_19
ADC_REGULAR_RANK_20
ADC_REGULAR_RANK_21
ADC_REGULAR_RANK_22
ADC_REGULAR_RANK_23
ADC_REGULAR_RANK_24
ADC_REGULAR_RANK_25
ADC_REGULAR_RANK_26
ADC_REGULAR_RANK_27
ADC_REGULAR_RANK_28

ADC Resolution

ADC_RESOLUTION_12B	ADC 12-bit resolution
ADC_RESOLUTION_10B	ADC 10-bit resolution
ADC_RESOLUTION_8B	ADC 8-bit resolution
ADC_RESOLUTION_6B	ADC 6-bit resolution

ADC sampling times

ADC_SAMPLETIME_4CYCLES	Sampling time 4 ADC clock cycles
ADC_SAMPLETIME_9CYCLES	Sampling time 9 ADC clock cycles
ADC_SAMPLETIME_16CYCLES	Sampling time 16 ADC clock cycles
ADC_SAMPLETIME_24CYCLES	Sampling time 24 ADC clock cycles
ADC_SAMPLETIME_48CYCLES	Sampling time 48 ADC clock cycles
ADC_SAMPLETIME_96CYCLES	Sampling time 96 ADC clock cycles
ADC_SAMPLETIME_192CYCLES	Sampling time 192 ADC clock cycles
ADC_SAMPLETIME_384CYCLES	Sampling time 384 ADC clock cycles

ADC sampling times all channels

ADC_SAMPLETIME_ALLCHANNELS_SMPR3BIT2

ADC_SAMPLETIME_ALLCHANNELS_SMPR2BIT2

ADC_SAMPLETIME_ALLCHANNELS_SMPR1BIT2

ADC_SAMPLETIME_ALLCHANNELS_SMPR0BIT2

ADC_SAMPLETIME_ALLCHANNELS_SMPR3BIT1

ADC_SAMPLETIME_ALLCHANNELS_SMPR2BIT1

ADC_SAMPLETIME_ALLCHANNELS_SMPR1BIT1

ADC_SAMPLETIME_ALLCHANNELS_SMPR0BIT1

ADC_SAMPLETIME_ALLCHANNELS_SMPR3BIT0

ADC_SAMPLETIME_ALLCHANNELS_SMPR2BIT0

ADC_SAMPLETIME_ALLCHANNELS_SMPR1BIT0

ADC_SAMPLETIME_ALLCHANNELS_SMPR0BIT0

ADC Scan mode

ADC_SCAN_DISABLE

ADC_SCAN_ENABLE

7 HAL ADC Extension Driver

7.1 ADCEx Firmware driver registers structures

7.1.1 ADC_InjectionConfTypeDef

Data Fields

- ***uint32_t InjectedChannel***
- ***uint32_t InjectedRank***
- ***uint32_t InjectedSamplingTime***
- ***uint32_t InjectedOffset***
- ***uint32_t InjectedNbrOfConversion***
- ***uint32_t InjectedDiscontinuousConvMode***
- ***uint32_t AutoInjectedConv***
- ***uint32_t ExternalTrigInjecConv***
- ***uint32_t ExternalTrigInjecConvEdge***

Field Documentation

- ***uint32_t ADC_InjectionConfTypeDef::InjectedChannel***
  Selection of ADC channel to configure This parameter can be a value of ***ADC_channels*** Note: Depending on devices, some channels may not be available on package pins. Refer to device datasheet for channels availability.
- ***uint32_t ADC_InjectionConfTypeDef::InjectedRank***
  Rank in the injected group sequencer This parameter must be a value of ***ADCEx_injected_rank*** Note: In case of need 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 can be 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 ADC clock cycles at ADC resolution 12 bits, 11 cycles at 10 bits, 9 cycles at 8 bits, 7 cycles at 6 bits). This parameter can be a value of ***ADC_sampling_times*** Caution: This parameter updates the parameter property of the channel, that can be used into regular and/or injected groups. If this same channel has been previously configured in the other group (regular/injected), it will be updated to 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, parameters TS_vrefint, TS_temp (values rough order: 4us min).
- ***uint32_t ADC_InjectionConfTypeDef::InjectedOffset***
  Defines the offset to be subtracted from the raw converted data (for channels set on injected group only). 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.
- ***uint32_t ADC_InjectionConfTypeDef::InjectedNbrOfConversion***
  Specifies the number of ranks that will be converted within the injected group 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.

- ***uint32_t ADC_InjectionConfTypeDef::InjectedDiscontinuousConvMode***
  Specifies whether the conversions sequence of injected group 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. Note: For injected group, number of discontinuous ranks increment is fixed to one-by-one. 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::AutoInjectedConv***
  Enables or disables the selected ADC automatic injected group 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_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.
- ***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. If set to external trigger source, triggering is on event rising edge. This parameter can be a value of ***ADCEx_External_trigger_source_Injected*** 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 behaviour in case of another parameter update on the fly) 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 ***ADCEx_External_trigger_edge_Injected***. If trigger 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.

7.2 ADCEx Firmware driver API description

7.2.1 IO operation functions

This section provides functions allowing to:

- Start conversion of injected group.
- Stop conversion of injected group.
- Poll for conversion complete on injected group.
- Get result of injected channel conversion.

- Start conversion of injected group and enable interruptions.
- Stop conversion of injected group and disable interruptions.

This section contains the following APIs:

- ***HAL_ADCEx_InjectedStart()***
- ***HAL_ADCEx_InjectedStop()***
- ***HAL_ADCEx_InjectedPollForConversion()***
- ***HAL_ADCEx_InjectedStart_IT()***
- ***HAL_ADCEx_InjectedStop_IT()***
- ***HAL_ADCEx_InjectedGetValue()***
- ***HAL_ADCEx_InjectedConvCpltCallback()***

7.2.2 Peripheral Control functions

This section provides functions allowing to:

- Configure channels on injected group

This section contains the following APIs:

- ***HAL_ADCEx_InjectedConfigChannel()***

7.2.3 Detailed description of functions

HAL_ADCEx_InjectedStart

Function name	**HAL_StatusTypeDef HAL_ADCEx_InjectedStart (ADC_HandleTypeDef * hadc)**
Function description	Enables ADC, starts conversion of injected group.
Parameters	• **hadc:** ADC handle
Return values	• **HAL:** status

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	• **None:**
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 auto-injection mode, HAL_ADC_Stop must be used.

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

HAL_ADCEx_InjectedStart_IT

Function name: **HAL_StatusTypeDef HAL_ADCEx_InjectedStart_IT (ADC_HandleTypeDef * hadc)**

Function description: Enables ADC, starts conversion of injected group with interruption.

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:
- **None:**

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.

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: Injected Channel1 selected
  - ADC_INJECTED_RANK_2: Injected Channel2 selected
  - ADC_INJECTED_RANK_3: Injected Channel3 selected
  - ADC_INJECTED_RANK_4: Injected Channel4 selected

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_InjectedConfigChannel

Function name	**HAL_StatusTypeDef HAL_ADCEx_InjectedConfigChannel (ADC_HandleTypeDef * hadc, ADC_InjectionConfTypeDef * sConfigInjected)**
Function description	Configures the ADC injected group and the selected channel to be linked to the injected group.
Parameters	• **hadc:** ADC handle • **sConfigInjected:** Structure of ADC injected group and ADC channel for injected group.
Return values	• **None:**
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 reseting the ADC. The setting of these parameters is conditioned to ADC state: this function must be called when ADC is not under conversion.

7.3 ADCEx Firmware driver defines

7.3.1 ADCEx

ADCEx Exported Macros

__HAL_ADC_CHANNELS_BANK

Description:

- Selection of channels bank.

Parameters:

- __HANDLE__: ADC handle
- __BANK__: Bank selection. This parameter can be a value of

Return value:

- None

__HAL_ADC_CHANNEL_SPEED_FAST	Limited to channels 3, 8, 13 and to devices category Cat.3, Cat.4, Cat.5.
__HAL_ADC_CHANNEL_SPEED_SLOW	

ADCEx external trigger enable for injected group

ADC_EXTERNALTRIGINJECCONV_EDGE_NONE

ADC_EXTERNALTRIGINJECCONV_EDGE_RISING

ADC_EXTERNALTRIGINJECCONV_EDGE_FALLING

ADC_EXTERNALTRIGINJECCONV_EDGE_RISINGFALLING

ADCEx External trigger source Injected

ADC_EXTERNALTRIGINJECCONV_T2_CC1

ADC_EXTERNALTRIGINJECCONV_T2_TRGO

ADC_EXTERNALTRIGINJECCONV_T3_CC4

ADC_EXTERNALTRIGINJECCONV_T4_TRGO

ADC_EXTERNALTRIGINJECCONV_T4_CC1

ADC_EXTERNALTRIGINJECCONV_T4_CC2

ADC_EXTERNALTRIGINJECCONV_T4_CC3

ADC_EXTERNALTRIGINJECCONV_T7_TRGO

ADC_EXTERNALTRIGINJECCONV_T9_CC1

ADC_EXTERNALTRIGINJECCONV_T9_TRGO

ADC_EXTERNALTRIGINJECCONV_T10_CC1

ADC_EXTERNALTRIGINJECCONV_EXT_IT15

ADC_INJECTED_SOFTWARE_START

ADCEx injected nb conv verification

IS_ADC_INJECTED_NB_CONV

ADCEx rank into injected group

ADC_INJECTED_RANK_1

ADC_INJECTED_RANK_2

ADC_INJECTED_RANK_3

ADC_INJECTED_RANK_4

ADCEx Internal HAL driver Ext trig src Injected

ADC_EXTERNALTRIGINJEC_T9_CC1

ADC_EXTERNALTRIGINJEC_T9_TRGO

ADC_EXTERNALTRIGINJEC_T2_TRGO

ADC_EXTERNALTRIGINJEC_T2_CC1

ADC_EXTERNALTRIGINJEC_T3_CC4

ADC_EXTERNALTRIGINJEC_T4_TRGO

ADC_EXTERNALTRIGINJEC_T4_CC1

ADC_EXTERNALTRIGINJEC_T4_CC2

ADC_EXTERNALTRIGINJEC_T4_CC3

ADC_EXTERNALTRIGINJEC_T10_CC1

ADC_EXTERNALTRIGINJEC_T7_TRGO

ADC_EXTERNALTRIGINJEC_EXT_IT15

8 HAL COMP Generic Driver

8.1 COMP Firmware driver registers structures

8.1.1 COMP_InitTypeDef

Data Fields

- ***uint32_t InvertingInput***
- ***uint32_t NonInvertingInput***
- ***uint32_t Output***
- ***uint32_t Mode***
- ***uint32_t WindowMode***
- ***uint32_t TriggerMode***
- ***uint32_t NonInvertingInputPull***

Field Documentation

- ***uint32_t COMP_InitTypeDef::InvertingInput***
  Selects the inverting input of the comparator. This parameter can be a value of ***COMP_InvertingInput*** Note: Inverting input can be changed on the fly, while comparator is running. Note: This feature is available on COMP2 only. If COMP1 is selected, this parameter is discarded (On COMP1, inverting input is fixed to Vrefint).
- ***uint32_t COMP_InitTypeDef::NonInvertingInput***
  Selects the non inverting input of the comparator. This parameter can be a value of ***COMPEx_NonInvertingInput***
- ***uint32_t COMP_InitTypeDef::Output***
  Selects the output redirection of the comparator. This parameter can be a value of ***COMP_Output*** Note: This feature is available on COMP2 only. If COMP1 is selected, this parameter is discarded.
- ***uint32_t COMP_InitTypeDef::Mode***
  Selects the operating consumption mode of the comparator to adjust the speed/consumption. This parameter can be a value of ***COMP_Mode*** Note: This feature is available on COMP2 only. If COMP1 is selected, this parameter is discarded.
- ***uint32_t COMP_InitTypeDef::WindowMode***
  Selects the window mode of the 2 comparators. If enabled, non-inverting inputs of the 2 comparators are connected together and are using inputs of COMP2 only (COMP1 non-inverting input is no more accessible, even from ADC channel VCOMP). This parameter can be a value of ***COMP_WindowMode*** Note: This feature must be enabled from COMP2 instance. If COMP1 is selected, this parameter is discarded.
- ***uint32_t COMP_InitTypeDef::TriggerMode***
  Selects the trigger mode of the comparator when using interruption on EXTI line (interrupt mode). This parameter can be a value of ***COMP_TriggerMode*** Note: This feature is used with function "HAL_COMP_Start_IT()". In all other functions, this parameter is discarded.
- ***uint32_t COMP_InitTypeDef::NonInvertingInputPull***
  Selects the internal pulling resistor connected on non inverting input. This parameter can be a value of ***COMP_NonInvertingInputPull*** Note: To avoid extra power consumption, only one resistor should be enabled at a time. Note: This feature is available on COMP1 only. If COMP2 is selected, this parameter is discarded.

8.1.2 COMP_HandleTypeDef

Data Fields

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

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

8.2 COMP Firmware driver API description

8.2.1 COMP Peripheral features

The STM32L1xx device family integrates 2 analog comparators COMP1 and COMP2:

1. The non inverting input and inverting input can be set to GPIO pins. HAL COMP driver configures the Routing Interface (RI) to connect the selected I/O pins to comparator input. Caution: Comparator COMP1 and ADC cannot be used at the same time as ADC since they share the ADC switch matrix: COMP1 non-inverting input is routed through ADC switch matrix. Except if ADC is intended to measure voltage on COMP1 non-inverting input: it can be performed on ADC channel VCOMP.
2. The COMP output is available using HAL_COMP_GetOutputLevel().
3. The COMP output can be redirected to embedded timers (TIM2, TIM3, TIM4, TIM10). COMP output cannot be redirected to any I/O pin.
4. The comparators COMP1 and COMP2 can be combined in window mode. In this mode, COMP2 non inverting input is used as common non-inverting input.
5. The 2 comparators have interrupt capability with wake-up from Sleep and Stop modes (through the EXTI controller):
   - COMP1 is internally connected to EXTI Line 21
   - COMP2 is internally connected to EXTI Line 22 From the corresponding IRQ handler, the right interrupt source can be retrieved with the macros __HAL_COMP_COMP1_EXTI_GET_FLAG() and __HAL_COMP_COMP2_EXTI_GET_FLAG().
6. The comparators also offer the possibility to output the voltage reference (VrefInt), used on inverting inputs, on I/O pin through a buffer. To use it, refer to macro "__HAL_SYSCFG_VREFINT_OUT_ENABLE()".

8.2.2 How to use this driver

This driver provides functions to configure and program the Comparators of all STM32L1xx devices. To use the comparator, perform the following steps:

1. Initialize the COMP low level resources by implementing the HAL_COMP_MspInit().
   - Configure the comparator input I/O pin using HAL_GPIO_Init(): - For all inputs: I/O pin in analog mode (Schmitt trigger disabled) - Possible alternate configuration, for non-inverting inputs of comparator 2: I/O pin in floating mode

(Schmitt trigger enabled). It is recommended to use analog configuration to avoid any overconsumption around VDD/2.
  - Enable COMP Peripheral clock using macro __HAL_RCC_COMP_CLK_ENABLE()
  - If required enable the COMP interrupt (EXTI line Interrupt): enable the comparator interrupt vector using HAL_NVIC_EnableIRQ(COMP_IRQn) and HAL_NVIC_SetPriority(COMP_IRQn, xxx, xxx) functions.
2. Configure the comparator using HAL_COMP_Init() function:
  - Select the inverting input (COMP2 only)
  - Select the non-inverting input
  - Select the output redirection to timers (COMP2 only)
  - Select the speed mode (COMP2 only)
  - Select the window mode (related to COMP1 and COMP2, but selected by COMP2 only)
  - Select the pull-up/down resistors on non-inverting input (COMP1 only)
3. Enable the comparator using HAL_COMP_Start() or HAL_COMP_Start_IT() function
4. If needed, use HAL_COMP_GetOutputLevel() or HAL_COMP_TriggerCallback() functions to manage comparator actions (output level or events)
5. Disable the comparator using HAL_COMP_Stop() or HAL_COMP_Stop_IT() function
6. De-initialize the comparator using HAL_COMP_DeInit() function

8.2.3 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()***

8.2.4 IO operation functions

This subsection provides a set of functions allowing to manage the COMP start and stop actions with or without interruption on ExtI line.

This section contains the following APIs:

- ***HAL_COMP_Start()***
- ***HAL_COMP_Stop()***
- ***HAL_COMP_Start_IT()***
- ***HAL_COMP_Stop_IT()***
- ***HAL_COMP_IRQHandler()***

8.2.5 Peripheral Control functions

This subsection provides a set of functions allowing to control the COMP management functions: Lock status, comparator output level check, IRQ callback (in case of usage of comparator with interruption on ExtI line).

This section contains the following APIs:

- ***HAL_COMP_Lock()***
- ***HAL_COMP_GetOutputLevel()***
- ***HAL_COMP_TriggerCallback()***

8.2.6 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()***

8.2.7 Detailed description of functions

HAL_COMP_Init

Function name	**HAL_StatusTypeDef HAL_COMP_Init (COMP_HandleTypeDef * hcomp)**
Function description	Initializes the COMP according to the specified parameters in the COMP_InitTypeDef and create 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	DeInitializes the COMP peripheral.
Parameters	• **hcomp:** COMP handle
Return values	• **HAL:** status
Notes	• Deinitialization can't 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	Initializes the COMP MSP.
Parameters	• **hcomp:** COMP handle
Return values	• **None:**

HAL_COMP_MspDeInit

Function name	**void HAL_COMP_MspDeInit (COMP_HandleTypeDef * hcomp)**
Function description	DeInitializes 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_Start_IT

Function name	**HAL_StatusTypeDef HAL_COMP_Start_IT (COMP_HandleTypeDef * hcomp)**
Function description	Enables the interrupt and starts the comparator.
Parameters	• **hcomp:** COMP handle
Return values	• **HAL:** status.

HAL_COMP_Stop_IT

Function name	**HAL_StatusTypeDef HAL_COMP_Stop_IT (COMP_HandleTypeDef * hcomp)**
Function description	Disable the interrupt and 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	• **HAL:** status

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

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 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 state.

Parameters
- **hcomp:** : COMP handle

Return values
- **HAL:** state

8.3 COMP Firmware driver defines

8.3.1 COMP

COMP Exported Macro

__HAL_COMP_RESET_HANDLE_STATE

Description:
- Reset COMP handle state.

Parameters:
- __HANDLE__: COMP handle.

Return value:
- None

__HAL_COMP_ENABLE

Description:
- Enables the specified comparator.

Parameters:
- __HANDLE__: COMP handle.

Return value:

- None.

__HAL_COMP_DISABLE

Description:

- Disables the specified comparator.

Parameters:

- __HANDLE__: COMP handle.

Return value:

- None.

__HAL_COMP_GET_FLAG

Description:

- Checks whether the specified COMP flag is set or not.

Parameters:

- __HANDLE__: specifies the COMP Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - COMP_FLAG_LOCK: lock flag

Return value:

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

__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_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 or not. **Return value:** • RESET: or SET
__HAL_COMP_COMP1_EXTI_CLEAR_FLAG	**Description:** • Clear the the COMP1 EXTI flag. **Return value:** • None
__HAL_COMP_COMP1_EXTI_GENERATE_SWIT	**Description:** • Generates a Software interrupt on COMP1 EXTI Line. **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.

Return value:

- None

__HAL_COMP_COMP2_EXTI_DISABLE_IT

Description:

- Disable 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 or not.

Return value:

- RESET: or SET

__HAL_COMP_COMP2_EXTI_CLEAR_FLAG

Description:

- Clear the the COMP2 EXTI flag.

Return value:

- None

__HAL_COMP_COMP2_EXTI_GENERATE_SWIT

Description:

- Generates a Software interrupt on COMP1 EXTI Line.

Return value:

- None

COMP ExtiLineEvent

COMP_EXTI_LINE_COMP1	External interrupt line 21 Connected to COMP1
COMP_EXTI_LINE_COMP2	External interrupt line 22 Connected to COMP2

COMP InvertingInput

COMP_INVERTINGINPUT_IO	External I/O (COMP2_INM connected to pin PB3) connected to comparator 2 inverting input
COMP_INVERTINGINPUT_VREFINT	VREFINT connected to comparator 2 inverting input
COMP_INVERTINGINPUT_3_4VREFINT	3/4 VREFINT connected to comparator 2 inverting input
COMP_INVERTINGINPUT_1_2VREFINT	1/2 VREFINT connected to comparator 2 inverting input
COMP_INVERTINGINPUT_1_4VREFINT	1/4 VREFINT connected to comparator 2 inverting input
COMP_INVERTINGINPUT_DAC1	DAC_OUT1 (PA4) connected to comparator 2 inverting input
COMP_INVERTINGINPUT_DAC2	DAC2_OUT (PA5) connected to comparator 2 inverting input

IS_COMP_INVERTINGINPUT

COMP Mode

COMP_MODE_LOWSPEED	Low Speed
COMP_MODE_HIGHSPEED	High Speed

IS_COMP_MODE

COMP NonInvertingInputPull

COMP_NONINVERTINGINPUT_NOPULL	No internal pull-up or pull-down resistor connected to comparator non inverting input
COMP_NONINVERTINGINPUT_10KPU	Internal 10kOhm pull-up resistor connected to comparator non inverting input
COMP_NONINVERTINGINPUT_10KPD	Internal 10kOhm pull-down resistor connected to comparator non inverting input
COMP_NONINVERTINGINPUT_400KPU	Internal 400kOhm pull-up resistor connected to comparator non inverting input
COMP_NONINVERTINGINPUT_400KPD	Internal 400kOhm pull-down resistor connected to comparator non inverting input

IS_COMP_NONINVERTINGINPUTPULL

COMP Output

COMP_OUTPUT_TIM2IC4	COMP2 output connected to TIM2 Input Capture 4
COMP_OUTPUT_TIM2OCREFCLR	COMP2 output connected to TIM2 OCREF Clear
COMP_OUTPUT_TIM3IC4	COMP2 output connected to TIM3 Input Capture 4
COMP_OUTPUT_TIM3OCREFCLR	COMP2 output connected to TIM3 OCREF Clear
COMP_OUTPUT_TIM4IC4	COMP2 output connected to TIM4 Input Capture 4
COMP_OUTPUT_TIM4OCREFCLR	COMP2 output connected to TIM4 OCREF Clear
COMP_OUTPUT_TIM10IC1	COMP2 output connected to TIM10 Input Capture 1
COMP_OUTPUT_NONE	COMP2 output is not connected to other peripherals

IS_COMP_OUTPUT

COMP OutputLevel

COMP_OUTPUTLEVEL_LOW

COMP_OUTPUTLEVEL_HIGH

COMP TriggerMode

COMP_TRIGGERMODE_NONE	No External Interrupt trigger detection
COMP_TRIGGERMODE_IT_RISING	External Interrupt Mode with Rising edge trigger detection
COMP_TRIGGERMODE_IT_FALLING	External Interrupt Mode with Falling edge trigger detection
COMP_TRIGGERMODE_IT_RISING_FALLING	External Interrupt Mode with Rising/Falling edge trigger detection

IS_COMP_TRIGGERMODE

COMP WindowMode

COMP_WINDOWMODE_DISABLE	Window mode disabled: COMP1 non-inverting input is independant
COMP_WINDOWMODE_ENABLE	Window mode enabled: COMP1 non-inverting input is no more accessible, even from ADC channel VCOMP) (connected to COMP2 non-inverting input)

IS_COMP_WINDOWMODE

9 HAL COMP Extension Driver

9.1 COMPEx Firmware driver defines

9.1.1 COMPEx

COMPEx NonInvertingInput

COMP_NONINVERTINGINPUT_PB4	I/O pin PB4 connection to COMP2 non-inverting input
COMP_NONINVERTINGINPUT_PB5	I/O pin PB5 connection to COMP2 non-inverting input
COMP_NONINVERTINGINPUT_PB6	I/O pin PB6 connection to COMP2 non-inverting input
COMP_NONINVERTINGINPUT_PB7	I/O pin PB7 connection to COMP2 non-inverting input
COMP_NONINVERTINGINPUT_NONE	In case of window mode: No I/O pin connection to COMP1 non-inverting input. Instead, connection to COMP2 non-inverting input.
COMP_NONINVERTINGINPUT_PA0	I/O pin PA0 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA1	I/O pin PA1 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA2	I/O pin PA2 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA3	I/O pin PA3 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA4	I/O pin PA4 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA5	I/O pin PA5 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA6	I/O pin PA5 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PA7	I/O pin PA7 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PB0	I/O pin PB0 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PB1	I/O pin PB1 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PC0	I/O pin PC0 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PC1	I/O pin PC1 connection to COMP1 non-inverting input

COMP_NONINVERTINGINPUT_PC2	I/O pin PC2 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PC3	I/O pin PC3 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PC4	I/O pin PC4 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PC5	I/O pin PC5 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PB12	I/O pin PB12 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PB13	I/O pin PB13 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PB14	I/O pin PB14 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PB15	I/O pin PB15 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PE7	I/O pin PE7 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PE8	I/O pin PE8 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PE9	I/O pin PE9 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PE10	I/O pin PE10 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PF6	I/O pin PF6 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PF7	I/O pin PF7 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PF8	I/O pin PF8 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PF9	I/O pin PF9 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_PF10	I/O pin PF10 connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_OPAMP1	OPAMP1 output connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_OPAMP2	OPAMP2 output connection to COMP1 non-inverting input
COMP_NONINVERTINGINPUT_OPAMP3	OPAMP3 output connection to COMP1 non-inverting input
IS_COMP_NONINVERTINGINPUT	

10 HAL CORTEX Generic Driver

10.1 CORTEX Firmware driver registers structures

10.1.1 MPU_Region_InitTypeDef

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***

10.2 CORTEX Firmware driver API description

10.2.1 Initialization and de-initialization functions

This section provide 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()***

10.2.2 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_MPU_Enable()***
- ***HAL_MPU_Disable()***
- ***HAL_MPU_ConfigRegion()***
- ***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()***

10.2.3 Detailed description of functions

HAL_NVIC_SetPriorityGrouping

Function name — **void HAL_NVIC_SetPriorityGrouping (uint32_t PriorityGroup)**

Function description — Sets 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 bits for pre-emption priority 4 bits for subpriority
  - NVIC_PRIORITYGROUP_1: 1 bits 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 bits for subpriority
- NVIC_PRIORITYGROUP_4: 4 bits for pre-emption priority 0 bits 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 Sets 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 (stm32l1xx.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 Enables 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 (stm32l1xx.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 Disables 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 (stm32l1xxxx.h))

Return values
- **None:**

HAL_NVIC_SystemReset

Function name **void HAL_NVIC_SystemReset (void)**

Function description Initiates 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 Initializes the System Timer and its interrupt, and starts the System Tick Timer.

Parameters
- **TicksNumb:** Specifies the ticks Number of ticks between two interrupts.

Return values
- **status:** - 0 Function succeeded.
  - 1 Function failed.

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 Initializes and configures 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:**

HAL_NVIC_GetPriorityGrouping

Function name **uint32_t HAL_NVIC_GetPriorityGrouping (void)**

Function description Gets 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 Gets 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 (stm32l1xxxx.h))
- **PriorityGroup:** the priority grouping bits length. This parameter can be one of the following values:
  - NVIC_PRIORITYGROUP_0: 0 bits for pre-emption priority 4 bits for subpriority
  - NVIC_PRIORITYGROUP_1: 1 bits 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 bits for subpriority
  - NVIC_PRIORITYGROUP_4: 4 bits for pre-emption priority 0 bits 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 Gets Pending Interrupt (reads the pending register in the NVIC and returns 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 (stm32l1xxxx.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 Sets 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 (stm32l1xxxx.h))

Return values
- **None:**

HAL_NVIC_ClearPendingIRQ

Function name **void HAL_NVIC_ClearPendingIRQ (IRQn_Type IRQn)**

Function description Clears 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 (stm32l1xxxx.h))

Return values
- **None:**

HAL_NVIC_GetActive

Function name **uint32_t HAL_NVIC_GetActive (IRQn_Type IRQn)**

Function description Gets active interrupt (reads the active register in NVIC and returns 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 (stm32l1xxxx.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 Configures 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 This function handles SYSTICK interrupt request.

Return values
- **None:**

HAL_SYSTICK_Callback

Function name	**void HAL_SYSTICK_Callback (void)**
Function description	SYSTICK callback.
Return values	• **None:**

10.3 CORTEX Firmware driver defines

10.3.1 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

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

MPU TEX Levels

MPU_TEX_LEVEL0

MPU_TEX_LEVEL1

MPU_TEX_LEVEL2

CORTEX Preemption Priority Group

NVIC_PRIORITYGROUP_0 0 bits for pre-emption priority 4 bits for subpriority

NVIC_PRIORITYGROUP_1 1 bits 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 bits for subpriority

NVIC_PRIORITYGROUP_4 4 bits for pre-emption priority 0 bits for subpriority

CORTEX Preemption Priority Group

IS_NVIC_PRIORITY_GROUP

IS_NVIC_PREEMPTION_PRIORITY

IS_NVIC_SUB_PRIORITY

IS_NVIC_DEVICE_IRQ

CORTEX SysTick clock source

SYSTICK_CLKSOURCE_HCLK_DIV8

SYSTICK_CLKSOURCE_HCLK

11 HAL CRC Generic Driver

11.1 CRC Firmware driver registers structures

11.1.1 CRC_HandleTypeDef

Data Fields

- ***CRC_TypeDef * Instance***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_CRC_StateTypeDef State***

Field Documentation

- ***CRC_TypeDef* CRC_HandleTypeDef::Instance***
  Register base address
- ***HAL_LockTypeDef CRC_HandleTypeDef::Lock***
  CRC locking object
- ***__IO HAL_CRC_StateTypeDef CRC_HandleTypeDef::State***
  CRC communication state

11.2 CRC Firmware driver API description

11.2.1 How to use this driver

The CRC HAL driver can be used as follows:

1. Enable CRC AHB clock using __HAL_RCC_CRC_CLK_ENABLE();
2. Use HAL_CRC_Accumulate() function to compute the CRC value of a 32-bit data buffer using combination of the previous CRC value and the new one.
3. Use HAL_CRC_Calculate() function to compute the CRC Value of a new 32-bit data buffer. This function resets the CRC computation unit before starting the computation to avoid getting wrong CRC values.

11.2.2 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
- DeInitialize CRC MSP

This section contains the following APIs:

- ***HAL_CRC_Init()***
- ***HAL_CRC_DeInit()***
- ***HAL_CRC_MspInit()***
- ***HAL_CRC_MspDeInit()***

11.2.3 Peripheral Control functions

This section provides functions allowing to:

- Compute the 32-bit CRC value of 32-bit data buffer, using combination of the previous CRC value and the new one.

- Compute the 32-bit CRC value of 32-bit data buffer, independently of the previous CRC value.

This section contains the following APIs:

- ***HAL_CRC_Accumulate()***
- ***HAL_CRC_Calculate()***

11.2.4 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_CRC_GetState()***
- ***HAL_CRC_Accumulate()***
- ***HAL_CRC_Calculate()***

11.2.5 Detailed description of functions

HAL_CRC_Init

Function name	**HAL_StatusTypeDef HAL_CRC_Init (CRC_HandleTypeDef * hcrc)**
Function description	Initializes the CRC according to the specified parameters in the CRC_InitTypeDef and creates the associated handle.
Parameters	• **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC
Return values	• **HAL:** status

HAL_CRC_DeInit

Function name	**HAL_StatusTypeDef HAL_CRC_DeInit (CRC_HandleTypeDef * hcrc)**
Function description	DeInitializes the CRC peripheral.
Parameters	• **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC
Return values	• **HAL:** status

HAL_CRC_MspInit

Function name	**void HAL_CRC_MspInit (CRC_HandleTypeDef * hcrc)**
Function description	Initializes the CRC MSP.
Parameters	• **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC
Return values	• **None:**

HAL_CRC_MspDeInit

Function name	**void HAL_CRC_MspDeInit (CRC_HandleTypeDef * hcrc)**
Function description	DeInitializes the CRC MSP.

Parameters
- **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC

Return values
- **None:**

HAL_CRC_Accumulate

Function name **uint32_t HAL_CRC_Accumulate (CRC_HandleTypeDef * hcrc, uint32_t pBuffer, uint32_t BufferLength)**

Function description Computes the 32-bit CRC of 32-bit data buffer using combination of the previous CRC value and the new one.

Parameters
- **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC
- **pBuffer:** pointer to the buffer containing the data to be computed
- **BufferLength:** length of the buffer to be computed (defined in word, 4 bytes)

Return values
- **32-bit:** CRC

HAL_CRC_Calculate

Function name **uint32_t HAL_CRC_Calculate (CRC_HandleTypeDef * hcrc, uint32_t pBuffer, uint32_t BufferLength)**

Function description Computes the 32-bit CRC of 32-bit data buffer independently of the previous CRC value.

Parameters
- **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC
- **pBuffer:** Pointer to the buffer containing the data to be computed
- **BufferLength:** Length of the buffer to be computed (defined in word, 4 bytes)

Return values
- **32-bit:** CRC

HAL_CRC_GetState

Function name **HAL_CRC_StateTypeDef HAL_CRC_GetState (CRC_HandleTypeDef * hcrc)**

Function description Returns the CRC state.

Parameters
- **hcrc:** pointer to a CRC_HandleTypeDef structure that contains the configuration information for CRC

Return values
- **HAL:** state

11.3 CRC Firmware driver defines

11.3.1 CRC

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:

- Resets CRC Data Register.

Parameters:

- __HANDLE__: CRC handle

Return value:

- None

__HAL_CRC_SET_IDR

Description:

- Stores a 8-bit data in the Independent Data(ID) register.

Parameters:

- __HANDLE__: CRC handle
- __VALUE__: 8-bit value to be stored in the ID register

Return value:

- None

__HAL_CRC_GET_IDR

Description:

- Returns the 8-bit data stored in the Independent Data(ID) register.

Parameters:

- __HANDLE__: CRC handle

Return value:

- 8-bit: value of the ID register

12 HAL CRYP Generic Driver

12.1 CRYP Firmware driver registers structures

12.1.1 CRYP_InitTypeDef

Data Fields

- ***uint32_t DataType***
- ***uint8_t * pKey***
- ***uint8_t * pInitVect***

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***
- ***uint8_t* CRYP_InitTypeDef::pKey***
  The key used for encryption/decryption
- ***uint8_t* CRYP_InitTypeDef::pInitVect***
  The initialization vector used also as initialization counter in CTR mode

12.1.2 CRYP_HandleTypeDef

Data Fields

- ***AES_TypeDef * Instance***
- ***CRYP_InitTypeDef Init***
- ***uint8_t * pCrypInBuffPtr***
- ***uint8_t * pCrypOutBuffPtr***
- ***__IO uint16_t CrypInCount***
- ***__IO uint16_t CrypOutCount***
- ***HAL_StatusTypeDef Status***
- ***HAL_PhaseTypeDef Phase***
- ***DMA_HandleTypeDef * hdmain***
- ***DMA_HandleTypeDef * hdmaout***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_CRYP_STATETypeDef State***

Field Documentation

- ***AES_TypeDef* CRYP_HandleTypeDef::Instance***
  Register base address
- ***CRYP_InitTypeDef CRYP_HandleTypeDef::Init***
  CRYP required parameters
- ***uint8_t* CRYP_HandleTypeDef::pCrypInBuffPtr***
  Pointer to CRYP processing (encryption, decryption,...) buffer
- ***uint8_t* CRYP_HandleTypeDef::pCrypOutBuffPtr***
  Pointer to CRYP processing (encryption, decryption,...) buffer
- ***__IO uint16_t CRYP_HandleTypeDef::CrypInCount***
  Counter of inputed data
- ***__IO uint16_t CRYP_HandleTypeDef::CrypOutCount***
  Counter of outputed data
- ***HAL_StatusTypeDef CRYP_HandleTypeDef::Status***
  CRYP peripheral status

- ***HAL_PhaseTypeDef CRYP_HandleTypeDef::Phase***
  CRYP peripheral phase
- ***DMA_HandleTypeDef* CRYP_HandleTypeDef::hdmain***
  CRYP In DMA handle parameters
- ***DMA_HandleTypeDef* CRYP_HandleTypeDef::hdmaout***
  CRYP Out DMA handle parameters
- ***HAL_LockTypeDef CRYP_HandleTypeDef::Lock***
  CRYP locking object
- ***__IO HAL_CRYP_STATETypeDef CRYP_HandleTypeDef::State***
  CRYP peripheral state

12.2 CRYP Firmware driver API description

12.2.1 Initialization and de-initialization 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
- DeInitialize CRYP MSP

This section contains the following APIs:

- ***HAL_CRYP_Init()***
- ***HAL_CRYP_DeInit()***
- ***HAL_CRYP_MspInit()***
- ***HAL_CRYP_MspDeInit()***

12.2.2 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()***

12.2.3 DMA callback functions

This section provides DMA callback functions:

- DMA Input data transfer complete
- DMA Output data transfer complete
- DMA error

This section contains the following APIs:

- ***HAL_CRYP_ErrorCallback()***
- ***HAL_CRYP_InCpltCallback()***
- ***HAL_CRYP_OutCpltCallback()***

12.2.4 CRYP IRQ handler management

This section provides CRYP IRQ handler function.

This section contains the following APIs:

- ***HAL_CRYP_IRQHandler()***

12.2.5 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()***

12.2.6 Detailed description of functions

HAL_CRYP_Init

Function name	**HAL_StatusTypeDef HAL_CRYP_Init (CRYP_HandleTypeDef * hcryp)**
Function description	Initializes the CRYP according to the specified parameters in the CRYP_InitTypeDef and creates the associated handle.
Parameters	• **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
Return values	• **HAL:** status

HAL_CRYP_DeInit

Function name	**HAL_StatusTypeDef HAL_CRYP_DeInit (CRYP_HandleTypeDef * hcryp)**
Function description	DeInitializes 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 Initializes 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 DeInitializes 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 Initializes the CRYP peripheral in AES ECB encryption mode then encrypt pPlainData.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Timeout:** Specify Timeout value

Return values
- **HAL:** status

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 Initializes the CRYP peripheral in AES ECB decryption mode then decrypted pCypherData.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Timeout:** Specify Timeout value

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES CBC encryption mode then encrypt pPlainData.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Timeout:** Specify Timeout value

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES ECB decryption mode then decrypted pCypherData.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Timeout:** Specify Timeout value

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES CTR encryption mode then encrypt pPlainData.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Timeout:** Specify Timeout value

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES CTR decryption mode then decrypted pCypherData.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Timeout:** Specify Timeout value

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES ECB encryption mode using Interrupt.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES CBC encryption mode using Interrupt.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES CTR encryption mode using Interrupt.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES ECB decryption mode using Interrupt.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)

Return values
- **HAL:** status

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
Initializes the CRYP peripheral in AES CTR decryption mode using Interrupt.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)

Return values
- **HAL:** status

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: Initializes the CRYP peripheral in AES CBC decryption mode using IT.

Parameters:
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)

Return values:
- **HAL:** status

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: Initializes the CRYP peripheral in AES ECB encryption mode using DMA.

Parameters:
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)

Return values:
- **HAL:** status

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: Initializes the CRYP peripheral in AES ECB decryption mode using DMA.

Parameters:
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)

Return values:
- **HAL:** status

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 — Initializes the CRYP peripheral in AES CBC encryption mode using DMA.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)

Return values
- **HAL:** status

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 — Initializes the CRYP peripheral in AES CBC encryption mode using DMA.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16 bytes
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)

Return values
- **HAL:** status

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 — Initializes the CRYP peripheral in AES CTR encryption mode using DMA.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16.
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)

Return values
- **HAL:** status

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 — Initializes the CRYP peripheral in AES CTR decryption mode using DMA.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module
- **pCypherData:** Pointer to the cyphertext buffer (aligned on u32)
- **Size:** Length of the plaintext buffer, must be a multiple of 16
- **pPlainData:** Pointer to the plaintext buffer (aligned on u32)

Return values
- **HAL:** status

HAL_CRYP_InCpltCallback

Function name **void HAL_CRYP_InCpltCallback (CRYP_HandleTypeDef * hcryp)**

Function description Input transfer completed 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 transfer completed 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 This function handles CRYP 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 Returns the CRYP state.

Parameters
- **hcryp:** pointer to a CRYP_HandleTypeDef structure that contains the configuration information for CRYP module

Return values
- **HAL:** state

12.3 CRYP Firmware driver defines

12.3.1 CRYP

AES Clear Flags

CRYP_CLEARFLAG_CCF Computation Complete Flag Clear

CRYP_CLEARFLAG_RDERR Read Error Clear

CRYP_CLEARFLAG_WRERR Write Error Clear

AES Flags

CRYP_FLAG_CCF Computation Complete Flag

CRYP_FLAG_RDERR Read Error Flag

CRYP_FLAG_WRERR Write Error Flag

AES Interrupts

CRYP_IT_CC Computation Complete interrupt

CRYP_IT_ERR Error interrupt

CRYP Algo Mode Direction

CRYP_CR_ALGOMODE_DIRECTION

CRYP_CR_ALGOMODE_AES_ECB_ENCRYPT

CRYP_CR_ALGOMODE_AES_ECB_KEYDERDECRYPT

CRYP_CR_ALGOMODE_AES_CBC_ENCRYPT

CRYP_CR_ALGOMODE_AES_CBC_KEYDERDECRYPT

CRYP_CR_ALGOMODE_AES_CTR_ENCRYPT

CRYP_CR_ALGOMODE_AES_CTR_DECRYPT

CRYP Data Type

CRYP_DATATYPE_32B

CRYP_DATATYPE_16B

CRYP_DATATYPE_8B

CRYP_DATATYPE_1B

IS_CRYP_DATATYPE

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/Disable the CRYP peripheral.

Parameters:

- __HANDLE__: specifies the CRYP handle.

Return value:

- None

__HAL_CRYP_DISABLE

__HAL_CRYP_SET_MODE

Description:

- Set the algorithm mode: AES-ECB, AES-CBC, AES-CTR, DES-ECB, DES-CBC,...

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __MODE__: The algorithm mode.

Return value:

- None

__HAL_CRYP_GET_FLAG

Description:

- Check whether the specified CRYP 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_CCF : Computation Complete Flag
  - CRYP_FLAG_RDERR : Read Error Flag
  - CRYP_FLAG_WRERR : Write Error Flag

Return value:

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

__HAL_CRYP_CLEAR_FLAG

Description:

- Clear the CRYP pending flag.

Parameters:

- __HANDLE__: specifies the CRYP

handle.
- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - CRYP_CLEARFLAG_CCF : Computation Complete Clear Flag
  - CRYP_CLEARFLAG_RDERR : Read Error Clear
  - CRYP_CLEARFLAG_WRERR : Write Error Clear

Return value:

- None

__HAL_CRYP_ENABLE_IT

Description:

- Enable the CRYP interrupt.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP Interrupt.

Return value:

- None

__HAL_CRYP_DISABLE_IT

Description:

- Disable the CRYP interrupt.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP interrupt.

Return value:

- None

__HAL_CRYP_GET_IT_SOURCE

Description:

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

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __INTERRUPT__: CRYP interrupt source to check This parameter can be one of the following values:
  - CRYP_IT_CC : Computation Complete interrupt
  - CRYP_IT_ERR : Error interrupt (used for RDERR and WRERR)

Return value:

- State: of interruption (SET or RESET)

__HAL_CRYP_CLEAR_IT

Description:

- Clear the CRYP pending IT.

Parameters:

- __HANDLE__: specifies the CRYP handle.
- __IT__: specifies the IT to clear. This parameter can be one of the following values:
  - CRYP_CLEARFLAG_CCF : Computation Complete Clear Flag
  - CRYP_CLEARFLAG_RDERR : Read Error Clear
  - CRYP_CLEARFLAG_WRERR : Write Error Clear

Return value:

- None

13 HAL CRYP Extension Driver

13.1 CRYPEx Firmware driver API description

13.1.1 Extended features functions

This section provides callback functions:

- Computation completed.

This section contains the following APIs:

- ***HAL_CRYPEx_ComputationCpltCallback()***

13.1.2 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:**

14 HAL DAC Generic Driver

14.1 DAC Firmware driver registers structures

14.1.1 DAC_HandleTypeDef

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

14.1.2 DAC_ChannelConfTypeDef

Data Fields

- ***uint32_t DAC_Trigger***
- ***uint32_t DAC_OutputBuffer***

Field Documentation

- ***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***

14.2 DAC Firmware driver API description

14.2.1 DAC Peripheral features

DAC Channels

The device integrates two 12-bit Digital Analog Converters that can be used independently or simultaneously (dual mode):

1. DAC channel1 with DAC_OUT1 (PA4) as output
2. DAC channel2 with DAC_OUT2 (PA5) as output

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, TIM4, TIM6, TIM7, TIM9 (DAC_Trigger_T2_TRGO, DAC_Trigger_T4_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;

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 channel1 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 wave generation feature

Both DAC channels can be used to generate

1. Noise wave using HAL_DACEx_NoiseWaveGenerate()
2. Triangle wave using HAL_DACEx_TriangleWaveGenerate()

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 correspondance

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()

DMA1 requests are mapped as following:

1. DAC channel1 : mapped on DMA1 channel2 which must be already configured
2. DAC channel2 : mapped on DMA1 channel3 which must be already configured For Dual mode and specific signal (Triangle and noise) generation please refer to Extension Features Driver description

14.2.2 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

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
- At the middle of data transfer HAL_DACEx_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_DAC_ConvHalfCpltCallbackCh2
- At The end of data transfer HAL_DAC_ConvCpltCallbackCh1()or HAL_DAC_ConvCpltCallbackCh2() function is executed and user can add his own code by customization of function pointer HAL_DAC_ConvCpltCallbackCh1 or HAL_DAC_ConvCpltCallbackCh2
- In case of transfer Error, HAL_DAC_ErrorCallbackCh1() or HAL_DACEx_ErrorCallbackCh2() function is executed and user can add his own code by customization of function pointer HAL_DAC_ErrorCallbackCh1 or HAL_DACEx_ErrorCallbackCh2
- For STM32F100x devices with specific feature: DMA underrun. 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 add his own code by customization of function pointer HAL_DAC_ErrorCallbackCh1

- Stop the DAC peripheral using HAL_DAC_Stop_DMA()

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

You can refer to the DAC HAL driver header file for more useful macros

14.2.3 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()***

14.2.4 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_GetValue()***
- ***HAL_DAC_IRQHandler()***
- ***HAL_DAC_ConvCpltCallbackCh1()***
- ***HAL_DAC_ConvHalfCpltCallbackCh1()***
- ***HAL_DAC_ErrorCallbackCh1()***
- ***HAL_DAC_DMAUnderrunCallbackCh1()***
- ***HAL_DAC_SetValue()***
- ***HAL_DAC_ConfigChannel()***

- *HAL_DAC_GetState()*
- *HAL_DAC_GetError()*

14.2.5 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_ConfigChannel()*
- *HAL_DAC_SetValue()*

14.2.6 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()*

14.2.7 Detailed description of functions

HAL_DAC_Init

Function name	**HAL_StatusTypeDef HAL_DAC_Init (DAC_HandleTypeDef * hdac)**
Function description	Initializes the DAC peripheral according to the specified parameters in the DAC_InitStruct.
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	Deinitializes 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	Initializes 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 DeInitializes 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

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_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_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

Return values
- **HAL:** status

HAL_DAC_GetState

Function name **HAL_DAC_StateTypeDef HAL_DAC_GetState (DAC_HandleTypeDef * hdac)**

Function description return the DAC state

Parameters
- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values
- **HAL:** state

HAL_DAC_IRQHandler

Function name **void HAL_DAC_IRQHandler (DAC_HandleTypeDef * hdac)**

Function description Handles DAC interrupt request.

Parameters
- **hdac:** pointer to a DAC_HandleTypeDef structure that contains the configuration information for the specified DAC.

Return values
- **None:**

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

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:**

14.3 DAC Firmware driver defines

14.3.1 DAC

DAC Channel selection

DAC_CHANNEL_1

DAC_CHANNEL_2

DAC data alignement

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

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

__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:

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

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 IT definition

DAC_IT_DMAUDR1

DAC_IT_DMAUDR2

DAC output buffer

DAC_OUTPUTBUFFER_ENABLE

DAC_OUTPUTBUFFER_DISABLE

DAC trigger selection

DAC_TRIGGER_NONE	Conversion is automatic once the DAC1_DHRxxxx register has been loaded, and not by external trigger
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_T9_TRGO	TIM9 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_EXT_IT9	EXTI Line9 event selected as external conversion trigger for DAC channel
DAC_TRIGGER_SOFTWARE	Conversion started by software trigger for DAC channel

15 HAL DAC Extension Driver

15.1 DACEx Firmware driver API description

15.1.1 How to use this driver

- When Dual mode is enabled (i.e DAC Channel1 and Channel2 are used simultaneously) : Use HAL_DACEx_DualGetValue() to get digital data to be converted and use HAL_DACEx_DualSetValue() to set digital value to converted simultaneously in Channel 1 and Channel 2.
- Use HAL_DACEx_TriangleWaveGenerate() to generate Triangle signal.
- Use HAL_DACEx_NoiseWaveGenerate() to generate Noise signal.

15.1.2 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_DualGetValue()***
- ***HAL_DACEx_TriangleWaveGenerate()***
- ***HAL_DACEx_NoiseWaveGenerate()***
- ***HAL_DACEx_DualSetValue()***
- ***HAL_DACEx_ConvCpltCallbackCh2()***
- ***HAL_DACEx_ConvHalfCpltCallbackCh2()***
- ***HAL_DACEx_ErrorCallbackCh2()***
- ***HAL_DACEx_DMAUnderrunCallbackCh2()***

15.1.3 Detailed description of functions

HAL_DACEx_DualGetValue

Function name **uint32_t HAL_DACEx_DualGetValue (DAC_HandleTypeDef * hdac)**

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.

Return values
- **The:** selected DAC channel data output value.

HAL_DACEx_TriangleWaveGenerate

Function name **HAL_StatusTypeDef HAL_DACEx_TriangleWaveGenerate (DAC_HandleTypeDef * hdac, uint32_t Channel, uint32_t Amplitude)**

Function description: Enables or disables 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_CHANNEL_2
- **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: Enables or disables 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_CHANNEL_2
- **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 Channel2 to be loaded in the selected data holding register.
- **Data2:** Data for DAC Channel1 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_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:**

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_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:**

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:**

15.2 DACEx Firmware driver defines

15.2.1 DACEx

DACEx lfsrunmask triangleamplitude

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

IS_DAC_LFSR_UNMASK_TRIANGLE_AMPLITUDE

DACEx wave generation

DAC_WAVE_NOISE

DAC_WAVE_TRIANGLE

16 HAL DMA Generic Driver

16.1 DMA Firmware driver registers structures

16.1.1 DMA_InitTypeDef

Data Fields

- ***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::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***

16.1.2 __DMA_HandleTypeDef

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***

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

16.2 DMA Firmware driver API description

16.2.1 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.
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 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 by customization of function pointer XferCpltCallback and XferErrorCallback (i.e. a member of DMA handle structure).

DMA HAL driver macros list

Below the list of most used 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 has occurred or not.

You can refer to the DMA HAL driver header file for more useful macros

16.2.2 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()***

16.2.3 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()***

16.2.4 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()***

16.2.5 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 Stream.

Return values:
- **HAL:** status

HAL_DMA_PollForTransfer

Function name	**HAL_StatusTypeDef HAL_DMA_PollForTransfer (DMA_HandleTypeDef * hdma, uint32_t 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 Stream. • **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 Stream. • **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 hande 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

16.3 DMA Firmware driver defines

16.3.1 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	no ongoing transfer
HAL_DMA_ERROR_TIMEOUT	Timeout error
HAL_DMA_ERROR_NOT_SUPPORTED	Not supported mode

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

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_0

DMA_REQUEST_1

DMA_REQUEST_2

DMA_REQUEST_3

DMA_REQUEST_4

DMA_REQUEST_5

DMA_REQUEST_6

DMA_REQUEST_7

17 HAL FLASH Generic Driver

17.1 FLASH Firmware driver registers structures

17.1.1 FLASH_ProcessTypeDef

Data Fields

- ***__IO FLASH_ProcedureTypeDef ProcedureOnGoing***
- ***__IO uint32_t NbPagesToErase***
- ***__IO uint32_t Address***
- ***__IO uint32_t Page***
- ***HAL_LockTypeDef Lock***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***__IO FLASH_ProcedureTypeDef FLASH_ProcessTypeDef::ProcedureOnGoing***
  Internal variable to indicate which procedure is ongoing or not in IT context
- ***__IO uint32_t FLASH_ProcessTypeDef::NbPagesToErase***
  Internal variable to save the remaining sectors to erase in IT context
- ***__IO uint32_t FLASH_ProcessTypeDef::Address***
  Internal variable to save address selected for program or erase
- ***__IO uint32_t FLASH_ProcessTypeDef::Page***
  Internal variable to define the current page which is erasing
- ***HAL_LockTypeDef FLASH_ProcessTypeDef::Lock***
  FLASH locking object
- ***__IO uint32_t FLASH_ProcessTypeDef::ErrorCode***
  FLASH error code This parameter can be a value of ***FLASH_Error_Codes***

17.2 FLASH Firmware driver API description

17.2.1 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.

The FLASH main features are:

- Flash memory read operations
- Flash memory program/erase operations
- Read / write protections
- Prefetch on I-Code
- Option Bytes programming

17.2.2 How to use this driver

This driver provides functions and macros to configure and program the FLASH memory of all STM32L1xx devices.

1. FLASH Memory I/O Programming functions: this group includes all needed functions to erase and program the main memory:

- Lock and Unlock the FLASH interface
- Erase function: Erase page
- Program functions: Fast Word and Half Page(should be executed from internal SRAM).

2. DATA EEPROM Programming functions: this group includes all needed functions to erase and program the DATA EEPROM memory:
   - Lock and Unlock the DATA EEPROM interface.
   - Erase function: Erase Byte, erase HalfWord, erase Word, erase Double Word (should be executed from internal SRAM).
   - Program functions: Fast Program Byte, Fast Program Half-Word, FastProgramWord, Program Byte, Program Half-Word, Program Word and Program Double-Word (should be executed from internal SRAM).
3. FLASH Option Bytes Programming functions: this group includes all needed functions to manage the Option Bytes:
   - Lock and Unlock the Option Bytes
   - Set/Reset the write protection
   - Set the Read protection Level
   - Program the user Option Bytes
   - Launch the Option Bytes loader
   - Set/Get the Read protection Level.
   - Set/Get the BOR level.
   - Get the Write protection.
   - Get the user option bytes.
4. Interrupts and flags management functions : this group includes all needed functions to:
   - Handle FLASH interrupts
   - Wait for last FLASH operation according to its status
   - Get error flag status
5. FLASH Interface configuration functions: this group includes the management of following features:
   - Enable/Disable the RUN PowerDown mode.
   - Enable/Disable the SLEEP PowerDown mode.
6. FLASH Peripheral State methods: this group includes the management of following features:
   - Wait for the FLASH operation
   - Get the specific FLASH error flag

In addition to these function, this driver includes a set of macros allowing to handle the following operations:

- Set/Get the latency
- Enable/Disable the prefetch buffer
- Enable/Disable the 64 bit Read Access.
- Enable/Disable the Flash power-down
- Enable/Disable the FLASH interrupts
- Monitor the FLASH flags status

17.2.3 Programming operation functions

This subsection provides a set of functions allowing to manage the FLASH program operations.

The FLASH Memory Programming functions, includes the following functions:

- HAL_FLASH_Unlock(void);
- HAL_FLASH_Lock(void);

- HAL_FLASH_Program(uint32_t TypeProgram, uint32_t Address, uint32_t Data)
- HAL_FLASH_Program_IT(uint32_t TypeProgram, uint32_t Address, uint32_t Data)

Any operation of erase or program should follow these steps:

1. Call the HAL_FLASH_Unlock() function to enable the flash control register and program memory access.
2. Call the desired function to erase page or program data.
3. Call the HAL_FLASH_Lock() to disable the flash program memory access (recommended to protect the FLASH memory against possible unwanted operation).

17.2.4 Option Bytes Programming functions

The FLASH_Option Bytes Programming_functions, includes the following functions:

- HAL_FLASH_OB_Unlock(void);
- HAL_FLASH_OB_Lock(void);
- HAL_FLASH_OB_Launch(void);
- HAL_FLASHEx_OBProgram(FLASH_OBProgramInitTypeDef *pOBInit);
- HAL_FLASHEx_OBGetConfig(FLASH_OBProgramInitTypeDef *pOBInit);

Any operation of erase or program should follow these steps:

1. Call the HAL_FLASH_OB_Unlock() function to enable the Flash option control register access.
2. Call the following functions to program the desired option bytes.
   – HAL_FLASHEx_OBProgram(FLASH_OBProgramInitTypeDef *pOBInit);
3. Once all needed option bytes to be programmed are correctly written, call the HAL_FLASH_OB_Launch(void) function to launch the Option Bytes programming process.
4. Call the HAL_FLASH_OB_Lock() to disable the Flash option control register access (recommended to protect the option Bytes against possible unwanted operations).

Proprietary code Read Out Protection (PcROP):

1. The PcROP sector is selected by using the same option bytes as the Write protection. As a result, these 2 options are exclusive each other.
2. To activate PCROP mode for Flash sectors(s), you need to follow the sequence below:
   – Use this function HAL_FLASHEx_AdvOBProgram with PCROPState = OB_PCROP_STATE_ENABLE.

17.2.5 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()***

17.2.6 Peripheral Errors functions

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

This section contains the following APIs:

- ***HAL_FLASH_GetError()***

17.2.7 Detailed description of functions

HAL_FLASH_Program

Function name **HAL_StatusTypeDef HAL_FLASH_Program (uint32_t TypeProgram, uint32_t Address, uint32_t Data)**

Function description Program word at a specified address.

Parameters
- **TypeProgram:** Indicate the way to program at a specified address. This parameter can be a value of FLASH Type Program
- **Address:** Specifie the address to be programmed.
- **Data:** Specifie the data to be programmed

Return values
- **HAL_StatusTypeDef:** HAL Status

Notes
- To correctly run this function, the HAL_FLASH_Unlock() function must be called before. Call the HAL_FLASH_Lock() to disable the flash memory access (recommended to protect the FLASH memory against possible unwanted operation).

HAL_FLASH_Program_IT

Function name **HAL_StatusTypeDef HAL_FLASH_Program_IT (uint32_t TypeProgram, uint32_t Address, uint32_t Data)**

Function description Program word 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 Type Program
- **Address:** Specifie the address to be programmed.
- **Data:** Specifie the data to be programmed

Return values
- **HAL_StatusTypeDef:** HAL Status

HAL_FLASH_IRQHandler

Function name **void HAL_FLASH_IRQHandler (void)**

Function description This function handles 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
  - Pages Erase: Address of the 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
  – Pages Erase: Address of the page 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 Locks 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 Control 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 Control 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

Notes
- This function will reset automatically the MCU.

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: FLASH Error Codes

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:** Status

17.3 FLASH Firmware driver defines

17.3.1 FLASH

FLASH Error Codes

HAL_FLASH_ERROR_NONE	No error
HAL_FLASH_ERROR_PGA	Programming alignment error
HAL_FLASH_ERROR_WRP	Write protection error
HAL_FLASH_ERROR_OPTV	Option validity error
HAL_FLASH_ERROR_SIZE	
HAL_FLASH_ERROR_RD	Read protected error
HAL_FLASH_ERROR_OPTVUSR	Option UserValidity Error.
HAL_FLASH_ERROR_OPERATION	Not used

FLASH Flags

FLASH_FLAG_BSY	FLASH Busy flag
FLASH_FLAG_EOP	FLASH End of Programming flag
FLASH_FLAG_ENDHV	FLASH End of High Voltage flag
FLASH_FLAG_READY	FLASH Ready flag after low power mode
FLASH_FLAG_WRPERR	FLASH Write protected error flag
FLASH_FLAG_PGAERR	FLASH Programming Alignment error flag
FLASH_FLAG_SIZERR	FLASH Size error flag
FLASH_FLAG_OPTVERR	FLASH Option Validity error flag
FLASH_FLAG_OPTVERRUSR	FLASH Option User Validity error flag

FLASH Interrupts

__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_ERR Error 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_ERR Error Interrupt

Return value:

- none

__HAL_FLASH_GET_FLAG

Description:

- Get the specified FLASH flag status.

Parameters:

- __FLAG__: specifies the FLASH flag to check. This parameter can be one of the following values:
  - FLASH_FLAG_BSY FLASH Busy flag
  - FLASH_FLAG_EOP FLASH End of Operation flag
  - FLASH_FLAG_ENDHV FLASH End of High Voltage flag
  - FLASH_FLAG_READY FLASH Ready flag after low power mode
  - FLASH_FLAG_PGAERR FLASH Programming Alignment error flag
  - FLASH_FLAG_SIZERR FLASH Size error flag
  - FLASH_FLAG_OPTVERR FLASH Option validity error error flag
  - FLASH_FLAG_OPTVERRUSR FLASH Option User validity error
  - FLASH_FLAG_WRPERR FLASH Write protected error flag

Return value:

- The: new state of __FLAG__ (SET or RESET).

__HAL_FLASH_CLEAR_FLAG

Description:

- Clear the specified FLASH flag.

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_PGAERR FLASH Programming Alignment error flag
  - FLASH_FLAG_SIZERR FLASH Size error flag
  - FLASH_FLAG_OPTVERR FLASH Option validity error error flag
  - FLASH_FLAG_OPTVERRUSR FLASH Option User validity error
  - FLASH_FLAG_WRPERR FLASH Write protected error flag

Return value:

- none

FLASH Interrupts

FLASH_IT_EOP	End of programming interrupt source
FLASH_IT_ERR	Error interrupt source

FLASH Keys

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_PEKEY1	Flash program erase key1
FLASH_PEKEY2	Flash program erase key: used with FLASH_PEKEY2 to unlock the write access to the FLASH_PECR register and data EEPROM
FLASH_PRGKEY1	Flash program memory key1
FLASH_PRGKEY2	Flash program memory key2: used with FLASH_PRGKEY2 to unlock the program memory
FLASH_OPTKEY1	Flash option key1
FLASH_OPTKEY2	Flash option key2: used with FLASH_OPTKEY1 to unlock the write access to the option byte block

FLASH Latency

FLASH_LATENCY_0	FLASH Zero Latency cycle
FLASH_LATENCY_1	FLASH One Latency cycle

FLASH size information

FLASH_SIZE	
FLASH_PAGE_SIZE	FLASH Page Size in bytes

FLASH Type Program

FLASH_TYPEPROGRAM_WORD	Program a word (32-bit) at a specified address.

18 HAL FLASH Extension Driver

18.1 FLASHEx Firmware driver registers structures

18.1.1 FLASH_EraseInitTypeDef

Data Fields

- ***uint32_t TypeErase***
- ***uint32_t PageAddress***
- ***uint32_t NbPages***

Field Documentation

- ***uint32_t FLASH_EraseInitTypeDef::TypeErase***
  TypeErase: Page Erase only. This parameter can be a value of ***FLASHEx_Type_Erase***
- ***uint32_t FLASH_EraseInitTypeDef::PageAddress***
  PageAddress: Initial FLASH address to be erased This parameter must be a value belonging to FLASH Programm address (depending on the devices)
- ***uint32_t FLASH_EraseInitTypeDef::NbPages***
  NbPages: Number of pages to be erased. This parameter must be a value between 1 and (max number of pages - value of Initial page)

18.1.2 FLASH_OBProgramInitTypeDef

Data Fields

- ***uint32_t OptionType***
- ***uint32_t WRPState***
- ***uint32_t WRPSector0To31***
- ***uint32_t WRPSector32To63***
- ***uint32_t WRPSector64To95***
- ***uint8_t RDPLevel***
- ***uint8_t BORLevel***
- ***uint8_t USERConfig***

Field Documentation

- ***uint32_t FLASH_OBProgramInitTypeDef::OptionType***
  OptionType: Option byte to be configured. This parameter can be a value of ***FLASHEx_Option_Type***
- ***uint32_t FLASH_OBProgramInitTypeDef::WRPState***
  WRPState: Write protection activation or deactivation. This parameter can be a value of ***FLASHEx_WRP_State***
- ***uint32_t FLASH_OBProgramInitTypeDef::WRPSector0To31***
  WRPSector0To31: specifies the sector(s) which are write protected between Sector 0 to 31 This parameter can be a combination of ***FLASHEx_Option_Bytes_Write_Protection1***
- ***uint32_t FLASH_OBProgramInitTypeDef::WRPSector32To63***
  WRPSector32To63: specifies the sector(s) which are write protected between Sector 32 to 63 This parameter can be a combination of ***FLASHEx_Option_Bytes_Write_Protection2***
- ***uint32_t FLASH_OBProgramInitTypeDef::WRPSector64To95***
  WRPSector64to95: specifies the sector(s) which are write protected between Sector

64 to 95 This parameter can be a combination of ***FLASHEx_Option_Bytes_Write_Protection3***

- ***uint8_t FLASH_OBProgramInitTypeDef::RDPLevel***
  RDPLevel: Set the read protection level. This parameter can be a value of ***FLASHEx_Option_Bytes_Read_Protection***
- ***uint8_t FLASH_OBProgramInitTypeDef::BORLevel***
  BORLevel: Set the BOR Level. This parameter can be a value of ***FLASHEx_Option_Bytes_BOR_Level***
- ***uint8_t FLASH_OBProgramInitTypeDef::USERConfig***
  USERConfig: Program the FLASH User Option Byte: IWDG_SW / RST_STOP / RST_STDBY. This parameter can be a combination of ***FLASHEx_Option_Bytes_IWatchdog***, ***FLASHEx_Option_Bytes_nRST_STOP*** and ***FLASHEx_Option_Bytes_nRST_STDBY***

18.1.3 FLASH_AdvOBProgramInitTypeDef

Data Fields

- ***uint32_t OptionType***
- ***uint16_t BootConfig***

Field Documentation

- ***uint32_t FLASH_AdvOBProgramInitTypeDef::OptionType***
  OptionType: Option byte to be configured for extension . This parameter can be a value of ***FLASHEx_OptionAdv_Type***
- ***uint16_t FLASH_AdvOBProgramInitTypeDef::BootConfig***
  BootConfig: specifies Option bytes for boot config This parameter can be a value of ***FLASHEx_Option_Bytes_BOOT***

18.2 FLASHEx Firmware driver API description

18.2.1 FLASH Erasing Programming functions

The FLASH Memory Erasing functions, includes the following functions:

- @ref HAL_FLASHEx_Erase: return only when erase has been done
- @ref HAL_FLASHEx_Erase_IT: end of erase is done when @ref HAL_FLASH_EndOfOperationCallback is called with parameter 0xFFFFFFFF

Any operation of erase should follow these steps:

1. Call the @ref HAL_FLASH_Unlock() function to enable the flash control register and program memory access.
2. Call the desired function to erase page.
3. Call the @ref HAL_FLASH_Lock() to disable the flash program memory access (recommended to protect the FLASH memory against possible unwanted operation).

This section contains the following APIs:

- ***HAL_FLASHEx_Erase()***
- ***HAL_FLASHEx_Erase_IT()***

18.2.2 Option Bytes Programming functions

Any operation of erase or program should follow these steps:

1. Call the @ref HAL_FLASH_OB_Unlock() function to enable the Flash option control register access.
2. Call following function to program the desired option bytes.

- @ref HAL_FLASHEx_OBProgram: - To Enable/Disable the desired sector write protection. - To set the desired read Protection Level. - To configure the user option Bytes: IWDG, STOP and the Standby. - To Set the BOR level.

3. Once all needed option bytes to be programmed are correctly written, call the @ref HAL_FLASH_OB_Launch(void) function to launch the Option Bytes programming process.
4. Call the @ref HAL_FLASH_OB_Lock() to disable the Flash option control register access (recommended to protect the option Bytes against possible unwanted operations).

Proprietary code Read Out Protection (PcROP):

1. The PcROP sector is selected by using the same option bytes as the Write protection (nWRPi bits). As a result, these 2 options are exclusive each other.
2. In order to activate the PcROP (change the function of the nWRPi option bits), the SPRMOD option bit must be activated.
3. The active value of nWRPi bits is inverted when PCROP mode is active, this means: if SPRMOD = 1 and nWRPi = 1 (default value), then the user sector "i" is read/write protected.
4. To activate PCROP mode for Flash sector(s), you need to call the following function:
   - @ref HAL_FLASHEx_AdvOBProgram in selecting sectors to be read/write protected
   - @ref HAL_FLASHEx_OB_SelectPCROP to enable the read/write protection
5. PcROP is available only in STM32L151xBA, STM32L152xBA, STM32L151xC, STM32L152xC & STM32L162xC devices.

This section contains the following APIs:

- ***HAL_FLASHEx_OBProgram()***
- ***HAL_FLASHEx_OBGetConfig()***
- ***HAL_FLASHEx_AdvOBProgram()***
- ***HAL_FLASHEx_AdvOBGetConfig()***

18.2.3 DATA EEPROM Programming functions

Any operation of erase or program should follow these steps:

1. Call the @ref HAL_FLASHEx_DATAEEPROM_Unlock() function to enable the data EEPROM access and Flash program erase control register access.
2. Call the desired function to erase or program data.
3. Call the @ref HAL_FLASHEx_DATAEEPROM_Lock() to disable the data EEPROM access and Flash program erase control register access(recommended to protect the DATA_EEPROM against possible unwanted operation).

This section contains the following APIs:

- ***HAL_FLASHEx_DATAEEPROM_Unlock()***
- ***HAL_FLASHEx_DATAEEPROM_Lock()***
- ***HAL_FLASHEx_DATAEEPROM_Erase()***
- ***HAL_FLASHEx_DATAEEPROM_Program()***
- ***HAL_FLASHEx_DATAEEPROM_EnableFixedTimeProgram()***
- ***HAL_FLASHEx_DATAEEPROM_DisableFixedTimeProgram()***

18.2.4 Detailed description of functions

HAL_FLASHEx_Erase

Function name **HAL_StatusTypeDef HAL_FLASHEx_Erase**

(FLASH_EraseInitTypeDef * pEraseInit, uint32_t * PageError)

Function description: 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_StatusTypeDef:** HAL Status

Notes:
- To correctly run this function, the HAL_FLASH_Unlock() function must be called before. Call the HAL_FLASH_Lock() to disable the flash memory access (recommended to protect the FLASH memory against possible unwanted operation)
- For STM32L151xDX/STM32L152xDX/STM32L162xDX, as memory is not continuous between 2 banks, user should perform pages erase by bank only.

HAL_FLASHEx_Erase_IT

Function name: **HAL_StatusTypeDef HAL_FLASHEx_Erase_IT (FLASH_EraseInitTypeDef * pEraseInit)**

Function description: Perform a page erase of 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_StatusTypeDef:** HAL Status

Notes:
- To correctly run this function, the HAL_FLASH_Unlock() function must be called before. Call the HAL_FLASH_Lock() to disable the flash memory access (recommended to protect the FLASH memory against possible unwanted operation) End of erase is done when HAL_FLASH_EndOfOperationCallback is called with parameter 0xFFFFFFFF
- For STM32L151xDX/STM32L152xDX/STM32L162xDX, as memory is not continuous between 2 banks, user should perform pages erase by bank only.

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_StatusTypeDef:** HAL Status

HAL_FLASHEx_OBGetConfig

Function name: **void HAL_FLASHEx_OBGetConfig**

(FLASH_OBProgramInitTypeDef * pOBInit)

Function description: Get the Option byte configuration.

Parameters:
- **pOBInit:** pointer to an FLASH_OBInitStruct structure that contains the configuration information for the programming.

Return values:
- **None:**

HAL_FLASHEx_AdvOBProgram

Function name: **HAL_StatusTypeDef HAL_FLASHEx_AdvOBProgram (FLASH_AdvOBProgramInitTypeDef * pAdvOBInit)**

Function description: Program option bytes.

Parameters:
- **pAdvOBInit:** pointer to an FLASH_AdvOBProgramInitTypeDef structure that contains the configuration information for the programming.

Return values:
- **HAL_StatusTypeDef:** HAL Status

Notes:
- This function can be used only for Cat2 & Cat3 devices for PCROP and Cat4 & Cat5 for BFB2.

HAL_FLASHEx_AdvOBGetConfig

Function name: **void HAL_FLASHEx_AdvOBGetConfig (FLASH_AdvOBProgramInitTypeDef * pAdvOBInit)**

Function description: Get the OBEX byte configuration.

Parameters:
- **pAdvOBInit:** pointer to an FLASH_AdvOBProgramInitTypeDef structure that contains the configuration information for the programming.

Return values:
- **None:**

Notes:
- This function can be used only for Cat2 & Cat3 devices for PCROP and Cat4 & Cat5 for BFB2.

HAL_FLASHEx_DATAEEPROM_Unlock

Function name: **HAL_StatusTypeDef HAL_FLASHEx_DATAEEPROM_Unlock (void)**

Function description: Unlocks the data memory and FLASH_PECR register access.

Return values:
- **HAL_StatusTypeDef:** HAL Status

HAL_FLASHEx_DATAEEPROM_Lock

Function name: **HAL_StatusTypeDef HAL_FLASHEx_DATAEEPROM_Lock (void)**

Function description: Locks the Data memory and FLASH_PECR register access.

Return values:
- **HAL_StatusTypeDef:** HAL Status

HAL_FLASHEx_DATAEEPROM_Erase

Function name	**HAL_StatusTypeDef HAL_FLASHEx_DATAEEPROM_Erase (uint32_t TypeErase, uint32_t Address)**
Function description	Erase a word in data memory.
Parameters	• **Address:** specifies the address to be erased. • **TypeErase:** Indicate the way to erase at a specified address. This parameter can be a value of FLASH Type Program
Return values	• **HAL_StatusTypeDef:** HAL Status
Notes	• To correctly run this function, the HAL_FLASHEx_DATAEEPROM_Unlock() function must be called before. Call the HAL_FLASHEx_DATAEEPROM_Lock() to the data EEPROM access and Flash program erase control register access(recommended to protect the DATA_EEPROM against possible unwanted operation).

HAL_FLASHEx_DATAEEPROM_Program

Function name	**HAL_StatusTypeDef HAL_FLASHEx_DATAEEPROM_Program (uint32_t TypeProgram, uint32_t Address, uint32_t Data)**
Function description	Program word at a specified address.
Parameters	• **TypeProgram:** Indicate the way to program at a specified address. This parameter can be a value of FLASHEx Type Program Data • **Address:** specifie the address to be programmed. • **Data:** specifie the data to be programmed
Return values	• **HAL_StatusTypeDef:** HAL Status
Notes	• To correctly run this function, the HAL_FLASHEx_DATAEEPROM_Unlock() function must be called before. Call the HAL_FLASHEx_DATAEEPROM_Unlock() to he data EEPROM access and Flash program erase control register access(recommended to protect the DATA_EEPROM against possible unwanted operation). • The function HAL_FLASHEx_DATAEEPROM_EnableFixedTimeProgram() can be called before this function to configure the Fixed Time Programming.

HAL_FLASHEx_DATAEEPROM_EnableFixedTimeProgram

Function name	**void HAL_FLASHEx_DATAEEPROM_EnableFixedTimeProgram (void)**
Function description	Enable DATA EEPROM fixed Time programming (2*Tprog).
Return values	• **None:**

HAL_FLASHEx_DATAEEPROM_DisableFixedTimeProgram

Function name	**void HAL_FLASHEx_DATAEEPROM_DisableFixedTimeProgram (void)**
Function description	Disables DATA EEPROM fixed Time programming (2*Tprog).
Return values	• **None:**

18.3 FLASHEx Firmware driver defines

18.3.1 FLASHEx

FLASHEx Address

IS_FLASH_DATA_ADDRESS

IS_FLASH_PROGRAM_ADDRESS

IS_FLASH_PROGRAM_BANK1_ADDRESS

IS_FLASH_PROGRAM_BANK2_ADDRESS

IS_NBPAGES

FLASHEx 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 Latency cycle
  - FLASH_LATENCY_1 FLASH One Latency cycle

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 Latency cycle
  - FLASH_LATENCY_1 FLASH One Latency cycle

__HAL_FLASH_ACC64_ENABLE

Description:

- Enable the FLASH 64-bit access.

Return value:

- none

Notes:

- Read access 64 bit is used. This bit cannot be written at the same time as the LATENCY and PRFTEN bits.

__HAL_FLASH_ACC64_DISABLE

Description:

- Disable the FLASH 64-bit access.

Return value:

- none

Notes:

- Read access 32 bit is used To reset this bit, the LATENCY should be zero wait state and the prefetch off.

__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_SLEEP_POWERDOWN_ENABLE

Description:

- Enable the FLASH power down during Sleep mode.

Return value:

- none

__HAL_FLASH_SLEEP_POWERDOWN_DISABLE

Description:

- Disable the FLASH power down during Sleep mode.

Return value:

- none

__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.

FLASHEx Option Advanced Type

OPTIONBYTE_BOOTCONFIG BOOTConfig option byte configuration

FLASHEx Option Bytes BOOT

OB_BOOT_BANK2 At startup, if boot pins are set in boot from user Flash position and this parameter is selected the device will boot from Bank 2 or Bank 1, depending on the activation of the bank

OB_BOOT_BANK1 At startup, if boot pins are set in boot from user Flash position and this parameter is selected the device will boot from Bank1(Default)

FLASHEx Option Bytes BOR Level

OB_BOR_OFF BOR is disabled at power down, the reset is asserted when the VDD power supply reaches the PDR(Power Down Reset) threshold (1.5V)

OB_BOR_LEVEL1 BOR Reset threshold levels for 1.7V - 1.8V VDD power supply

OB_BOR_LEVEL2 BOR Reset threshold levels for 1.9V - 2.0V VDD power supply

OB_BOR_LEVEL3 BOR Reset threshold levels for 2.3V - 2.4V VDD power supply

OB_BOR_LEVEL4 BOR Reset threshold levels for 2.55V - 2.65V VDD power supply

OB_BOR_LEVEL5 BOR Reset threshold levels for 2.8V - 2.9V VDD power supply

FLASHEx Option Bytes IWatchdog

OB_IWDG_SW Software WDG selected

OB_IWDG_HW Hardware WDG selected

FLASHEx Option Bytes nRST_STDBY

OB_STDBY_NORST No reset generated when entering in STANDBY

OB_STDBY_RST Reset generated when entering in STANDBY

FLASHEx Option Bytes nRST_STOP

OB_STOP_NORST No reset generated when entering in STOP

OB_STOP_RST Reset generated when entering in STOP

FLASHEx Option Bytes Read Protection

OB_RDP_LEVEL_0

OB_RDP_LEVEL_1

OB_RDP_LEVEL_2

FLASHEx Option Bytes Write Protection1

OB_WRP1_PAGES0TO15
OB_WRP1_PAGES16TO31
OB_WRP1_PAGES32TO47
OB_WRP1_PAGES48TO63
OB_WRP1_PAGES64TO79
OB_WRP1_PAGES80TO95
OB_WRP1_PAGES96TO111
OB_WRP1_PAGES112TO127
OB_WRP1_PAGES128TO143
OB_WRP1_PAGES144TO159
OB_WRP1_PAGES160TO175
OB_WRP1_PAGES176TO191
OB_WRP1_PAGES192TO207
OB_WRP1_PAGES208TO223
OB_WRP1_PAGES224TO239
OB_WRP1_PAGES240TO255
OB_WRP1_PAGES256TO271
OB_WRP1_PAGES272TO287
OB_WRP1_PAGES288TO303
OB_WRP1_PAGES304TO319
OB_WRP1_PAGES320TO335
OB_WRP1_PAGES336TO351
OB_WRP1_PAGES352TO367
OB_WRP1_PAGES368TO383
OB_WRP1_PAGES384TO399
OB_WRP1_PAGES400TO415
OB_WRP1_PAGES416TO431
OB_WRP1_PAGES432TO447
OB_WRP1_PAGES448TO463
OB_WRP1_PAGES464TO479
OB_WRP1_PAGES480TO495
OB_WRP1_PAGES496TO511
OB_WRP1_ALLPAGES Write protection of all Sectors

FLASHEx Option Bytes Write Protection2

OB_WRP2_PAGES512TO527
OB_WRP2_PAGES528TO543

OB_WRP2_PAGES544TO559
OB_WRP2_PAGES560TO575
OB_WRP2_PAGES576TO591
OB_WRP2_PAGES592TO607
OB_WRP2_PAGES608TO623
OB_WRP2_PAGES624TO639
OB_WRP2_PAGES640TO655
OB_WRP2_PAGES656TO671
OB_WRP2_PAGES672TO687
OB_WRP2_PAGES688TO703
OB_WRP2_PAGES704TO719
OB_WRP2_PAGES720TO735
OB_WRP2_PAGES736TO751
OB_WRP2_PAGES752TO767
OB_WRP2_PAGES768TO783
OB_WRP2_PAGES784TO799
OB_WRP2_PAGES800TO815
OB_WRP2_PAGES816TO831
OB_WRP2_PAGES832TO847
OB_WRP2_PAGES848TO863
OB_WRP2_PAGES864TO879
OB_WRP2_PAGES880TO895
OB_WRP2_PAGES896TO911
OB_WRP2_PAGES912TO927
OB_WRP2_PAGES928TO943
OB_WRP2_PAGES944TO959
OB_WRP2_PAGES960TO975
OB_WRP2_PAGES976TO991
OB_WRP2_PAGES992TO1007
OB_WRP2_PAGES1008TO1023
OB_WRP2_ALLPAGES Write protection of all Sectors

FLASHEx Option Bytes Write Protection3

OB_WRP3_PAGES1024TO1039
OB_WRP3_PAGES1040TO1055
OB_WRP3_PAGES1056TO1071
OB_WRP3_PAGES1072TO1087

OB_WRP3_PAGES1088TO1103
OB_WRP3_PAGES1104TO1119
OB_WRP3_PAGES1120TO1135
OB_WRP3_PAGES1136TO1151
OB_WRP3_PAGES1152TO1167
OB_WRP3_PAGES1168TO1183
OB_WRP3_PAGES1184TO1199
OB_WRP3_PAGES1200TO1215
OB_WRP3_PAGES1216TO1231
OB_WRP3_PAGES1232TO1247
OB_WRP3_PAGES1248TO1263
OB_WRP3_PAGES1264TO1279
OB_WRP3_PAGES1280TO1295
OB_WRP3_PAGES1296TO1311
OB_WRP3_PAGES1312TO1327
OB_WRP3_PAGES1328TO1343
OB_WRP3_PAGES1344TO1359
OB_WRP3_PAGES1360TO1375
OB_WRP3_PAGES1376TO1391
OB_WRP3_PAGES1392TO1407
OB_WRP3_PAGES1408TO1423
OB_WRP3_PAGES1424TO1439
OB_WRP3_PAGES1440TO1455
OB_WRP3_PAGES1456TO1471
OB_WRP3_PAGES1472TO1487
OB_WRP3_PAGES1488TO1503
OB_WRP3_PAGES1504TO1519
OB_WRP3_PAGES1520TO1535
OB_WRP3_ALLPAGES Write protection of all Sectors

FLASHEx Option Type

OPTIONBYTE_WRP WRP option byte configuration
OPTIONBYTE_RDP RDP option byte configuration
OPTIONBYTE_USER USER option byte configuration
OPTIONBYTE_BOR BOR option byte configuration

FLASHEx_Type_Erase

FLASH_TYPEERASE_PAGES Page erase only

FLASHEx Type Erase Data

FLASH_TYPEERASEDATA_BYTE	Erase byte (8-bit) at a specified address.
FLASH_TYPEERASEDATA_HALFWORD	Erase a half-word (16-bit) at a specified address.
FLASH_TYPEERASEDATA_WORD	Erase a word (32-bit) at a specified address.

FLASHEx Type Program Data

FLASH_TYPEPROGRAMDATA_BYTE	Program byte (8-bit) at a specified address.
FLASH_TYPEPROGRAMDATA_HALFWORD	Program a half-word (16-bit) at a specified address.
FLASH_TYPEPROGRAMDATA_WORD	Program a word (32-bit) at a specified address.
FLASH_TYPEPROGRAMDATA_FASTBYTE	Fast Program byte (8-bit) at a specified address.
FLASH_TYPEPROGRAMDATA_FASTHALFWORD	Fast Program a half-word (16-bit) at a specified address.
FLASH_TYPEPROGRAMDATA_FASTWORD	Fast Program a word (32-bit) at a specified address.

FLASHEx WRP State

OB_WRPSTATE_DISABLE	Disable the write protection of the desired sectors
OB_WRPSTATE_ENABLE	Enable the write protection of the desired sectors

19 HAL FLASH__RAMFUNC Generic Driver

19.1 FLASH__RAMFUNC Firmware driver API description

19.1.1 Peripheral errors functions

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

This section contains the following APIs:

- ***HAL_FLASHEx_GetError()***

19.1.2 Detailed description of functions

HAL_FLASHEx_EnableRunPowerDown

Function name	**__RAM_FUNC HAL_FLASHEx_EnableRunPowerDown (void)**
Function description	Enable the power down mode during RUN mode.
Return values	• **HAL:** status
Notes	• This function can be used only when the user code is running from Internal SRAM.

HAL_FLASHEx_DisableRunPowerDown

Function name	**__RAM_FUNC HAL_FLASHEx_DisableRunPowerDown (void)**
Function description	Disable the power down mode during RUN mode.
Return values	• **HAL:** status
Notes	• This function can be used only when the user code is running from Internal SRAM.

HAL_FLASHEx_EraseParallelPage

Function name	**__RAM_FUNC HAL_FLASHEx_EraseParallelPage (uint32_t Page_Address1, uint32_t Page_Address2)**
Function description	Erases a specified 2 pages in program memory in parallel.
Parameters	• **Page_Address1:** The page address in program memory to be erased in the first Bank (BANK1). This parameter should be between FLASH_BASE and FLASH_BANK1_END. • **Page_Address2:** The page address in program memory to be erased in the second Bank (BANK2). This parameter should be between FLASH_BANK2_BASE and FLASH_BANK2_END.
Return values	• **HAL:** status
Notes	• This function can be used only for STM32L151xD, STM32L152xD), STM32L162xD and Cat5 devices. To correctly run this function, the HAL_FLASH_Unlock() function must be called before. Call the HAL_FLASH_Lock() to disable the flash memory access (recommended to protect the

FLASH memory against possible unwanted operation).
- A Page is erased in the Program memory only if the address to load is the start address of a page (multiple of FLASH_PAGE_SIZE bytes).

HAL_FLASHEx_ProgramParallelHalfPage

Function name
__RAM_FUNC HAL_FLASHEx_ProgramParallelHalfPage (uint32_t Address1, uint32_t * pBuffer1, uint32_t Address2, uint32_t * pBuffer2)

Function description
Program 2 half pages in program memory in parallel (half page size is 32 Words).

Parameters
- **Address1:** specifies the first address to be written in the first bank (BANK1). This parameter should be between FLASH_BASE and (FLASH_BANK1_END - FLASH_PAGE_SIZE).
- **pBuffer1:** pointer to the buffer containing the data to be written to the first half page in the first bank.
- **Address2:** specifies the second address to be written in the second bank (BANK2). This parameter should be between FLASH_BANK2_BASE and (FLASH_BANK2_END - FLASH_PAGE_SIZE).
- **pBuffer2:** pointer to the buffer containing the data to be written to the second half page in the second bank.

Return values
- **HAL:** status

Notes
- This function can be used only for STM32L151xD, STM32L152xD), STM32L162xD and Cat5 devices.
- To correctly run this function, the HAL_FLASH_Unlock() function must be called before. Call the HAL_FLASH_Lock() to disable the flash memory access (recommended to protect the FLASH memory against possible unwanted operation).
- Half page write is possible only from SRAM.
- If there are more than 32 words to write, after 32 words another Half Page programming operation starts and has to be finished.
- A half page is written to the program memory only if the first address to load is the start address of a half page (multiple of 128 bytes) and the 31 remaining words to load are in the same half page.
- During the Program memory half page write all read operations are forbidden (this includes DMA read operations and debugger read operations such as breakpoints, periodic updates, etc.).
- If a PGAERR is set during a Program memory half page write, the complete write operation is aborted. Software should then reset the FPRG and PROG/DATA bits and restart the write operation from the beginning.

HAL_FLASHEx_HalfPageProgram

Function name
__RAM_FUNC HAL_FLASHEx_HalfPageProgram (uint32_t Address, uint32_t * pBuffer)

Function description: Program a half page in program memory.

Parameters:
- **Address:** specifies the address to be written.
- **pBuffer:** pointer to the buffer containing the data to be written to the half page.

Return values:
- **HAL:** status

Notes:
- To correctly run this function, the HAL_FLASH_Unlock() function must be called before. Call the HAL_FLASH_Lock() to disable the flash memory access (recommended to protect the FLASH memory against possible unwanted operation)
- Half page write is possible only from SRAM.
- If there are more than 32 words to write, after 32 words another Half Page programming operation starts and has to be finished.
- A half page is written to the program memory only if the first address to load is the start address of a half page (multiple of 128 bytes) and the 31 remaining words to load are in the same half page.
- During the Program memory half page write all read operations are forbidden (this includes DMA read operations and debugger read operations such as breakpoints, periodic updates, etc.).
- If a PGAERR is set during a Program memory half page write, the complete write operation is aborted. Software should then reset the FPRG and PROG/DATA bits and restart the write operation from the beginning.

HAL_FLASHEx_GetError

Function name: **__RAM_FUNC HAL_FLASHEx_GetError (uint32_t * Error)**

Function description: Get the specific FLASH errors flag.

Parameters:
- **Error:** pointer is the error value. It can be a mixed of:
  - HAL_FLASH_ERROR_OPTVUSR FLASH Option User validity error
  - HAL_FLASH_ERROR_PGA FLASH Programming Alignment error flag
  - HAL_FLASH_ERROR_WRP FLASH Write protected error flag
  - HAL_FLASH_ERROR_OPTV FLASH Option valid error flag

Return values:
- **HAL:** Status

HAL_FLASHEx_DATAEEPROM_EraseDoubleWord

Function name: **__RAM_FUNC HAL_FLASHEx_DATAEEPROM_EraseDoubleWord (uint32_t Address)**

Function description: Erase a double word in data memory.

Parameters:
- **Address:** specifies the address to be erased.

Return values:
- **HAL:** status

Notes
- To correctly run this function, the HAL_FLASH_EEPROM_Unlock() function must be called before. Call the HAL_FLASH_EEPROM_Lock() to he data EEPROM access and Flash program erase control register access(recommended to protect the DATA_EEPROM against possible unwanted operation).
- Data memory double word erase is possible only from SRAM.
- A double word is erased to the data memory only if the first address to load is the start address of a double word (multiple of 8 bytes).
- During the Data memory double word erase, all read operations are forbidden (this includes DMA read operations and debugger read operations such as breakpoints, periodic updates, etc.).

HAL_FLASHEx_DATAEEPROM_ProgramDoubleWord

Function name
__RAM_FUNC HAL_FLASHEx_DATAEEPROM_ProgramDoubleWord (uint32_t Address, uint64_t Data)

Function description
Write a double word in data memory without erase.

Parameters
- **Address:** specifies the address to be written.
- **Data:** specifies the data to be written.

Return values
- **HAL:** status

Notes
- To correctly run this function, the HAL_FLASH_EEPROM_Unlock() function must be called before. Call the HAL_FLASH_EEPROM_Lock() to he data EEPROM access and Flash program erase control register access(recommended to protect the DATA_EEPROM against possible unwanted operation).
- Data memory double word write is possible only from SRAM.
- A data memory double word is written to the data memory only if the first address to load is the start address of a double word (multiple of double word).
- During the Data memory double word write, all read operations are forbidden (this includes DMA read operations and debugger read operations such as breakpoints, periodic updates, etc.).

20 HAL GPIO Generic Driver

20.1 GPIO Firmware driver registers structures

20.1.1 GPIO_InitTypeDef

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***

20.2 GPIO Firmware driver API description

20.2.1 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 s 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 28 edge detectors (depending on products 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.

20.2.2 How to use this driver

1. Enable the GPIO AHB clock using the following function : __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, the speed is configurable: Low, Medium and High.
   - If alternate mode is selected, 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. HAL_GPIO_DeInit allows to set register values to their reset value. It's also recommended to use it to unconfigure pin which was used as an external interrupt or in event mode. That's the only way to reset corresponding bit in EXTI & SYSCFG registers.
5. To get the level of a pin configured in input mode use HAL_GPIO_ReadPin().
6. To set/reset the level of a pin configured in output mode use HAL_GPIO_WritePin()/HAL_GPIO_TogglePin().
7. To lock pin configuration until next reset use HAL_GPIO_LockPin().
8. During and just after reset, the alternate functions are not active and the GPIO pins are configured in input floating mode (except JTAG pins).
9. 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.
10. 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.

20.2.3 Initialization and Configuration functions

This section contains the following APIs:

- ***HAL_GPIO_Init()***
- ***HAL_GPIO_DeInit()***

20.2.4 Detailed description of functions

HAL_GPIO_Init

Function name **void HAL_GPIO_Init (GPIO_TypeDef * GPIOx, GPIO_InitTypeDef * GPIO_Init)**

Function description Initializes the GPIOx peripheral according to the specified parameters in the GPIO_Init.

Parameters
- **GPIOx:** where x can be (A..G depending on device used) to select the GPIO peripheral for STM32L1XX family devices
- **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-initializes the GPIOx peripheral registers to their default reset values.

Parameters
- **GPIOx:** where x can be (A..G depending on device used) to select the GPIO peripheral for STM32L1XX family devices
- **GPIO_Pin:** specifies the port bit to be written. This parameter can be one 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 Reads the specified input port pin.

Parameters
- **GPIOx:** where x can be (A..G depending on device used) to select the GPIO peripheral for STM32L1XX family devices
- **GPIO_Pin:** specifies the port bit to read. This parameter can be 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 Sets or clears the selected data port bit.

Parameters
- **GPIOx:** where x can be (A..G depending on device used) to select the GPIO peripheral for STM32L1XX family devices
- **GPIO_Pin:** specifies the port bit to be written. This parameter can be one 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 register 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 Toggles the specified GPIO pin.

Parameters
- **GPIOx:** where x can be (A..G depending on device used) to select the GPIO peripheral for STM32L1XX family devices
- **GPIO_Pin:** specifies the pins 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 Locks GPIO Pins configuration registers.

Parameters
- **GPIOx:** where x can be (A..G depending on device used) to select the GPIO peripheral for STM32L1XX family devices
- **GPIO_Pin:** Specifies the port bit 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.
- Limitation concerning GPIOx_OTYPER: Locking of GPIOx_OTYPER[i] with i = 15..8 depends from setting of GPIOx_LCKR[i-8] and not from GPIOx_LCKR[i]. GPIOx_LCKR[i-8] is locking GPIOx_OTYPER[i] together with GPIOx_OTYPER[i-8]. It is not possible to lock GPIOx_OTYPER[i] with i = 15..8, without locking also GPIOx_OTYPER[i-8]. Workaround: When calling HAL_GPIO_LockPin with GPIO_Pin from GPIO_PIN_8 to GPIO_PIN_15, you must call also HAL_GPIO_LockPin with GPIO_Pin - 8. (When locking a pin from GPIO_PIN_8 to GPIO_PIN_15, you must lock also the corresponding GPIO_PIN_0 to GPIO_PIN_7).

HAL_GPIO_EXTI_IRQHandler

Function name	**void HAL_GPIO_EXTI_IRQHandler (uint16_t GPIO_Pin)**
Function description	This function handles 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 callbacks.
Parameters	• **GPIO_Pin:** Specifies the port pin connected to corresponding EXTI line.
Return values	• **None:**

20.3 GPIO Firmware driver defines

20.3.1 GPIO

GPIO Exported Macros

__HAL_GPIO_EXTI_GET_FLAG

Description:

- Checks 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:

- Clears 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:

- Checks 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:

- Clears 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:

- Generates 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_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	max: 400 KHz, please refer to the product datasheet
GPIO_SPEED_FREQ_MEDIUM	max: 1 MHz to 2 MHz, please refer to the product datasheet
GPIO_SPEED_FREQ_HIGH	max: 2 MHz to 10 MHz, please refer to the product datasheet
GPIO_SPEED_FREQ_VERY_HIGH	max: 8 MHz to 50 MHz, please refer to the product datasheet

21 HAL GPIO Extension Driver

21.1 GPIOEx Firmware driver defines

21.1.1 GPIOEx

GPIOEx Alternate function selection

GPIO_AF0_MCO	MCO Alternate Function mapping
GPIO_AF0_TAMPER	TAMPER Alternate Function mapping
GPIO_AF0_SWJ	SWJ (SWD and JTAG) Alternate Function mapping
GPIO_AF0_TRACE	TRACE Alternate Function mapping
GPIO_AF0_RTC_50Hz	RTC_OUT Alternate Function mapping
GPIO_AF1_TIM2	TIM2 Alternate Function mapping
GPIO_AF2_TIM3	TIM3 Alternate Function mapping
GPIO_AF2_TIM4	TIM4 Alternate Function mapping
GPIO_AF2_TIM5	TIM5 Alternate Function mapping
GPIO_AF3_TIM9	TIM9 Alternate Function mapping
GPIO_AF3_TIM10	TIM10 Alternate Function mapping
GPIO_AF3_TIM11	TIM11 Alternate Function mapping
GPIO_AF4_I2C1	I2C1 Alternate Function mapping
GPIO_AF4_I2C2	I2C2 Alternate Function mapping
GPIO_AF5_SPI1	SPI1/I2S1 Alternate Function mapping
GPIO_AF5_SPI2	SPI2/I2S2 Alternate Function mapping
GPIO_AF6_SPI3	SPI3/I2S3 Alternate Function mapping
GPIO_AF7_USART1	USART1 Alternate Function mapping
GPIO_AF7_USART2	USART2 Alternate Function mapping
GPIO_AF7_USART3	USART3 Alternate Function mapping
GPIO_AF8_UART4	UART4 Alternate Function mapping
GPIO_AF8_UART5	UART5 Alternate Function mapping
GPIO_AF11_LCD	LCD Alternate Function mapping
GPIO_AF12_FSMC	FSMC Alternate Function mapping
GPIO_AF12_SDIO	SDIO Alternate Function mapping
GPIO_AF14_TIM_IC1	TIMER INPUT CAPTURE Alternate Function mapping
GPIO_AF14_TIM_IC2	TIMER INPUT CAPTURE Alternate Function mapping
GPIO_AF14_TIM_IC3	TIMER INPUT CAPTURE Alternate Function mapping
GPIO_AF14_TIM_IC4	TIMER INPUT CAPTURE Alternate Function mapping
GPIO_AF15_EVENTOUT	EVENTOUT Alternate Function mapping

22 HAL I2C Generic Driver

22.1 I2C Firmware driver registers structures

22.1.1 I2C_InitTypeDef

Data Fields

- ***uint32_t ClockSpeed***
- ***uint32_t DutyCycle***
- ***uint32_t OwnAddress1***
- ***uint32_t AddressingMode***
- ***uint32_t DualAddressMode***
- ***uint32_t OwnAddress2***
- ***uint32_t GeneralCallMode***
- ***uint32_t NoStretchMode***

Field Documentation

- ***uint32_t I2C_InitTypeDef::ClockSpeed***
  Specifies the clock frequency. This parameter must be set to a value lower than 400kHz
- ***uint32_t I2C_InitTypeDef::DutyCycle***
  Specifies the I2C fast mode duty cycle. This parameter can be a value of ***I2C_duty_cycle_in_fast_mode***
- ***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::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***

22.1.2 I2C_HandleTypeDef

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***
- ***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 Devaddress***
- ***__IO uint32_t Memaddress***
- ***__IO uint32_t MemaddSize***
- ***__IO uint32_t EventCount***

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 transfer options
- ***__IO uint32_t I2C_HandleTypeDef::PreviousState***
  I2C communication Previous state and mode context for internal usage
- ***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::Devaddress***
  I2C Target device address
- ***__IO uint32_t I2C_HandleTypeDef::Memaddress***
  I2C Target memory address
- ***__IO uint32_t I2C_HandleTypeDef::MemaddSize***
  I2C Target memory address size
- ***__IO uint32_t I2C_HandleTypeDef::EventCount***
  I2C Event counter

22.2 I2C Firmware driver API description

22.2.1 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 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 Speed, Duty cycle, Addressing mode, Own Address1, Dual Addressing mode, Own Address2, General call and Nostretch mode in the hi2c Init structure.
4. Initialize the I2C registers by calling the HAL_I2C_Init(), configures also the low level Hardware (GPIO, CLOCK, NVIC...etc) by calling the customized HAL_I2C_MspInit(&hi2c) API.
5. To check if target device is ready for communication, use the function 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 HAL_I2C_Master_Transmit()
- Receive in master mode an amount of data in blocking mode using HAL_I2C_Master_Receive()
- Transmit in slave mode an amount of data in blocking mode using HAL_I2C_Slave_Transmit()
- Receive in slave mode an amount of data in blocking mode using HAL_I2C_Slave_Receive()

Polling mode IO MEM operation

- Write an amount of data in blocking mode to a specific memory address using HAL_I2C_Mem_Write()
- Read an amount of data in blocking mode from a specific memory address using HAL_I2C_Mem_Read()

Interrupt mode IO operation

- Transmit in master mode an amount of data in non-blocking mode using HAL_I2C_Master_Transmit_IT()
- At transmission end of transfer, HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterTxCpltCallback()

- Receive in master mode an amount of data in non-blocking mode using HAL_I2C_Master_Receive_IT()
- At reception end of transfer, HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterRxCpltCallback()
- Transmit in slave mode an amount of data in non-blocking mode using HAL_I2C_Slave_Transmit_IT()
- At transmission end of transfer, HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveTxCpltCallback()
- Receive in slave mode an amount of data in non-blocking mode using HAL_I2C_Slave_Receive_IT()
- At reception end of transfer, HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
- End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using __HAL_I2C_GENERATE_NACK() macro. This action will inform Master to generate a Stop condition to discard the communication.

Interrupt mode IO sequential operation

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_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
- Differents sequential I2C interfaces are listed below:
  - Sequential transmit in master I2C mode an amount of data in non-blocking mode using HAL_I2C_Master_Sequential_Transmit_IT()
    - At transmission end of current frame transfer, HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterTxCpltCallback()

- Sequential receive in master I2C mode an amount of data in non-blocking mode using HAL_I2C_Master_Sequential_Receive_IT()
  - At reception end of current frame transfer, HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterRxCpltCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
  - End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Enable/disable the Address listen mode in slave I2C mode using HAL_I2C_EnableListen_IT() HAL_I2C_DisableListen_IT()
  - When address slave I2C match, 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 HAL_I2C_ListenCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_ListenCpltCallback()
- Sequential transmit in slave I2C mode an amount of data in non-blocking mode using HAL_I2C_Slave_Sequential_Transmit_IT()
  - At transmission end of current frame transfer, HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveTxCpltCallback()
- Sequential receive in slave I2C mode an amount of data in non-blocking mode using HAL_I2C_Slave_Sequential_Receive_IT()
  - At reception end of current frame transfer, HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
- End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using __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 HAL_I2C_Mem_Write_IT()
- At Memory end of write transfer, HAL_I2C_MemTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemTxCpltCallback()
- Read an amount of data in non-blocking mode with Interrupt from a specific memory address using HAL_I2C_Mem_Read_IT()
- At Memory end of read transfer, HAL_I2C_MemRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()

DMA mode IO operation

- Transmit in master mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Master_Transmit_DMA()
- At transmission end of transfer, HAL_I2C_MasterTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterTxCpltCallback()
- Receive in master mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Master_Receive_DMA()
- At reception end of transfer, HAL_I2C_MasterRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MasterRxCpltCallback()
- Transmit in slave mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Slave_Transmit_DMA()
- At transmission end of transfer, HAL_I2C_SlaveTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveTxCpltCallback()
- Receive in slave mode an amount of data in non-blocking mode (DMA) using HAL_I2C_Slave_Receive_DMA()
- At reception end of transfer, HAL_I2C_SlaveRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_SlaveRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()
- Abort a master I2C process communication with Interrupt using HAL_I2C_Master_Abort_IT()
- End of abort process, HAL_I2C_AbortCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_AbortCpltCallback()
- Discard a slave I2C process communication using __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 HAL_I2C_Mem_Write_DMA()
- At Memory end of write transfer, HAL_I2C_MemTxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemTxCpltCallback()
- Read an amount of data in non-blocking mode with DMA from a specific memory address using HAL_I2C_Mem_Read_DMA()
- At Memory end of read transfer, HAL_I2C_MemRxCpltCallback() is executed and user can add his own code by customization of function pointer HAL_I2C_MemRxCpltCallback()
- In case of transfer Error, HAL_I2C_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2C_ErrorCallback()

I2C HAL driver macros list

Below the list of most used macros in I2C HAL driver.

- __HAL_I2C_ENABLE: Enable the I2C peripheral
- __HAL_I2C_DISABLE: Disable the I2C peripheral
- __HAL_I2C_GENERATE_NACK: Generate a Non-Acknowledge I2C peripheral in Slave mode
- __HAL_I2C_GET_FLAG: Check whether the specified I2C flag is set or not

- __HAL_I2C_CLEAR_FLAG: Clear the specified I2C pending flag
- __HAL_I2C_ENABLE_IT: Enable the specified I2C interrupt
- __HAL_I2C_DISABLE_IT: Disable the specified I2C interrupt

You can refer to the I2C HAL driver header file for more useful macros

22.2.2 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:
  - Communication Speed
  - Duty cycle
  - Addressing mode
  - Own Address 1
  - Dual Addressing mode
  - Own Address 2
  - 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()***

22.2.3 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_Master_Sequential_Transmit_IT()
- HAL_I2C_Master_Sequential_Receive_IT()
- HAL_I2C_Slave_Sequential_Transmit_IT()
- HAL_I2C_Slave_Sequential_Receive_IT()
- HAL_I2C_Mem_Write_IT()
- HAL_I2C_Mem_Read_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()
5. A set of Transfer Complete Callbacks are provided in non Blocking mode:
   - HAL_I2C_MemTxCpltCallback()
   - HAL_I2C_MemRxCpltCallback()
   - HAL_I2C_MasterTxCpltCallback()
   - HAL_I2C_MasterRxCpltCallback()
   - HAL_I2C_SlaveTxCpltCallback()
   - HAL_I2C_SlaveRxCpltCallback()
   - 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_Master_Sequential_Transmit_IT()***
- ***HAL_I2C_Master_Sequential_Receive_IT()***
- ***HAL_I2C_Slave_Transmit_IT()***
- ***HAL_I2C_Slave_Receive_IT()***
- ***HAL_I2C_Slave_Sequential_Transmit_IT()***
- ***HAL_I2C_Slave_Sequential_Receive_IT()***
- ***HAL_I2C_EnableListen_IT()***
- ***HAL_I2C_DisableListen_IT()***
- ***HAL_I2C_Master_Transmit_DMA()***
- ***HAL_I2C_Master_Receive_DMA()***
- ***HAL_I2C_Master_Abort_IT()***
- ***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_EV_IRQHandler()***
- ***HAL_I2C_ER_IRQHandler()***
- ***HAL_I2C_MasterTxCpltCallback()***
- ***HAL_I2C_MasterRxCpltCallback()***
- ***HAL_I2C_SlaveTxCpltCallback()***
- ***HAL_I2C_SlaveRxCpltCallback()***
- ***HAL_I2C_AddrCallback()***
- ***HAL_I2C_ListenCpltCallback()***
- ***HAL_I2C_MemTxCpltCallback()***
- ***HAL_I2C_MemRxCpltCallback()***
- ***HAL_I2C_ErrorCallback()***
- ***HAL_I2C_AbortCpltCallback()***

22.2.4 Peripheral State, Mode and Error 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_I2C_GetState()***
- ***HAL_I2C_GetMode()***
- ***HAL_I2C_GetError()***

22.2.5 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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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_Sequential_Transmit_IT

Function name **HAL_StatusTypeDef HAL_I2C_Master_Sequential_Transmit_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**

Function description Sequential 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 shift at right before call interface
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **XferOptions:** Options of Transfer, value of I2C XferOptions definition

Return values
- **HAL:** status

Notes
- This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Master_Sequential_Receive_IT

Function name **HAL_StatusTypeDef HAL_I2C_Master_Sequential_Receive_IT (I2C_HandleTypeDef * hi2c, uint16_t DevAddress, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**

Function description	Sequential 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 shift at right before call interface • **pData:** Pointer to data buffer • **Size:** Amount of data to be sent • **XferOptions:** Options of Transfer, value of I2C XferOptions definition
Return values	• **HAL:** status
Notes	• This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Slave_Sequential_Transmit_IT

Function name	**HAL_StatusTypeDef HAL_I2C_Slave_Sequential_Transmit_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**
Function description	Sequential 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 • **XferOptions:** Options of Transfer, value of I2C XferOptions definition
Return values	• **HAL:** status
Notes	• This interface allow to manage repeated start condition when a direction change during transfer

HAL_I2C_Slave_Sequential_Receive_IT

Function name	**HAL_StatusTypeDef HAL_I2C_Slave_Sequential_Receive_IT (I2C_HandleTypeDef * hi2c, uint8_t * pData, uint16_t Size, uint32_t XferOptions)**
Function description	Sequential 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 • **XferOptions:** Options of Transfer, value of I2C XferOptions definition
Return values	• **HAL:** status
Notes	• This interface allow to manage repeated start condition when a direction change during transfer

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 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 shift at right before call interface
Return values	• **HAL:** status
Notes	• This abort can be called only if state is ready

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_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 shift at right before call 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 shift at right before call 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 shift at right before call 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 shift at right before call 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_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 XferDirection definition 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	Return 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

22.3 I2C Firmware driver defines

22.3.1 I2C

I2C addressing mode

I2C_ADDRESSINGMODE_7BIT

I2C_ADDRESSINGMODE_10BIT

I2C dual addressing mode

I2C_DUALADDRESS_DISABLE

I2C_DUALADDRESS_ENABLE

I2C duty cycle in fast mode

I2C_DUTYCYCLE_2

I2C_DUTYCYCLE_16_9

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	AF error
HAL_I2C_ERROR_OVR	OVR error
HAL_I2C_ERROR_DMA	DMA transfer error
HAL_I2C_ERROR_TIMEOUT	Timeout 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_BUF: Buffer interrupt enable
  - I2C_IT_EVT: Event interrupt enable
  - I2C_IT_ERR: Error 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_BUF: Buffer interrupt enable
  - I2C_IT_EVT: Event interrupt enable
  - I2C_IT_ERR: Error 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_BUF: Buffer interrupt enable
- I2C_IT_EVT: Event interrupt enable
- I2C_IT_ERR: Error interrupt enable

Return value:

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

__HAL_I2C_GET_FLAG

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_OVR: Overrun/Underrun flag
  - I2C_FLAG_AF: Acknowledge failure flag
  - I2C_FLAG_ARLO: Arbitration lost flag
  - I2C_FLAG_BERR: Bus error flag
  - I2C_FLAG_TXE: Data register empty flag
  - I2C_FLAG_RXNE: Data register not empty flag
  - I2C_FLAG_STOPF: Stop detection flag
  - I2C_FLAG_ADD10: 10-bit header sent flag
  - I2C_FLAG_BTF: Byte transfer finished flag
  - I2C_FLAG_ADDR: Address sent flag Address matched flag
  - I2C_FLAG_SB: Start bit flag
  - I2C_FLAG_DUALF: Dual flag
  - I2C_FLAG_GENCALL: General call header flag
  - I2C_FLAG_TRA: Transmitter/Receiver flag
  - I2C_FLAG_BUSY: Bus busy flag
  - I2C_FLAG_MSL: Master/Slave flag

Return value:

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

__HAL_I2C_CLEAR_FLAG

Description:

- Clear the I2C pending flags which are cleared by writing 0 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_OVR: Overrun/Underrun flag (Slave mode)
  - I2C_FLAG_AF: Acknowledge failure flag
  - I2C_FLAG_ARLO: Arbitration lost flag (Master mode)
  - I2C_FLAG_BERR: Bus error flag

Return value:

- None

__HAL_I2C_CLEAR_ADDRFLAG

Description:

- Clears the I2C ADDR pending flag.

Parameters:

- __HANDLE__: specifies the I2C Handle.

Return value:

- None

__HAL_I2C_CLEAR_STOPFLAG

Description:

- Clears the I2C STOPF pending flag.

Parameters:

- __HANDLE__: specifies the I2C Handle.

Return value:

- None

__HAL_I2C_ENABLE

Description:

- Enable the I2C peripheral.

Parameters:

- __HANDLE__: specifies the I2C Handle. This parameter can be I2Cx where x: 1 or 2 to select the I2C peripheral.

Return value:

- None

__HAL_I2C_DISABLE

Description:

- Disable the I2C peripheral.

Parameters:

- __HANDLE__: specifies the I2C Handle. This parameter can be I2Cx where x: 1 or 2 to select the I2C peripheral.

Return value:

- None

I2C Flag definition

I2C_FLAG_OVR

I2C_FLAG_AF

I2C_FLAG_ARLO

I2C_FLAG_BERR

I2C_FLAG_TXE

I2C_FLAG_RXNE

I2C_FLAG_STOPF

I2C_FLAG_ADD10

I2C_FLAG_BTF

I2C_FLAG_ADDR

I2C_FLAG_SB

I2C_FLAG_DUALF

I2C_FLAG_GENCALL

I2C_FLAG_TRA

I2C_FLAG_BUSY

I2C_FLAG_MSL

I2C general call addressing mode

I2C_GENERALCALL_DISABLE

I2C_GENERALCALL_ENABLE

I2C Interrupt configuration definition

I2C_IT_BUF

I2C_IT_EVT

I2C_IT_ERR

I2C Memory Address Size

I2C_MEMADD_SIZE_8BIT

I2C_MEMADD_SIZE_16BIT

I2C nostretch mode

I2C_NOSTRETCH_DISABLE

I2C_NOSTRETCH_ENABLE

I2C XferDirection definition Master Point of View

I2C_DIRECTION_RECEIVE

I2C_DIRECTION_TRANSMIT

I2C XferOptions definition

I2C_FIRST_FRAME

I2C_NEXT_FRAME

I2C_FIRST_AND_LAST_FRAME

I2C_LAST_FRAME

23 HAL I2S Generic Driver

23.1 I2S Firmware driver registers structures

23.1.1 I2S_InitTypeDef

Data Fields

- ***uint32_t Mode***
- ***uint32_t Standard***
- ***uint32_t DataFormat***
- ***uint32_t MCLKOutput***
- ***uint32_t AudioFreq***
- ***uint32_t CPOL***

Field Documentation

- ***uint32_t I2S_InitTypeDef::Mode***
  Specifies the I2S operating mode. This parameter can be a value of ***I2S_Mode***
- ***uint32_t I2S_InitTypeDef::Standard***
  Specifies the standard used for the I2S communication. This parameter can be a value of ***I2S_Standard***
- ***uint32_t I2S_InitTypeDef::DataFormat***
  Specifies the data format for the I2S communication. This parameter can be a value of ***I2S_Data_Format***
- ***uint32_t I2S_InitTypeDef::MCLKOutput***
  Specifies whether the I2S MCLK output is enabled or not. This parameter can be a value of ***I2S_MCLK_Output***
- ***uint32_t I2S_InitTypeDef::AudioFreq***
  Specifies the frequency selected for the I2S communication. This parameter can be a value of ***I2S_Audio_Frequency***
- ***uint32_t I2S_InitTypeDef::CPOL***
  Specifies the idle state of the I2S clock. This parameter can be a value of ***I2S_Clock_Polarity***

23.1.2 I2S_HandleTypeDef

Data Fields

- ***SPI_TypeDef * Instance***
- ***I2S_InitTypeDef Init***
- ***uint16_t * pTxBuffPtr***
- ***__IO uint16_t TxXferSize***
- ***__IO uint16_t TxXferCount***
- ***uint16_t * pRxBuffPtr***
- ***__IO uint16_t RxXferSize***
- ***__IO uint16_t RxXferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***__IO HAL_LockTypeDef Lock***
- ***__IO HAL_I2S_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***SPI_TypeDef* I2S_HandleTypeDef::Instance***
- ***I2S_InitTypeDef I2S_HandleTypeDef::Init***
- ***uint16_t* I2S_HandleTypeDef::pTxBuffPtr***
- ***__IO uint16_t I2S_HandleTypeDef::TxXferSize***
- ***__IO uint16_t I2S_HandleTypeDef::TxXferCount***
- ***uint16_t* I2S_HandleTypeDef::pRxBuffPtr***
- ***__IO uint16_t I2S_HandleTypeDef::RxXferSize***
- ***__IO uint16_t I2S_HandleTypeDef::RxXferCount***
- ***DMA_HandleTypeDef* I2S_HandleTypeDef::hdmatx***
- ***DMA_HandleTypeDef* I2S_HandleTypeDef::hdmarx***
- ***__IO HAL_LockTypeDef I2S_HandleTypeDef::Lock***
- ***__IO HAL_I2S_StateTypeDef I2S_HandleTypeDef::State***
- ***__IO uint32_t I2S_HandleTypeDef::ErrorCode***

23.2 I2S Firmware driver API description

23.2.1 How to use this driver

The I2S HAL driver can be used as follow:

1. Declare a I2S_HandleTypeDef handle structure.
2. Initialize the I2S low level resources by implement the HAL_I2S_MspInit() API:
   a. Enable the SPIx interface clock.
   b. I2S pins configuration:
      – Enable the clock for the I2S GPIOs.
      – Configure these I2S pins as alternate function.
   c. NVIC configuration if you need to use interrupt process (HAL_I2S_Transmit_IT() and HAL_I2S_Receive_IT() APIs).
      – Configure the I2Sx interrupt priority.
      – Enable the NVIC I2S IRQ handle.
   d. DMA Configuration if you need to use DMA process (HAL_I2S_Transmit_DMA() and HAL_I2S_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 initilalized DMA handle to the I2S 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 Mode, Standard, Data Format, MCLK Output, Audio frequency and Polarity using HAL_I2S_Init() function. The specific I2S interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_I2S_ENABLE_IT() and __HAL_I2S_DISABLE_IT() inside the transmit and receive process. Make sure that either: External clock source is configured after setting correctly the define constant HSE_VALUE in the stm32l1xx_hal_conf.h file.
4. Three mode of operations are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_I2S_Transmit()
- Receive an amount of data in blocking mode using HAL_I2S_Receive()

Interrupt mode IO operation

- Send an amount of data in non blocking mode using HAL_I2S_Transmit_IT()
- At transmission end of half transfer HAL_I2S_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxHalfCpltCallback
- At transmission end of transfer HAL_I2S_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxCpltCallback
- Receive an amount of data in non blocking mode using HAL_I2S_Receive_IT()
- At reception end of half transfer HAL_I2S_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxHalfCpltCallback
- At reception end of transfer HAL_I2S_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxCpltCallback
- In case of transfer Error, HAL_I2S_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2S_ErrorCallback

DMA mode IO operation

- Send an amount of data in non blocking mode (DMA) using HAL_I2S_Transmit_DMA()
- At transmission end of half transfer HAL_I2S_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxHalfCpltCallback
- At transmission end of transfer HAL_I2S_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_TxCpltCallback
- Receive an amount of data in non blocking mode (DMA) using HAL_I2S_Receive_DMA()
- At reception end of half transfer HAL_I2S_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxHalfCpltCallback
- At reception end of transfer HAL_I2S_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_I2S_RxCpltCallback
- In case of transfer Error, HAL_I2S_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_I2S_ErrorCallback
- Pause the DMA Transfer using HAL_I2S_DMAPause()
- Resume the DMA Transfer using HAL_I2S_DMAResume()
- Stop the DMA Transfer using HAL_I2S_DMAStop()

I2S HAL driver macros list

Below the list of most used macros in USART HAL driver.

- __HAL_I2S_ENABLE: Enable the specified SPI peripheral (in I2S mode)
- __HAL_I2S_DISABLE: Disable the specified SPI peripheral (in I2S mode)
- __HAL_I2S_ENABLE_IT : Enable the specified I2S interrupts
- __HAL_I2S_DISABLE_IT : Disable the specified I2S interrupts
- __HAL_I2S_GET_FLAG: Check whether the specified I2S flag is set or not

You can refer to the I2S HAL driver header file for more useful macros

23.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialiaze the I2Sx peripheral in simplex mode:

- User must Implement HAL_I2S_MspInit() function in which he configures all related peripherals resources (CLOCK, GPIO, DMA, IT and NVIC).
- Call the function HAL_I2S_Init() to configure the selected device with the selected configuration:
  - Mode
  - Standard
  - Data Format
  - MCLK Output
  - Audio frequency
  - Polarity
- Call the function HAL_I2S_DeInit() to restore the default configuration of the selected I2Sx periperal.

This section contains the following APIs:

- ***HAL_I2S_Init()***
- ***HAL_I2S_DeInit()***
- ***HAL_I2S_MspInit()***
- ***HAL_I2S_MspDeInit()***

23.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the I2S 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 I2S IRQ when using Interrupt mode or the DMA IRQ when using DMA mode.
2. Blocking mode functions are :
   - HAL_I2S_Transmit()
   - HAL_I2S_Receive()
3. No-Blocking mode functions with Interrupt are :
   - HAL_I2S_Transmit_IT()
   - HAL_I2S_Receive_IT()
4. No-Blocking mode functions with DMA are :
   - HAL_I2S_Transmit_DMA()
   - HAL_I2S_Receive_DMA()
5. A set of Transfer Complete Callbacks are provided in non Blocking mode:
   - HAL_I2S_TxCpltCallback()
   - HAL_I2S_RxCpltCallback()
   - HAL_I2S_ErrorCallback()

This section contains the following APIs:

- ***HAL_I2S_Transmit()***
- ***HAL_I2S_Receive()***
- ***HAL_I2S_Transmit_IT()***
- ***HAL_I2S_Receive_IT()***
- ***HAL_I2S_Transmit_DMA()***

- ***HAL_I2S_Receive_DMA()***
- ***HAL_I2S_DMAPause()***
- ***HAL_I2S_DMAResume()***
- ***HAL_I2S_DMAStop()***
- ***HAL_I2S_IRQHandler()***
- ***HAL_I2S_TxHalfCpltCallback()***
- ***HAL_I2S_TxCpltCallback()***
- ***HAL_I2S_RxHalfCpltCallback()***
- ***HAL_I2S_RxCpltCallback()***
- ***HAL_I2S_ErrorCallback()***

23.2.4 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_I2S_GetState()***
- ***HAL_I2S_GetError()***

23.2.5 Detailed description of functions

HAL_I2S_Init

Function name	**HAL_StatusTypeDef HAL_I2S_Init (I2S_HandleTypeDef * hi2s)**
Function description	Initializes the I2S according to the specified parameters in the I2S_InitTypeDef and create the associated handle.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **HAL:** status

HAL_I2S_DeInit

Function name	**HAL_StatusTypeDef HAL_I2S_DeInit (I2S_HandleTypeDef * hi2s)**
Function description	DeInitializes the I2S peripheral.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **HAL:** status

HAL_I2S_MspInit

Function name	**void HAL_I2S_MspInit (I2S_HandleTypeDef * hi2s)**
Function description	I2S MSP Init.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **None:**

HAL_I2S_MspDeInit

Function name **void HAL_I2S_MspDeInit (I2S_HandleTypeDef * hi2s)**

Function description I2S MSP DeInit.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **None:**

HAL_I2S_Transmit

Function name **HAL_StatusTypeDef HAL_I2S_Transmit (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Transmit an amount of data in blocking mode.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
- **pData:** a 16-bit pointer to data buffer.
- **Size:** number of data sample to be sent:
- **Timeout:** Timeout duration

Return values
- **HAL:** status

Notes
- When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.
- The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_Receive

Function name **HAL_StatusTypeDef HAL_I2S_Receive (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
- **pData:** a 16-bit pointer to data buffer.
- **Size:** number of data sample to be sent:
- **Timeout:** Timeout duration

Return values
- **HAL:** status

Notes
- When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.
- The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

- In I2S Master Receiver mode, just after enabling the peripheral the clock will be generate in continouse way and as the I2S is not disabled at the end of the I2S transaction.

HAL_I2S_Transmit_IT

Function name	**HAL_StatusTypeDef HAL_I2S_Transmit_IT (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)**
Function description	Transmit an amount of data in non-blocking mode with Interrupt.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module • **pData:** a 16-bit pointer to data buffer. • **Size:** number of data sample to be sent:
Return values	• **HAL:** status
Notes	• When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length. • The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_Receive_IT

Function name	**HAL_StatusTypeDef HAL_I2S_Receive_IT (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)**
Function description	Receive an amount of data in non-blocking mode with Interrupt.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module • **pData:** a 16-bit pointer to the Receive data buffer. • **Size:** number of data sample to be sent:
Return values	• **HAL:** status
Notes	• When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length. • The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming). • It is recommended to use DMA for the I2S receiver to avoid de-synchronisation between Master and Slave otherwise the I2S interrupt should be optimized.

HAL_I2S_IRQHandler

Function name **void HAL_I2S_IRQHandler (I2S_HandleTypeDef * hi2s)**

Function description This function handles I2S interrupt request.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **None:**

HAL_I2S_Transmit_DMA

Function name **HAL_StatusTypeDef HAL_I2S_Transmit_DMA (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)**

Function description Transmit an amount of data in non-blocking mode with DMA.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
- **pData:** a 16-bit pointer to the Transmit data buffer.
- **Size:** number of data sample to be sent:

Return values
- **HAL:** status

Notes
- When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.
- The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_Receive_DMA

Function name **HAL_StatusTypeDef HAL_I2S_Receive_DMA (I2S_HandleTypeDef * hi2s, uint16_t * pData, uint16_t Size)**

Function description Receive an amount of data in non-blocking mode with DMA.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
- **pData:** a 16-bit pointer to the Receive data buffer.
- **Size:** number of data sample to be sent:

Return values
- **HAL:** status

Notes
- When a 16-bit data frame or a 16-bit data frame extended is selected during the I2S configuration phase, the Size parameter means the number of 16-bit data length in the transaction and when a 24-bit data frame or a 32-bit data frame is selected the Size parameter means the number of 16-bit data length.
- The I2S is kept enabled at the end of transaction to avoid the clock de-synchronization between Master and Slave(example: audio streaming).

HAL_I2S_DMAPause

Function name **HAL_StatusTypeDef HAL_I2S_DMAPause (I2S_HandleTypeDef * hi2s)**

Function description Pauses the audio stream playing from the Media.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **HAL:** status

HAL_I2S_DMAResume

Function name **HAL_StatusTypeDef HAL_I2S_DMAResume (I2S_HandleTypeDef * hi2s)**

Function description Resumes the audio stream playing from the Media.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **HAL:** status

HAL_I2S_DMAStop

Function name **HAL_StatusTypeDef HAL_I2S_DMAStop (I2S_HandleTypeDef * hi2s)**

Function description Resumes the audio stream playing from the Media.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **HAL:** status

HAL_I2S_TxHalfCpltCallback

Function name **void HAL_I2S_TxHalfCpltCallback (I2S_HandleTypeDef * hi2s)**

Function description Tx Transfer Half completed callbacks.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **None:**

HAL_I2S_TxCpltCallback

Function name **void HAL_I2S_TxCpltCallback (I2S_HandleTypeDef * hi2s)**

Function description Tx Transfer completed callbacks.

Parameters
- **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module

Return values
- **None:**

HAL_I2S_RxHalfCpltCallback

Function name **void HAL_I2S_RxHalfCpltCallback (I2S_HandleTypeDef * hi2s)**

Function description	Rx Transfer half completed callbacks.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **None:**

HAL_I2S_RxCpltCallback

Function name	**void HAL_I2S_RxCpltCallback (I2S_HandleTypeDef * hi2s)**
Function description	Rx Transfer completed callbacks.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **None:**

HAL_I2S_ErrorCallback

Function name	**void HAL_I2S_ErrorCallback (I2S_HandleTypeDef * hi2s)**
Function description	I2S error callbacks.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **None:**

HAL_I2S_GetState

Function name	**HAL_I2S_StateTypeDef HAL_I2S_GetState (I2S_HandleTypeDef * hi2s)**
Function description	Return the I2S state.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **HAL:** state

HAL_I2S_GetError

Function name	**uint32_t HAL_I2S_GetError (I2S_HandleTypeDef * hi2s)**
Function description	Return the I2S error code.
Parameters	• **hi2s:** pointer to a I2S_HandleTypeDef structure that contains the configuration information for I2S module
Return values	• **I2S:** Error Code

23.3 I2S Firmware driver defines

23.3.1 I2S

I2S Audio Frequency

I2S_AUDIOFREQ_192K

I2S_AUDIOFREQ_96K

I2S_AUDIOFREQ_48K

I2S_AUDIOFREQ_44K

I2S_AUDIOFREQ_32K

I2S_AUDIOFREQ_22K

I2S_AUDIOFREQ_16K

I2S_AUDIOFREQ_11K

I2S_AUDIOFREQ_8K

I2S_AUDIOFREQ_DEFAULT

IS_I2S_AUDIO_FREQ

I2S Clock Polarity

I2S_CPOL_LOW

I2S_CPOL_HIGH

IS_I2S_CPOL

I2S Data Format

I2S_DATAFORMAT_16B

I2S_DATAFORMAT_16B_EXTENDED

I2S_DATAFORMAT_24B

I2S_DATAFORMAT_32B

IS_I2S_DATA_FORMAT

I2S Error Codes

HAL_I2S_ERROR_NONE	No error
HAL_I2S_ERROR_UDR	I2S Underrun error
HAL_I2S_ERROR_OVR	I2S Overrun error
HAL_I2S_ERROR_FRE	I2S Frame format error
HAL_I2S_ERROR_DMA	DMA transfer error

I2S Exported Macros

__HAL_I2S_RESET_HANDLE_STATE

Description:

- Reset I2S handle state.

Parameters:

- __HANDLE__: specifies the I2S Handle.

Return value:

- None

__HAL_I2S_ENABLE

Description:

- Enable or disable the specified SPI peripheral (in I2S mode).

Parameters:

- __HANDLE__: specifies the I2S Handle.

Return value:

- None

__HAL_I2S_DISABLE

__HAL_I2S_ENABLE_IT

Description:

- Enable or disable the specified I2S interrupts.

Parameters:

- __HANDLE__: specifies the I2S Handle.
- __INTERRUPT__: specifies the interrupt source to enable or disable. This parameter can be one of the following values:
  - I2S_IT_TXE: Tx buffer empty interrupt enable
  - I2S_IT_RXNE: RX buffer not empty interrupt enable
  - I2S_IT_ERR: Error interrupt enable

Return value:

- None

__HAL_I2S_DISABLE_IT

__HAL_I2S_GET_IT_SOURCE

Description:

- Checks if the specified I2S interrupt source is enabled or disabled.

Parameters:

- __HANDLE__: specifies the I2S Handle. This parameter can be I2S where x: 1, 2, or 3 to select the I2S peripheral.
- __INTERRUPT__: specifies the I2S interrupt source to check. This parameter can be one of the following values:
  - I2S_IT_TXE: Tx buffer empty interrupt enable
  - I2S_IT_RXNE: RX buffer not empty interrupt enable
  - I2S_IT_ERR: Error interrupt enable

Return value:

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

__HAL_I2S_GET_FLAG

Description:

- Checks whether the specified I2S flag is set or not.

Parameters:

- __HANDLE__: specifies the I2S Handle.
- __FLAG__: specifies the flag to check. This parameter can be one of the following

values:
- I2S_FLAG_RXNE: Receive buffer not empty flag
- I2S_FLAG_TXE: Transmit buffer empty flag
- I2S_FLAG_UDR: Underrun flag
- I2S_FLAG_OVR: Overrun flag
- I2S_FLAG_FRE: Frame error flag
- I2S_FLAG_CHSIDE: Channel Side flag
- I2S_FLAG_BSY: Busy flag

Return value:

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

__HAL_I2S_CLEAR_OVRFLAG

Description:

- Clears the I2S OVR pending flag.

Parameters:

- __HANDLE__: specifies the I2S Handle.

Return value:

- None

__HAL_I2S_CLEAR_UDRFLAG

Description:

- Clears the I2S UDR pending flag.

Parameters:

- __HANDLE__: specifies the I2S Handle.

Return value:

- None

I2S Flag definition

I2S_FLAG_TXE

I2S_FLAG_RXNE

I2S_FLAG_UDR

I2S_FLAG_OVR

I2S_FLAG_FRE

I2S_FLAG_CHSIDE

I2S_FLAG_BSY

I2S Interrupt configuration definition

I2S_IT_TXE

I2S_IT_RXNE

I2S_IT_ERR

I2S MCLK Output

I2S_MCLKOUTPUT_ENABLE

I2S_MCLKOUTPUT_DISABLE

IS_I2S_MCLK_OUTPUT

I2S Mode

I2S_MODE_SLAVE_TX

I2S_MODE_SLAVE_RX

I2S_MODE_MASTER_TX

I2S_MODE_MASTER_RX

IS_I2S_MODE

I2S Standard

I2S_STANDARD_PHILIPS

I2S_STANDARD_MSB

I2S_STANDARD_LSB

I2S_STANDARD_PCM_SHORT

I2S_STANDARD_PCM_LONG

IS_I2S_STANDARD

24 HAL IRDA Generic Driver

24.1 IRDA Firmware driver registers structures

24.1.1 IRDA_InitTypeDef

Data Fields

- ***uint32_t BaudRate***
- ***uint32_t WordLength***
- ***uint32_t Parity***
- ***uint32_t Mode***
- ***uint8_t Prescaler***
- ***uint32_t IrDAMode***

Field Documentation

- ***uint32_t IRDA_InitTypeDef::BaudRate***
  This member configures the IRDA communication baud rate. The baud rate is computed using the following formula:IntegerDivider = ((PCLKx) / (16 * (hirda->Init.BaudRate)))FractionalDivider = ((IntegerDivider - ((uint32_t) IntegerDivider)) * 16) + 0.5
- ***uint32_t IRDA_InitTypeDef::WordLength***
  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***IRDA_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 wether 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 prescaler value to be programmed in the IrDA low-power Baud Register, for defining pulse width on which burst acceptance/rejection will be decided. This value is used as divisor of system clock to achieve required pulse width.
- ***uint32_t IRDA_InitTypeDef::IrDAMode***
  Specifies the IrDA mode This parameter can be a value of ***IRDA_Low_Power***

24.1.2 IRDA_HandleTypeDef

Data Fields

- ***USART_TypeDef * Instance***
- ***IRDA_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***uint16_t RxXferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***

- ***HAL_LockTypeDef Lock***
- ***__IO HAL_IRDA_StateTypeDef State***
- ***__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
- ***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
- ***uint16_t IRDA_HandleTypeDef::RxXferCount***
  IRDA Rx Transfer Counter
- ***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::State***
  IRDA communication state
- ***__IO uint32_t IRDA_HandleTypeDef::ErrorCode***
  IRDA Error code

24.2 IRDA Firmware driver API description

24.2.1 How to use this driver

The IRDA HAL driver can be used as follows:

1. Declare a IRDA_HandleTypeDef handle structure.
2. Initialize the IRDA low level resources by implementing the HAL_IRDA_MspInit() API:
   a. Enable the USARTx interface clock.
   b. IRDA pins configuration:
      – Enable the clock for the IRDA GPIOs.
      – Configure the IRDA pins as alternate function pull-up.
   c. NVIC configuration if you need to use interrupt process (HAL_IRDA_Transmit_IT() and HAL_IRDA_Receive_IT() APIs):
      – Configure the USARTx interrupt priority.
      – Enable the NVIC USART IRQ handle.
   d. 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 initilalized 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.
  - Configure the USARTx interrupt priority and enable the NVIC USART IRQ handle (used for last byte sending completion detection in DMA non circular mode)

3. Program the Baud Rate, Word Length, Parity, IrDA Mode, Prescaler and Mode(Receiver/Transmitter) in the hirda 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 customed HAL_IRDA_MspInit() API. 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 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 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 the specified IRDA interrupt has occurred or not

You can refer to the IRDA HAL driver header file for more useful macros

24.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USARTx or the UARTy in IrDA mode.

- For the asynchronous mode only these parameters can be configured:
  - Baud Rate
  - Word Length
  - Parity
  - Prescaler: A pulse of width less than two and greater than one PSC period(s) may or may not be rejected. The receiver set up time should be managed by software. The IrDA physical layer specification specifies a minimum of 10 ms delay between transmission and reception (IrDA is a half duplex protocol).
  - Mode: Receiver/transmitter modes
  - IrDAMode: the IrDA can operate in the Normal mode or in the Low power mode.

The HAL_IRDA_Init() function follows IRDA configuration procedures (details for the procedures are available in reference manual (RM0038)).

This section contains the following APIs:

- ***HAL_IRDA_Init()***
- ***HAL_IRDA_DeInit()***
- ***HAL_IRDA_MspInit()***
- ***HAL_IRDA_MspDeInit()***

24.2.3 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.
   - 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 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()

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_IRQHandler()***
- ***HAL_IRDA_TxCpltCallback()***
- ***HAL_IRDA_TxHalfCpltCallback()***
- ***HAL_IRDA_RxCpltCallback()***
- ***HAL_IRDA_RxHalfCpltCallback()***
- ***HAL_IRDA_ErrorCallback()***

24.2.4 Peripheral State and Errors 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.
- HAL_IRDA_GetError() check in run-time errors that could be occurred during communication.

This section contains the following APIs:

- ***HAL_IRDA_GetState()***
- ***HAL_IRDA_GetError()***

24.2.5 Detailed description of functions

HAL_IRDA_Init

Function name **HAL_StatusTypeDef HAL_IRDA_Init (IRDA_HandleTypeDef * hirda)**

Function description Initializes the IRDA mode according to the specified parameters in the IRDA_InitTypeDef and create 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 DeInitializes 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 IRDA MSP Init.

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 IRDA MSP DeInit.

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 Sends 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 Sends an amount of data in non-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

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 Receives an amount of data in non-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

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 Sends an amount of data in non-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

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 non-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

Return values
- **HAL:** status

Notes
- When the IRDA parity is enabled (PCE = 1) the data received contain the parity bit.

HAL_IRDA_DMAPause

Function name **HAL_StatusTypeDef HAL_IRDA_DMAPause (IRDA_HandleTypeDef * hirda)**

Function description Pauses 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 Resumes 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 Stops 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_IRQHandler

Function name **void HAL_IRDA_IRQHandler (IRDA_HandleTypeDef * hirda)**

Function description This function handles 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 callbacks.

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 callbacks.

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 callbacks.

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 callbacks.

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 callbacks.

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 Returns the IRDA 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 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

24.3 IRDA Firmware driver defines

24.3.1 IRDA

IRDA Error Codes

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

IRDA Exported Macros

__HAL_IRDA_RESET_HANDLE_STATE

Description:

- Reset IRDA handle state.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_FLUSH_DRREGISTER

Description:

- Flush the IRDA DR register.

Parameters:

- __HANDLE__: specifies the USART Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

__HAL_IRDA_GET_FLAG

Description:

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

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - 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_IDLE: Idle Line detection 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_CLEAR_FLAG

Description:

- Clear the specified IRDA pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - IRDA_FLAG_TC: Transmission Complete flag.
  - IRDA_FLAG_RXNE: Receive data register not empty flag.

Return value:

- None

Notes:

- PE (Parity error), FE (Framing error), NE (Noise error), ORE (OverRun error) and IDLE (Idle line detected) flags are cleared by software sequence: a read operation to USART_SR register followed by a read operation to USART_DR register. RXNE flag can be also cleared by a read to the USART_DR register. TC flag can be also cleared by software sequence: a read operation to USART_SR register followed by a write operation to USART_DR register. TXE flag is cleared only by a write to the USART_DR register.

__HAL_IRDA_CLEAR_PEFLAG

Description:

- Clear the IRDA PE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_CLEAR_FEFLAG

Description:

- Clear the IRDA FE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_CLEAR_NEFLAG

Description:

- Clear the IRDA NE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_CLEAR_OREFLAG

Description:

- Clear the IRDA ORE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_CLEAR_IDLEFLAG

Description:

- Clear the IRDA IDLE pending flag.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_ENABLE_IT

Description:

- Enable the specified IRDA interrupt.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __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. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __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_SOURCE

Description:

- Check whether the specified IRDA interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __IT__: 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: Error interrupt
  - IRDA_IT_PE: Parity Error interrupt

Return value:

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

__HAL_IRDA_ONE_BIT_SAMPLE_ENABLE

Description:

- Enables the IRDA one bit sample method.

Parameters:

- __HANDLE__: specifies the IRDA Handle.

Return value:

- None

__HAL_IRDA_ONE_BIT_SAMPLE_DISABLE

Description:

- Disables 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. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_IRDA_DISABLE

Description:

- Disable UART/USART associated to IRDA Handle.

Parameters:

- __HANDLE__: specifies the IRDA Handle. IRDA Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

IRDA Flags

IRDA_FLAG_TXE

IRDA_FLAG_TC

IRDA_FLAG_RXNE

IRDA_FLAG_IDLE

IRDA_FLAG_ORE

IRDA_FLAG_NE

IRDA_FLAG_FE

IRDA_FLAG_PE

IRDA Interrupt Definitions

IRDA_IT_PE

IRDA_IT_TXE

IRDA_IT_TC

IRDA_IT_RXNE

IRDA_IT_IDLE

IRDA_IT_LBD

IRDA_IT_CTS

IRDA_IT_ERR

IRDA Low Power

IRDA_POWERMODE_LOWPOWER

IRDA_POWERMODE_NORMAL

IRDA One Bit Sampling

IRDA_ONE_BIT_SAMPLE_DISABLE

IRDA_ONE_BIT_SAMPLE_ENABLE

IRDA Parity

IRDA_PARITY_NONE

IRDA_PARITY_EVEN

IRDA_PARITY_ODD

IRDA Transfer Mode

IRDA_MODE_RX

IRDA_MODE_TX

IRDA_MODE_TX_RX

IRDA Word Length

IRDA_WORDLENGTH_8B

IRDA_WORDLENGTH_9B

25 HAL IWDG Generic Driver

25.1 IWDG Firmware driver registers structures

25.1.1 IWDG_InitTypeDef

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t Reload***

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

25.1.2 IWDG_HandleTypeDef

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

25.2 IWDG Firmware driver API description

25.2.1 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 @37KHz (LSI): ~108us / ~28.3s The IWDG timeout may vary due to LSI frequency dispersion. STM32L1xx devices provide the capability to measure the LSI frequency (LSI clock connected internally to TIM10 CH1 input capture). The measured value can be used to have an IWDG timeout with an acceptable accuracy. For more information, please refer to the STM32L1xx Reference manual.

25.2.2 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 downcounting.
   - Enable write access to configuration register: IWDG_PR, IWDG_RLR.
   - 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"
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

25.2.3 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.
- 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()***

25.2.4 IO operation functions

This section provides functions allowing to:

- Refresh the IWDG.

This section contains the following APIs:

- ***HAL_IWDG_Refresh()***

25.2.5 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

25.3 IWDG Firmware driver defines

25.3.1 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 & 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

26 HAL LCD Generic Driver

26.1 LCD Firmware driver registers structures

26.1.1 LCD_InitTypeDef

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***
  Configures the LCD High Drive. 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 set to ENABLE or DISABLE.

26.1.2 LCD_HandleTypeDef

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***

26.2 LCD Firmware driver API description

26.2.1 How to use this driver

The LCD HAL driver can be used as follows:

1. Declare a LCD_HandleTypeDef handle structure.
2. Initialize the LCD low level resources by implement the HAL_LCD_MspInit() API:
   a. 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)
      – 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.
   b. LCD pins configuration:
      – Enable the clock for the LCD GPIOs.
      – Configure these LCD pins as alternate function no-pull.
   c. Enable the LCD interface clock.
3. Program the Prescaler, Divider, Blink mode, Blink Frequency Duty, Bias, Voltage Source, Dead Time, Pulse On Duration and Contrast in the hlcd Init structure.
4. Initialize the LCD registers by calling the HAL_LCD_Init() API. The HAL_LCD_Init() API configures also the low level Hardware GPIO, CLOCK, ...etc) by calling the custumed HAL_LCD_MspInit() API. 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
   – 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 STOP mode.

26.2.2 Initialization and Configuration functions

This section contains the following APIs:

- ***HAL_LCD_DeInit()***
- ***HAL_LCD_Init()***
- ***HAL_LCD_MspDeInit()***
- ***HAL_LCD_MspInit()***

26.2.3 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()***

26.2.4 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()***

26.2.5 Detailed description of functions

HAL_LCD_DeInit

Function name **HAL_StatusTypeDef HAL_LCD_DeInit (LCD_HandleTypeDef * hlcd)**

Function description DeInitializes 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 Initializes the LCD peripheral according to the specified parameters in the LCD_InitStruct.

Parameters
- **hlcd:** LCD handle

Return values
- **None:**

Notes
- This function can be used only when the LCD is disabled. The LCD HighDrive can be enabled/disabled using related macros up to user.

HAL_LCD_MspInit

Function name **void HAL_LCD_MspInit (LCD_HandleTypeDef * hlcd)**

Function description LCD MSP Init.

Parameters
- **hlcd:** LCD handle

Return values
- **None:**

HAL_LCD_MspDeInit

Function name **void HAL_LCD_MspDeInit (LCD_HandleTypeDef * hlcd)**

Function description LCD MSP DeInit.

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 Writes 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 Clears 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 Enables 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	Returns the LCD 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	Waits until the LCD FCR register is synchronized in the LCDCLK domain.
Return values	• **None:**

26.3 LCD Firmware driver defines

26.3.1 LCD

LCD Bias

LCD_BIAS_1_4	1/4 Bias
LCD_BIAS_1_2	1/2 Bias
LCD_BIAS_1_3	1/3 Bias

IS_LCD_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

IS_LCD_BLINK_FREQUENCY

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)

IS_LCD_BLINK_MODE

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 = 3.25V
LCD_CONTRASTLEVEL_6	Maximum Voltage = 3.38V
LCD_CONTRASTLEVEL_7	Maximum Voltage = 3.51V

IS_LCD_CONTRAST

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

IS_LCD_DEAD_TIME

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

IS_LCD_DIVIDER

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

IS_LCD_DUTY

LCD Error Codes

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:

- macros to enables or disables the LCD

Parameters:

- __HANDLE__: specifies the LCD Handle.

Return value:

- None

__HAL_LCD_DISABLE

__HAL_LCD_HIGHDRIVER_ENABLE

Description:

- Macros to enable or disable the low resistance divider.

Parameters:

- __HANDLE__: specifies the LCD Handle.

Return value:

- None

Notes:

- When this mode is enabled, the PulseOn Duration (PON) have to be programmed to 1/CK_PS (LCD_PULSEONDURATION_1).

__HAL_LCD_HIGHDRIVER_DISABLE

__HAL_LCD_PULSEONDURATION_CONFIG

Description:

- Macro to configure the LCD pulses 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:

- Macro to 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:

- Macro to 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:

- Macro to 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:

- Enables or disables the specified LCD interrupt.

Parameters:

- __HANDLE__: specifies the LCD Handle.
- __INTERRUPT__: specifies the LCD interrupt source to be enabled or 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_DISABLE_IT

__HAL_LCD_GET_IT_SOURCE

Description:

- Checks whether the specified LCD

interrupt 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:

- Checks 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:

- Clears 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 Flag

LCD_FLAG_ENS

LCD_FLAG_SOF

LCD_FLAG_UDR

LCD_FLAG_UDD

LCD_FLAG_RDY

LCD_FLAG_FCRSF

LCD HighDrive

LCD_HIGHDRIVE_0	Low resistance Drive
LCD_HIGHDRIVE_1	High resistance Drive

IS_LCD_HIGHDRIVE

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]

IS_LCD_MUXSEGMENT

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

IS_LCD_PRESCALER

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

IS_LCD_PULSE_ON_DURATION

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

IS_LCD_RAM_REGISTER

LCD Voltage Source

LCD_VOLTAGESOURCE_INTERNAL	Internal voltage source for the LCD
LCD_VOLTAGESOURCE_EXTERNAL	External voltage source for the LCD

IS_LCD_VOLTAGE_SOURCE

27 HAL NOR Generic Driver

27.1 NOR Firmware driver registers structures

27.1.1 NOR_IDTypeDef

Data Fields

- ***uint16_t Manufacturer_Code***
- ***uint16_t Device_Code1***
- ***uint16_t Device_Code2***
- ***uint16_t Device_Code3***

Field Documentation

- ***uint16_t NOR_IDTypeDef::Manufacturer_Code***
  Defines the device's manufacturer code used to identify the memory
- ***uint16_t NOR_IDTypeDef::Device_Code1***
- ***uint16_t NOR_IDTypeDef::Device_Code2***
- ***uint16_t NOR_IDTypeDef::Device_Code3***
  Defines the device's codes used to identify the memory. These codes can be accessed by performing read operations with specific control signals and addresses set.They can also be accessed by issuing an Auto Select command

27.1.2 NOR_CFITypeDef

Data Fields

- ***uint16_t CFI_1***
- ***uint16_t CFI_2***
- ***uint16_t CFI_3***
- ***uint16_t CFI_4***

Field Documentation

- ***uint16_t NOR_CFITypeDef::CFI_1***
  < Defines the information stored in the memory's Common flash interface which contains a description of various electrical and timing parameters, density information and functions supported by the memory
- ***uint16_t NOR_CFITypeDef::CFI_2***
- ***uint16_t NOR_CFITypeDef::CFI_3***
- ***uint16_t NOR_CFITypeDef::CFI_4***

27.1.3 NOR_HandleTypeDef

Data Fields

- ***FSMC_NORSRAM_TypeDef * Instance***
- ***FSMC_NORSRAM_EXTENDED_TypeDef * Extended***
- ***FSMC_NORSRAM_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_NOR_StateTypeDef State***

Field Documentation

- ***FSMC_NORSRAM_TypeDef* NOR_HandleTypeDef::Instance***
  Register base address

- ***FSMC_NORSRAM_EXTENDED_TypeDef* NOR_HandleTypeDef::Extended***
  Extended mode register base address
- ***FSMC_NORSRAM_InitTypeDef NOR_HandleTypeDef::Init***
  NOR device control configuration parameters
- ***HAL_LockTypeDef NOR_HandleTypeDef::Lock***
  NOR locking object
- ***__IO HAL_NOR_StateTypeDef NOR_HandleTypeDef::State***
  NOR device access state

27.2 NOR Firmware driver API description

27.2.1 How to use this driver

This driver is a generic layered driver which contains a set of APIs used to control NOR flash memories. It uses the FSMC layer functions to interface with NOR devices. This driver is used as follows:

- NOR flash memory configuration sequence using the function HAL_NOR_Init() with control and timing parameters for both normal and extended mode.
- Read NOR flash memory manufacturer code and device IDs using the function HAL_NOR_Read_ID(). The read information is stored in the NOR_ID_TypeDef structure declared by the function caller.
- Access NOR flash memory by read/write data unit operations using the functions HAL_NOR_Read(), HAL_NOR_Program().
- Perform NOR flash erase block/chip operations using the functions HAL_NOR_Erase_Block() and HAL_NOR_Erase_Chip().
- Read the NOR flash CFI (common flash interface) IDs using the function HAL_NOR_Read_CFI(). The read information is stored in the NOR_CFI_TypeDef structure declared by the function caller.
- You can also control the NOR device by calling the control APIs HAL_NOR_WriteOperation_Enable()/ HAL_NOR_WriteOperation_Disable() to respectively enable/disable the NOR write operation
- You can monitor the NOR device HAL state by calling the function HAL_NOR_GetState()

This driver is a set of generic APIs which handle standard NOR flash operations. If a NOR flash device contains different operations and/or implementations, it should be implemented separately.

NOR HAL driver macros list

Below the list of most used macros in NOR HAL driver.

- NOR_WRITE : NOR memory write data to specified address

27.2.2 NOR Initialization and de_initialization functions

This section provides functions allowing to initialize/de-initialize the NOR memory

This section contains the following APIs:

- ***HAL_NOR_Init()***
- ***HAL_NOR_DeInit()***
- ***HAL_NOR_MspInit()***
- ***HAL_NOR_MspDeInit()***
- ***HAL_NOR_MspWait()***

27.2.3 NOR Input and Output functions

This section provides functions allowing to use and control the NOR memory

This section contains the following APIs:

- ***HAL_NOR_Read_ID()***
- ***HAL_NOR_ReturnToReadMode()***
- ***HAL_NOR_Read()***
- ***HAL_NOR_Program()***
- ***HAL_NOR_ReadBuffer()***
- ***HAL_NOR_ProgramBuffer()***
- ***HAL_NOR_Erase_Block()***
- ***HAL_NOR_Erase_Chip()***
- ***HAL_NOR_Read_CFI()***

27.2.4 NOR Control functions

This subsection provides a set of functions allowing to control dynamically the NOR interface.

This section contains the following APIs:

- ***HAL_NOR_WriteOperation_Enable()***
- ***HAL_NOR_WriteOperation_Disable()***

27.2.5 NOR State functions

This subsection permits to get in run-time the status of the NOR controller and the data flow.

This section contains the following APIs:

- ***HAL_NOR_GetState()***
- ***HAL_NOR_GetStatus()***

27.2.6 Detailed description of functions

HAL_NOR_Init

Function name	**HAL_StatusTypeDef HAL_NOR_Init (NOR_HandleTypeDef * hnor, FSMC_NORSRAM_TimingTypeDef * Timing, FSMC_NORSRAM_TimingTypeDef * ExtTiming)**
Function description	Perform the NOR memory Initialization sequence.
Parameters	• **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module. • **Timing:** pointer to NOR control timing structure • **ExtTiming:** pointer to NOR extended mode timing structure
Return values	• **HAL:** status

HAL_NOR_DeInit

Function name	**HAL_StatusTypeDef HAL_NOR_DeInit (NOR_HandleTypeDef * hnor)**
Function description	Perform NOR memory De-Initialization sequence.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

Return values
- **HAL:** status

HAL_NOR_MspInit

Function name **void HAL_NOR_MspInit (NOR_HandleTypeDef * hnor)**

Function description NOR MSP Init.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

Return values
- **None:**

HAL_NOR_MspDeInit

Function name **void HAL_NOR_MspDeInit (NOR_HandleTypeDef * hnor)**

Function description NOR MSP DeInit.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

Return values
- **None:**

HAL_NOR_MspWait

Function name **void HAL_NOR_MspWait (NOR_HandleTypeDef * hnor, uint32_t Timeout)**

Function description NOR MSP Wait fro Ready/Busy signal.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **Timeout:** Maximum timeout value

Return values
- **None:**

HAL_NOR_Read_ID

Function name **HAL_StatusTypeDef HAL_NOR_Read_ID (NOR_HandleTypeDef * hnor, NOR_IDTypeDef * pNOR_ID)**

Function description Read NOR flash IDs.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **pNOR_ID:** : pointer to NOR ID structure

Return values
- **HAL:** status

HAL_NOR_ReturnToReadMode

Function name **HAL_StatusTypeDef HAL_NOR_ReturnToReadMode (NOR_HandleTypeDef * hnor)**

Function description Returns the NOR memory to Read mode.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that

contains the configuration information for NOR module.

Return values
- **HAL:** status

HAL_NOR_Read

Function name **HAL_StatusTypeDef HAL_NOR_Read (NOR_HandleTypeDef * hnor, uint32_t * pAddress, uint16_t * pData)**

Function description Read data from NOR memory.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **pAddress:** pointer to Device address
- **pData:** : pointer to read data

Return values
- **HAL:** status

HAL_NOR_Program

Function name **HAL_StatusTypeDef HAL_NOR_Program (NOR_HandleTypeDef * hnor, uint32_t * pAddress, uint16_t * pData)**

Function description Program data to NOR memory.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **pAddress:** Device address
- **pData:** : pointer to the data to write

Return values
- **HAL:** status

HAL_NOR_ReadBuffer

Function name **HAL_StatusTypeDef HAL_NOR_ReadBuffer (NOR_HandleTypeDef * hnor, uint32_t uwAddress, uint16_t * pData, uint32_t uwBufferSize)**

Function description Reads a block of data from the FSMC NOR memory.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **uwAddress:** NOR memory internal address to read from.
- **pData:** pointer to the buffer that receives the data read from the NOR memory.
- **uwBufferSize:** : number of Half word to read.

Return values
- **HAL:** status

HAL_NOR_ProgramBuffer

Function name **HAL_StatusTypeDef HAL_NOR_ProgramBuffer (NOR_HandleTypeDef * hnor, uint32_t uwAddress, uint16_t * pData, uint32_t uwBufferSize)**

Function description Writes a half-word buffer to the FSMC NOR memory.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

- **uwAddress:** NOR memory internal address from which the data
- **pData:** pointer to source data buffer.
- **uwBufferSize:** number of Half words to write.

Return values
- **HAL:** status

Notes
- Some NOR memory need Address aligned to xx bytes (can be aligned to 64 bytes boundary for example).
- The maximum buffer size allowed is NOR memory dependent (can be 64 Bytes max for example).

HAL_NOR_Erase_Block

Function name **HAL_StatusTypeDef HAL_NOR_Erase_Block (NOR_HandleTypeDef * hnor, uint32_t BlockAddress, uint32_t Address)**

Function description Erase the specified block of the NOR memory.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **BlockAddress:** : Block to erase address
- **Address:** Device address

Return values
- **HAL:** status

HAL_NOR_Erase_Chip

Function name **HAL_StatusTypeDef HAL_NOR_Erase_Chip (NOR_HandleTypeDef * hnor, uint32_t Address)**

Function description Erase the entire NOR chip.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **Address:** : Device address

Return values
- **HAL:** status

HAL_NOR_Read_CFI

Function name **HAL_StatusTypeDef HAL_NOR_Read_CFI (NOR_HandleTypeDef * hnor, NOR_CFITypeDef * pNOR_CFI)**

Function description Read NOR flash CFI IDs.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **pNOR_CFI:** : pointer to NOR CFI IDs structure

Return values
- **HAL:** status

HAL_NOR_WriteOperation_Enable

Function name **HAL_StatusTypeDef HAL_NOR_WriteOperation_Enable (NOR_HandleTypeDef * hnor)**

Function description Enables dynamically NOR write operation.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

Return values
- **HAL:** status

HAL_NOR_WriteOperation_Disable

Function name **HAL_StatusTypeDef HAL_NOR_WriteOperation_Disable (NOR_HandleTypeDef * hnor)**

Function description Disables dynamically NOR write operation.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

Return values
- **HAL:** status

HAL_NOR_GetState

Function name **HAL_NOR_StateTypeDef HAL_NOR_GetState (NOR_HandleTypeDef * hnor)**

Function description return the NOR controller state

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.

Return values
- **NOR:** controller state

HAL_NOR_GetStatus

Function name **HAL_NOR_StatusTypeDef HAL_NOR_GetStatus (NOR_HandleTypeDef * hnor, uint32_t Address, uint32_t Timeout)**

Function description Returns the NOR operation status.

Parameters
- **hnor:** pointer to a NOR_HandleTypeDef structure that contains the configuration information for NOR module.
- **Address:** Device address
- **Timeout:** NOR progamming Timeout

Return values
- **NOR_Status:** The returned value can be: HAL_NOR_STATUS_SUCCESS, HAL_NOR_STATUS_ERROR or HAL_NOR_STATUS_TIMEOUT

27.3 NOR Firmware driver defines

27.3.1 NOR

NOR Exported Macros

__HAL_NOR_RESET_HANDLE_STATE **Description:**
- Reset NOR handle state.

Parameters:
- __HANDLE__: NOR handle

Return value:

- None

28 HAL OPAMP Generic Driver

28.1 OPAMP Firmware driver registers structures

28.1.1 OPAMP_InitTypeDef

Data Fields

- ***uint32_t PowerSupplyRange***
- ***uint32_t PowerMode***
- ***uint32_t Mode***
- ***uint32_t InvertingInput***
- ***uint32_t NonInvertingInput***
- ***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 or Follower
- ***uint32_t OPAMP_InitTypeDef::InvertingInput***
  Specifies the inverting input in Standalone modeIn Standalone mode: i.e when mode is OPAMP_STANDALONE_MODE This parameter must be a value of ***OPAMP_InvertingInput*** InvertingInput is either VM0 or VM1In 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*** Note: Non-inverting input availability depends on OPAMP instance: OPAMP1: Non-inverting input is either IO0, DAC_Channel1 OPAMP2: Non-inverting input is either IO0, DAC_Channel1, DAC_Channel2 OPAMP3: Non-inverting input is either IO0, DAC_Channel2 (OPAMP3 availability depends on STM32L1 devices)
- ***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. 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::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 = 30 (Trimming value 31 is forbidden) 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 = 30 (Trimming value 31 is forbidden) 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 = 30 (Trimming value 31 is forbidden) 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 = 30 (Trimming value 31 is forbidden) 16 is typical default value

28.1.2 OPAMP_HandleTypeDef

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

28.2 OPAMP Firmware driver API description

28.2.1 OPAMP Peripheral Features

The device integrates up to 3 operational amplifiers OPAMP1, OPAMP2, OPAMP3 (OPAMP3 availability depends on device category)

1. The OPAMP(s) provides several exclusive running modes.
   - Standalone mode
   - Follower mode
2. 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
3. Each OPAMP(s) can be configured in normal and low power mode.
4. 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 in 2 steps: for transistors differential pair high (PMOS) or low (NMOS)
  - 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)
  - For devices having several OPAMPs, HAL_OPAMPEx_SelfCalibrateAll runs calibration of all OPAMPs in parallel to save search time.
5. 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.
6. Running mode: Follower mode
  - No Inverting Input is connected.
  - The OPAMP(s) output(s) are internally connected to inverting input.

28.2.2 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. Configure the opamp using HAL_OPAMP_Init() function:
  - Select the mode
  - Select the inverting input
  - Select the non-inverting input
  - Select either factory or user defined trimming mode.
  - If the user defined trimming mode is enabled, select PMOS & NMOS trimming values (typ. settings returned by HAL_OPAMP_SelfCalibrate function).

3. Enable the opamp using HAL_OPAMP_Start() function.
4. Disable the opamp using HAL_OPAMP_Stop() function.
5. Lock the opamp in running mode using HAL_OPAMP_Lock() function. Caution: On STM32L1, HAL OPAMP lock is software lock only (not hardware lock as on some other STM32 devices)
6. 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, selects 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.

28.2.3 Initialization and de-initialization functions

This section provides functions allowing to:

This section contains the following APIs:

- ***HAL_OPAMP_Init()***
- ***HAL_OPAMP_DeInit()***
- ***HAL_OPAMP_MspInit()***
- ***HAL_OPAMP_MspDeInit()***

28.2.4 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()***

28.2.5 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()***

28.2.6 Peripheral State functions

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

This section contains the following APIs:

- ***HAL_OPAMP_GetState()***

28.2.7 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 create 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	DeInitializes the OPAMP peripheral.
Parameters	• **hopamp:** OPAMP handle
Return values	• **HAL:** status
Notes	• Deinitialization can be performed if the OPAMP configuration is locked. (the OPAMP lock is SW in STM32L1)

HAL_OPAMP_MspInit

Function name	**void HAL_OPAMP_MspInit (OPAMP_HandleTypeDef * hopamp)**
Function description	Initializes the OPAMP MSP.
Parameters	• **hopamp:** OPAMP handle
Return values	• **None:**

HAL_OPAMP_MspDeInit

Function name	**void HAL_OPAMP_MspDeInit (OPAMP_HandleTypeDef * hopamp)**
Function description	DeInitializes 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
- Trimming values (PMOS & NMOS) are updated and user trimming is enabled if calibration is succesful.
- 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

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 Caution: On STM32L1 OPAMP, user can retrieve factory trimming if OPAMP has never been set to user trimming before.

Parameters
- **hopamp:** : OPAMP handle
- **trimmingoffset:** : Trimming offset (P or N) This parameter must be a value of OPAMP FactoryTrimming

Return values
- **Trimming:** value (P or N): range: 0->31 or OPAMP_FACTORYTRIMMING_DUMMY if trimming value is not available

Notes
- 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 state.

Parameters
- **hopamp:** : OPAMP handle

Return values
- **HAL:** state

28.3 OPAMP Firmware driver defines

28.3.1 OPAMP

OPAMP Exported Constants

OPAMP_TRIM_VALUE_MASK

OPAMP_CSR_INSTANCE_OFFSET

OPAMP_OTR_INSTANCE_OFFSET

OPAMP FactoryTrimming

OPAMP_FACTORYTRIMMING_DUMMY	Dummy value if trimming value could not be retrieved
OPAMP_FACTORYTRIMMING_P	Offset trimming P
OPAMP_FACTORYTRIMMING_N	Offset trimming N

OPAMP InvertingInput

OPAMP_INVERTINGINPUT_IO0	Comparator inverting input connected to dedicated IO pin low-leakage
OPAMP_INVERTINGINPUT_IO1	Comparator inverting input connected to alternative IO pin available on some device packages

OPAMP Mode

OPAMP_STANDALONE_MODE	OPAMP standalone mode
OPAMP_FOLLOWER_MODE	OPAMP follower mode

OPAMP NonInvertingInput

OPAMP_NONINVERTINGINPUT_IO0	Comparator non-inverting input connected to dedicated IO pin low-leakage
OPAMP_NONINVERTINGINPUT_DAC_CH1	Comparator non-inverting input connected internally to DAC channel 1. Available only on OPAMP1 and OPAMP2.

OPAMP_NONINVERTINGINPUT_DAC_CH2	Comparator non-inverting input connected internally to DAC channel 2. Available only on OPAMP2 and OPAMP3 (OPAMP3 availability depends on STM32L1 devices).

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

29 HAL OPAMP Extension Driver

29.1 OPAMPEx Firmware driver API description

29.1.1 Peripheral Control functions

- OPAMP unlock.

This section contains the following APIs:

- ***HAL_OPAMPEx_Unlock()***

29.1.2 Extended IO operation functions

- OPAMP Self calibration.

This section contains the following APIs:

- ***HAL_OPAMPEx_SelfCalibrateAll()***

29.1.3 Detailed description of functions

HAL_OPAMPEx_SelfCalibrateAll

Function name	**HAL_StatusTypeDef HAL_OPAMPEx_SelfCalibrateAll (OPAMP_HandleTypeDef * hopamp1, OPAMP_HandleTypeDef * hopamp2, OPAMP_HandleTypeDef * hopamp3)**
Function description	Run the self calibration of the 3 OPAMPs in parallel.
Parameters	• **hopamp1:** handle • **hopamp2:** handle • **hopamp3:** handle
Return values	• **HAL:** status
Notes	• Trimming values (PMOS & NMOS) are updated and user trimming is enabled is calibration is succesful. • 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 dichotmy 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

29.2 OPAMPEx Firmware driver defines

29.2.1 OPAMPEx

OPAMPEx Exported Constants

OPAMP_CSR_OPAXPD_ALL

OPAMP_CSR_OPAXCAL_L_ALL

OPAMP_CSR_OPAXCAL_H_ALL

OPAMP_CSR_ALL_SWITCHES_ALL_OPAMPS

OPAMPEx Exported Macro

__HAL_OPAMP_OPAMP3OUT_CONNECT_ADC_COMP1

Description:

- Enable internal analog switch SW1 to connect OPAMP3 ouput to ADC switch matrix (ADC channel VCOMP, channel 26) and COMP1 non-inverting input (OPAMP3 available on STM32L1 devices Cat.4 only).

Return value:

- None

__HAL_OPAMP_OPAMP3OUT_DISCONNECT_ADC_COMP1

Description:

- Disable internal analog switch SW1 to disconnect OPAMP3 ouput from ADC switch matrix (ADC channel VCOMP, channel 26) and COMP1 non-inverting input.

Return value:

- None

30 HAL PCD Generic Driver

30.1 PCD Firmware driver registers structures

30.1.1 PCD_InitTypeDef

Data Fields

- ***uint32_t dev_endpoints***
- ***uint32_t speed***
- ***uint32_t ep0_mps***
- ***uint32_t phy_itface***
- ***uint32_t Sof_enable***
- ***uint32_t low_power_enable***
- ***uint32_t lpm_enable***
- ***uint32_t battery_charging_enable***

Field Documentation

- ***uint32_t PCD_InitTypeDef::dev_endpoints***
  Device Endpoints number. This parameter depends on the used USB core. This parameter must be a number between Min_Data = 1 and Max_Data = 15
- ***uint32_t PCD_InitTypeDef::speed***
  USB Core speed. This parameter can be any value of ***PCD_Core_Speed***
- ***uint32_t PCD_InitTypeDef::ep0_mps***
  Set the Endpoint 0 Max Packet size. This parameter can be any value of ***PCD_EP0_MPS***
- ***uint32_t PCD_InitTypeDef::phy_itface***
  Select the used PHY interface. This parameter can be any value of ***PCD_Core_PHY***
- ***uint32_t PCD_InitTypeDef::Sof_enable***
  Enable or disable the output of the SOF signal. This parameter can be set to ENABLE or DISABLE
- ***uint32_t PCD_InitTypeDef::low_power_enable***
  Enable or disable Low Power mode This parameter can be set to ENABLE or DISABLE
- ***uint32_t PCD_InitTypeDef::lpm_enable***
  Enable or disable the Link Power Management . This parameter can be set to ENABLE or DISABLE
- ***uint32_t PCD_InitTypeDef::battery_charging_enable***
  Enable or disable Battery charging. This parameter can be set to ENABLE or DISABLE

30.1.2 PCD_EPTypeDef

Data Fields

- ***uint8_t num***
- ***uint8_t is_in***
- ***uint8_t is_stall***
- ***uint8_t type***
- ***uint16_t pmaadress***
- ***uint16_t pmaaddr0***
- ***uint16_t pmaaddr1***
- ***uint8_t doublebuffer***

- ***uint32_t maxpacket***
- ***uint8_t * xfer_buff***
- ***uint32_t xfer_len***
- ***uint32_t xfer_count***

Field Documentation

- ***uint8_t PCD_EPTypeDef::num***
  Endpoint number This parameter must be a number between Min_Data = 1 and Max_Data = 15
- ***uint8_t PCD_EPTypeDef::is_in***
  Endpoint direction This parameter must be a number between Min_Data = 0 and Max_Data = 1
- ***uint8_t PCD_EPTypeDef::is_stall***
  Endpoint stall condition This parameter must be a number between Min_Data = 0 and Max_Data = 1
- ***uint8_t PCD_EPTypeDef::type***
  Endpoint type This parameter can be any value of ***PCD_EP_Type***
- ***uint16_t PCD_EPTypeDef::pmaadress***
  PMA Address This parameter can be any value between Min_addr = 0 and Max_addr = 1K
- ***uint16_t PCD_EPTypeDef::pmaaddr0***
  PMA Address0 This parameter can be any value between Min_addr = 0 and Max_addr = 1K
- ***uint16_t PCD_EPTypeDef::pmaaddr1***
  PMA Address1 This parameter can be any value between Min_addr = 0 and Max_addr = 1K
- ***uint8_t PCD_EPTypeDef::doublebuffer***
  Double buffer enable This parameter can be 0 or 1
- ***uint32_t PCD_EPTypeDef::maxpacket***
  Endpoint Max packet size This parameter must be a number between Min_Data = 0 and Max_Data = 64KB
- ***uint8_t* PCD_EPTypeDef::xfer_buff***
  Pointer to transfer buffer
- ***uint32_t PCD_EPTypeDef::xfer_len***
  Current transfer length
- ***uint32_t PCD_EPTypeDef::xfer_count***
  Partial transfer length in case of multi packet transfer

30.1.3 PCD_HandleTypeDef

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***
- ***uint32_t Setup***
- ***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[8]***
  IN endpoint parameters
- ***PCD_EPTypeDef PCD_HandleTypeDef::OUT_ep[8]***
  OUT endpoint parameters
- ***HAL_LockTypeDef PCD_HandleTypeDef::Lock***
  PCD peripheral status
- ***__IO PCD_StateTypeDef PCD_HandleTypeDef::State***
  PCD communication state
- ***uint32_t PCD_HandleTypeDef::Setup[12]***
  Setup packet buffer
- ***void* PCD_HandleTypeDef::pData***
  Pointer to upper stack Handler

30.2 PCD Firmware driver API description

30.2.1 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 HCD 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);
   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 HCD transmission and reception:
   a. HAL_PCD_Start();

30.2.2 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()***

30.2.3 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()*

30.2.4 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()*

30.2.5 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()*
- *HAL_PCDEx_SetConnectionState()*

30.2.6 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 create 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 This function handles PCD interrupt request.

Parameters
- **hpcd:** PCD handle

Return values
- **HAL:** status

HAL_PCD_DataOutStageCallback

Function name **void HAL_PCD_DataOutStageCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)**

Function description Data out stage callbacks.

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 callbacks.

Parameters
- **hpcd:** PCD handle
- **epnum:** endpoint number

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_SOFCallback

Function name **void HAL_PCD_SOFCallback (PCD_HandleTypeDef * hpcd)**

Function description USB Start Of Frame callbacks.

Parameters
- **hpcd:** PCD handle

Return values
- **None:**

HAL_PCD_ResetCallback

Function name **void HAL_PCD_ResetCallback (PCD_HandleTypeDef * hpcd)**

Function description USB Reset callbacks.

Parameters
- **hpcd:** PCD handle

Return values
- **None:**

HAL_PCD_SuspendCallback

Function name **void HAL_PCD_SuspendCallback (PCD_HandleTypeDef * hpcd)**

Function description Suspend event callbacks.

Parameters
- **hpcd:** PCD handle

Return values
- **None:**

HAL_PCD_ResumeCallback

Function name **void HAL_PCD_ResumeCallback (PCD_HandleTypeDef * hpcd)**

Function description Resume event callbacks.

Parameters
- **hpcd:** PCD handle

Return values
- **None:**

HAL_PCD_ISOOUTIncompleteCallback

Function name **void HAL_PCD_ISOOUTIncompleteCallback (PCD_HandleTypeDef * hpcd, uint8_t epnum)**

Function description Incomplete ISO OUT callbacks.

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 callbacks.

Parameters
- **hpcd:** PCD handle
- **epnum:** endpoint number

Return values
- **None:**

HAL_PCD_ConnectCallback

Function name **void HAL_PCD_ConnectCallback (PCD_HandleTypeDef * hpcd)**

Function description Connection event callbacks.

Parameters
- **hpcd:** PCD handle

Return values
- **None:**

HAL_PCD_DisconnectCallback

Function name **void HAL_PCD_DisconnectCallback (PCD_HandleTypeDef * hpcd)**

Function description Disconnection event callbacks.

Parameters
- **hpcd:** PCD handle

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	**uint16_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 HAL_PCD_ActivateRemoteWakeup : active 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 HAL_PCD_DeActivateRemoteWakeup : de-active 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 state.

Parameters
- **hpcd:** : PCD handle

Return values
- **HAL:** state

HAL_PCDEx_SetConnectionState

Function name **void HAL_PCDEx_SetConnectionState (PCD_HandleTypeDef * hpcd, uint8_t state)**

Function description Software Device Connection.

Parameters
- **hpcd:** PCD handle

- **state:** Device state

Return values

- **None:**

30.3 PCD Firmware driver defines

30.3.1 PCD

PCD Core PHY

PCD_PHY_EMBEDDED

PCD Core Speed

PCD_SPEED_HIGH

PCD_SPEED_FULL

PCD ENDP

PCD_ENDP0

PCD_ENDP1

PCD_ENDP2

PCD_ENDP3

PCD_ENDP4

PCD_ENDP5

PCD_ENDP6

PCD_ENDP7

IS_PCD_ALL_INSTANCE

PCD Endpoint Kind

PCD_SNG_BUF

PCD_DBL_BUF

PCD EP0 MPS

DEP0CTL_MPS_64

DEP0CTL_MPS_32

DEP0CTL_MPS_16

DEP0CTL_MPS_8

PCD_EP0MPS_64

PCD_EP0MPS_32

PCD_EP0MPS_16

PCD_EP0MPS_08

PCD EP Type

PCD_EP_TYPE_CTRL

PCD_EP_TYPE_ISOC

PCD_EP_TYPE_BULK

PCD_EP_TYPE_INTR

PCD Exported Macros

__HAL_PCD_GET_FLAG

__HAL_PCD_CLEAR_FLAG

__HAL_USB_WAKEUP_EXTI_ENABLE_IT

__HAL_USB_WAKEUP_EXTI_DISABLE_IT

__HAL_USB_WAKEUP_EXTI_GET_FLAG

__HAL_USB_WAKEUP_EXTI_CLEAR_FLAG

__HAL_USB_WAKEUP_EXTI_ENABLE_RISING_EDGE

__HAL_USB_WAKEUP_EXTI_ENABLE_FALLING_EDGE

__HAL_USB_WAKEUP_EXTI_ENABLE_RISING_FALLING_EDGE

PCD_Exti_Line_Wakeup

USB_WAKEUP_EXTI_LINE	External interrupt line 18 Connected to the USB FS EXTI Line

31 HAL PCD Extension Driver

31.1 PCDEx Firmware driver API description

31.1.1 Peripheral Control functions

This section provides functions allowing to:

- Configure PMA for the EndPoint

This section contains the following APIs:

- ***HAL_PCDEx_PMAConfig()***

31.1.2 Detailed description of functions

HAL_PCDEx_PMAConfig

Function name	**HAL_StatusTypeDef HAL_PCDEx_PMAConfig (PCD_HandleTypeDef * hpcd, uint16_t ep_addr, uint16_t ep_kind, uint32_t pmaadress)**
Function description	Configure PMA for EP.
Parameters	• **hpcd:** : Device instance • **ep_addr:** endpoint address • **ep_kind:** endpoint Kind USB_SNG_BUF: Single Buffer used USB_DBL_BUF: Double Buffer used • **pmaadress:** EP address in The PMA: In case of single buffer endpoint this parameter is 16-bit value providing the address in PMA allocated to endpoint. In case of double buffer endpoint this parameter is a 32-bit value providing the endpoint buffer 0 address in the LSB part of 32-bit value and endpoint buffer 1 address in the MSB part of 32-bit value.
Return values	• **::** status

32 HAL PWR Generic Driver

32.1 PWR Firmware driver registers structures

32.1.1 PWR_PVDTypeDef

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***

32.2 PWR Firmware driver API description

32.2.1 Initialization and de-initialization functions

After reset, the backup domain (RTC registers, 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() macro.
- Enable access to RTC domain using the HAL_PWR_EnableBkUpAccess() function.

This section contains the following APIs:

- ***HAL_PWR_DeInit()***
- ***HAL_PWR_EnableBkUpAccess()***
- ***HAL_PWR_DisableBkUpAccess()***

32.2.2 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 the PWR_CR).
- The PVD can use an external input analog voltage (PVD_IN) which is compared internally to VREFINT. The PVD_IN (PB7) has to be configured in Analog mode when PWR_PVDLevel_7 is selected (PLS[2:0] = 111).
- A 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_PWR_PVD_EXTI_ENABLE_IT() macro.
- The PVD is stopped in Standby mode.

WakeUp pin configuration

- WakeUp pin is used to wake up the system from Standby mode. This pin is forced in input pull-down configuration and is active on rising edges.
- There are two or three WakeUp pins: WakeUp Pin 1 on PA.00. WakeUp Pin 2 on PC.13. WakeUp Pin 3 on PE.06. : Only on product with GPIOE available

Main and Backup Regulators configuration

Low Power modes configuration

The device features 5 low-power modes:

- Low power run mode: regulator in low power mode, limited clock frequency, limited number of peripherals running.
- Sleep mode: Cortex-M3 core stopped, peripherals kept running.
- Low power sleep mode: Cortex-M3 core stopped, limited clock frequency, limited number of peripherals running, regulator in low power mode.
- Stop mode: All clocks are stopped, regulator running, regulator in low power mode.
- Standby mode: VCORE domain powered off

Low power run mode

To further reduce the consumption when the system is in Run mode, the regulator can be configured in low power mode. In this mode, the system frequency should not exceed MSI frequency range1. In Low power run mode, all I/O pins keep the same state as in Run mode.

- Entry:
  - VCORE in range2
  - Decrease the system frequency tonot exceed the frequency of MSI frequency range1.
  - The regulator is forced in low power mode using the HAL_PWREx_EnableLowPowerRunMode() function.
- Exit:
  - The regulator is forced in Main regulator mode using the HAL_PWREx_DisableLowPowerRunMode() function.
  - Increase the system frequency if needed.

Sleep mode

- Entry: The Sleep mode is entered by using the HAL_PWR_EnterSLEEPMode(PWR_MAINREGULATOR_ON, PWR_SLEEPENTRY_WFx) functions with
  - PWR_SLEEPENTRY_WFI: enter SLEEP mode with WFI instruction
  - PWR_SLEEPENTRY_WFE: enter SLEEP mode with WFE instruction
- Exit:
  - Any peripheral interrupt acknowledged by the nested vectored interrupt controller (NVIC) can wake up the device from Sleep mode.

Low power sleep mode

- Entry: The Low power sleep mode is entered by using the HAL_PWR_EnterSLEEPMode(PWR_LOWPOWERREGULATOR_ON, PWR_SLEEPENTRY_WFx) functions with

  - PWR_SLEEPENTRY_WFI: enter SLEEP mode with WFI instruction
  - PWR_SLEEPENTRY_WFE: enter SLEEP mode with WFE instruction
- The Flash memory can be switched off by using the control bits (SLEEP_PD in the FLASH_ACR register. This reduces power consumption but increases the wake-up time.
- Exit:
  - If the WFI instruction was used to enter Low power sleep mode, any peripheral interrupt acknowledged by the nested vectored interrupt controller (NVIC) can wake up the device from Low power sleep mode. If the WFE instruction was used to enter Low power sleep mode, the MCU exits Sleep mode as soon as an event occurs.

Stop mode

The Stop mode is based on the Cortex-M3 deepsleep mode combined with peripheral clock gating. The voltage regulator can be configured either in normal or low-power mode. In Stop mode, all clocks in the VCORE domain are stopped, the PLL, the MSI, the HSI and the HSE RC oscillators are disabled. Internal SRAM and register contents are preserved. To get the lowest consumption in Stop mode, the internal Flash memory also enters low power mode. When the Flash memory is in power-down mode, an additional startup delay is incurred when waking up from Stop mode. To minimize the consumption In Stop mode, VREFINT, the BOR, PVD, and temperature sensor can be switched off before entering Stop mode. They can be switched on again by software after exiting Stop mode using the ULP bit in the PWR_CR register. In Stop mode, all I/O pins keep the same state as in Run mode.

- Entry: The Stop mode is entered using the HAL_PWR_EnterSTOPMode(PWR_MAINREGULATOR_ON, PWR_SLEEPENTRY_WFI) function with:
  - Main regulator ON.
  - Low Power regulator ON.
  - PWR_SLEEPENTRY_WFI: enter SLEEP mode with WFI instruction
  - PWR_SLEEPENTRY_WFE: enter SLEEP mode with WFE instruction
- Exit:
  - By issuing an interrupt or a wakeup event, the MSI RC oscillator is selected as system clock.

Standby mode

The Standby mode allows to achieve the lowest power consumption. It is based on the Cortex-M3 deepsleep mode, with the voltage regulator disabled. The VCORE domain is consequently powered off. The PLL, the MSI, the HSI oscillator and the HSE oscillator are also switched off. SRAM and register contents are lost except for the RTC registers, RTC backup registers and Standby circuitry. To minimize the consumption In Standby mode, VREFINT, the BOR, PVD, and temperature sensor can be switched off before entering the Standby mode. They can be switched on again by software after exiting the Standby mode. function.

- Entry:
  - The Standby mode is entered using the HAL_PWR_EnterSTANDBYMode() function.
- Exit:
  - WKUP pin rising edge, RTC alarm (Alarm A and Alarm B), RTC wakeup, tamper event, time-stamp event, external reset in NRST pin, IWDG 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, a time-stamp event, or a comparator event, without depending on an external interrupt (Auto-wakeup mode).

- RTC auto-wakeup (AWU) from the Stop mode
  - To wake up from the Stop mode with an RTC alarm event, it is necessary to:
    - Configure the EXTI Line 17 to be sensitive to rising edges (Interrupt or Event modes) and Enable the RTC Alarm Interrupt using the HAL_RTC_SetAlarm_IT() function
    - Configure the RTC to generate the RTC alarm using the HAL_RTC_Init() and HAL_RTC_SetTime() functions.
  - To wake up from the Stop mode with an RTC Tamper or time stamp event, it is necessary to:
    - Configure the EXTI Line 19 to be sensitive to rising edges (Interrupt or Event modes) and Enable the RTC Tamper or time stamp Interrupt using the HAL_RTCEx_SetTamper_IT() or HAL_RTCEx_SetTimeStamp_IT() functions.
  - To wake up from the Stop mode with an RTC WakeUp event, it is necessary to:
    - Configure the EXTI Line 20 to be sensitive to rising edges (Interrupt or Event modes) and Enable the RTC WakeUp Interrupt using the HAL_RTCEx_SetWakeUpTimer_IT() function.
    - Configure the RTC to generate the RTC WakeUp event using the HAL_RTCEx_SetWakeUpTimer() function.
- RTC auto-wakeup (AWU) from the Standby mode
  - To wake up from the Standby mode with an RTC alarm event, it is necessary to:
    - Enable the RTC Alarm Interrupt using the HAL_RTC_SetAlarm_IT() function.
    - Configure the RTC to generate the RTC alarm using the HAL_RTC_Init() and HAL_RTC_SetTime() functions.
  - To wake up from the Standby mode with an RTC Tamper or time stamp event, it is necessary to:
    - Enable the RTC Tamper or time stamp Interrupt and 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 Standby mode with an RTC WakeUp event, it is necessary to:
    - Enable the RTC WakeUp Interrupt and Configure the RTC to generate the RTC WakeUp event using the HAL_RTCEx_SetWakeUpTimer_IT() and HAL_RTCEx_SetWakeUpTimer() functions.
- Comparator auto-wakeup (AWU) from the Stop mode
  - To wake up from the Stop mode with an comparator 1 or comparator 2 wakeup event, it is necessary to:
    - Configure the EXTI Line 21 or EXTI Line 22 for comparator to be sensitive to to the selected edges (falling, rising or falling and rising) (Interrupt or Event modes) using the COMP functions.
    - Configure the comparator to generate the event.

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_PVD_IRQHandler()***
- ***HAL_PWR_PVDCallback()***

32.2.3 Detailed description of functions

HAL_PWR_DeInit

Function name	**void HAL_PWR_DeInit (void)**
Function description	Deinitializes the PWR peripheral registers to their default reset values.
Return values	• **None:**
Notes	• Before calling this function, the VOS[1:0] bits should be configured to "10" and the system frequency has to be configured accordingly. To configure the VOS[1:0] bits, use the PWR_VoltageScalingConfig() function. • ULP and FWU bits are not reset by this function.

HAL_PWR_EnableBkUpAccess

Function name	**void HAL_PWR_EnableBkUpAccess (void)**
Function description	Enables access to the backup domain (RTC registers, RTC backup data registers).
Return values	• **None:**
Notes	• If the HSE divided by 2, 4, 8 or 16 is used as the RTC clock, the Backup Domain Access should be kept enabled.

HAL_PWR_DisableBkUpAccess

Function name	**void HAL_PWR_DisableBkUpAccess (void)**
Function description	Disables access to the backup domain (RTC registers, RTC backup data registers).
Return values	• **None:**
Notes	• If the HSE divided by 2, 4, 8 or 16 is used as the RTC clock, the Backup Domain Access should be kept enabled.

HAL_PWR_ConfigPVD

Function name	**void HAL_PWR_ConfigPVD (PWR_PVDTypeDef * sConfigPVD)**
Function description	Configures the voltage threshold detected by the Power Voltage Detector(PVD).

Parameters
- **sConfigPVD:** pointer to an PWR_PVDTypeDef structure that contains the configuration information for the PVD.

Return values
- **None:**

Notes
- Refer to the electrical characteristics of your device datasheet for more details about the voltage threshold corresponding to each detection level.

HAL_PWR_EnablePVD

Function name **void HAL_PWR_EnablePVD (void)**

Function description Enables the Power Voltage Detector(PVD).

Return values
- **None:**

HAL_PWR_DisablePVD

Function name **void HAL_PWR_DisablePVD (void)**

Function description Disables the Power Voltage Detector(PVD).

Return values
- **None:**

HAL_PWR_EnableWakeUpPin

Function name **void HAL_PWR_EnableWakeUpPin (uint32_t WakeUpPinx)**

Function description Enables the WakeUp PINx functionality.

Parameters
- **WakeUpPinx:** Specifies the Power Wake-Up pin to enable. This parameter can be one of the following values:
  - PWR_WAKEUP_PIN1
  - PWR_WAKEUP_PIN2
  - PWR_WAKEUP_PIN3: Only on product with GPIOE available

Return values
- **None:**

HAL_PWR_DisableWakeUpPin

Function name **void HAL_PWR_DisableWakeUpPin (uint32_t WakeUpPinx)**

Function description Disables 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: Only on product with GPIOE available

Return values
- **None:**

HAL_PWR_EnterSTOPMode

Function name **void HAL_PWR_EnterSTOPMode (uint32_t Regulator, uint8_t STOPEntry)**

Function description: Enters Stop mode.

Parameters:
- **Regulator:** Specifies the regulator state in Stop mode. This parameter can be one of the following values:
  - PWR_MAINREGULATOR_ON: Stop mode with regulator ON
  - PWR_LOWPOWERREGULATOR_ON: Stop mode with low power regulator ON
- **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 mode, all I/O pins keep the same state as in Run mode.
- When exiting Stop mode by using an interrupt or a wakeup event, MSI RC oscillator is selected as system clock.
- When the voltage regulator operates in low power mode, an additional startup delay is incurred when waking up from Stop mode. By keeping the internal regulator ON during Stop mode, the consumption is higher although the startup time is reduced.

HAL_PWR_EnterSLEEPMode

Function name: **void HAL_PWR_EnterSLEEPMode (uint32_t Regulator, uint8_t SLEEPEntry)**

Function description: Enters Sleep mode.

Parameters:
- **Regulator:** Specifies the regulator state in SLEEP mode. This parameter can be one of the following values:
  - PWR_MAINREGULATOR_ON: SLEEP mode with regulator ON
  - PWR_LOWPOWERREGULATOR_ON: SLEEP mode with low power regulator ON
- **SLEEPEntry:** Specifies if SLEEP mode is entered with WFI or WFE instruction. When WFI entry is used, tick interrupt have to be disabled if not desired as the interrupt wake up source. This parameter can be one of the following values:
  - PWR_SLEEPENTRY_WFI: enter SLEEP mode with WFI instruction
  - PWR_SLEEPENTRY_WFE: enter SLEEP mode with WFE instruction

Return values:
- **None:**

Notes:
- In Sleep mode, all I/O pins keep the same state as in Run mode.

HAL_PWR_EnterSTANDBYMode

Function name	**void HAL_PWR_EnterSTANDBYMode (void)**
Function description	Enters Standby mode.
Return values	• **None:**
Notes	• In Standby mode, all I/O pins are high impedance except for: Reset pad (still available)RTC_AF1 pin (PC13) if configured for tamper, time-stamp, RTC Alarm out, or RTC clock calibration out.WKUP pin 1 (PA0) if enabled.WKUP pin 2 (PC13) if enabled.WKUP pin 3 (PE6) if enabled.

HAL_PWR_EnableSleepOnExit

Function name	**void HAL_PWR_EnableSleepOnExit (void)**
Function description	Indicates 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	Disables Sleep-On-Exit feature when returning from Handler mode to Thread mode.
Return values	• **None:**
Notes	• Clears 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	Enables CORTEX M3 SEVONPEND bit.
Return values	• **None:**
Notes	• Sets 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	Disables CORTEX M3 SEVONPEND bit.
Return values	• **None:**

Notes	• Clears 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_PVD_IRQHandler

Function name	**void HAL_PWR_PVD_IRQHandler (void)**
Function description	This function handles the PWR PVD interrupt request.
Return values	• **None:**
Notes	• This API should be called under the PVD_IRQHandler().

HAL_PWR_PVDCallback

Function name	**void HAL_PWR_PVDCallback (void)**
Function description	PWR PVD interrupt callback.
Return values	• **None:**

32.3 PWR Firmware driver defines

32.3.1 PWR

PWR CR Register alias address

LPSDSR_BIT_NUMBER

CR_LPSDSR_BB

DBP_BIT_NUMBER

CR_DBP_BB

LPRUN_BIT_NUMBER

CR_LPRUN_BB

PVDE_BIT_NUMBER

CR_PVDE_BB

FWU_BIT_NUMBER

CR_FWU_BB

ULP_BIT_NUMBER

CR_ULP_BB

PWR CSR Register alias address

CSR_EWUP_BB

PWR Exported Macros

__HAL_PWR_VOLTAGESCALING_CONFIG

Description:

- macros configure the main internal regulator output voltage.

Parameters:

- __REGULATOR__: specifies the

regulator output voltage to achieve a tradeoff between performance and power consumption when the device does not operate at the maximum frequency (refer to the datasheets for more details). This parameter can be one of the following values:

- PWR_REGULATOR_VOLTAGE_SCALE1: Regulator voltage output Scale 1 mode, System frequency up to 32 MHz.
- PWR_REGULATOR_VOLTAGE_SCALE2: Regulator voltage output Scale 2 mode, System frequency up to 16 MHz.
- PWR_REGULATOR_VOLTAGE_SCALE3: Regulator voltage output Scale 3 mode, System frequency up to 4.2 MHz

Return value:

- None

__HAL_PWR_GET_FLAG

Description:

- Check PWR flag is set or not.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - PWR_FLAG_WU: Wake Up flag. This flag indicates that a wakeup event was received from the WKUP pin or from the RTC alarm (Alarm B), RTC Tamper event, RTC TimeStamp event or RTC Wakeup. An additional wakeup event is detected if the WKUP pin is enabled (by setting the EWUP bit) when the WKUP pin level is already high.
  - PWR_FLAG_SB: StandBy flag. This flag indicates that the system was resumed from StandBy mode.
  - PWR_FLAG_PVDO: PVD Output. This flag is valid only if PVD is enabled by the HAL_PWR_EnablePVD() function. The PVD is stopped by Standby mode For this reason, this bit is equal to 0 after Standby or reset until the PVDE bit is set.

- PWR_FLAG_VREFINTRDY: Internal voltage reference (VREFINT) ready flag. This bit indicates the state of the internal voltage reference, VREFINT.
- PWR_FLAG_VOS: Voltage Scaling select flag. A delay is required for the internal regulator to be ready after the voltage range is changed. The VOSF bit indicates that the regulator has reached the voltage level defined with bits VOS of PWR_CR register.
- PWR_FLAG_REGLP: Regulator LP flag. When the MCU exits from Low power run mode, this bit stays at 1 until the regulator is ready in main mode. A polling on this bit is recommended to wait for the regulator main mode. This bit is reset by hardware when the regulator is ready.

Return value:

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

__HAL_PWR_CLEAR_FLAG

Description:

- Clear the PWR's pending flags.

Parameters:

- __FLAG__: specifies the flag to clear. This parameter can be one of the following values:
  - PWR_FLAG_WU: Wake Up flag
  - PWR_FLAG_SB: StandBy flag

__HAL_PWR_PVD_EXTI_ENABLE_IT

Description:

- Enable interrupt on PVD Exti Line 16.

Return value:

- None.

__HAL_PWR_PVD_EXTI_DISABLE_IT

Description:

- Disable interrupt on PVD Exti Line 16.

Return value:

- None.

__HAL_PWR_PVD_EXTI_ENABLE_EVENT

Description:

	• Enable event on PVD Exti Line 16. **Return value:** • None.
__HAL_PWR_PVD_EXTI_DISABLE_EVENT	**Description:** • Disable event on PVD Exti Line 16. **Return value:** • None.
__HAL_PWR_PVD_EXTI_ENABLE_FALLING_EDGE	**Description:** • PVD EXTI line configuration: set falling edge 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_EDGE	**Description:** • PVD EXTI line configuration: set rising edge 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_RISING_FALLING_EDGE	**Description:** • PVD EXTI line configuration: set rising & falling edge 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_GET_FLAG	**Description:**

	• Check whether the specified PVD EXTI interrupt flag is set or not. **Return value:** • EXTI: PVD Line Status.
__HAL_PWR_PVD_EXTI_CLEAR_FLAG	**Description:** • Clear the PVD EXTI flag. **Return value:** • None.
__HAL_PWR_PVD_EXTI_GENERATE_SWIT	**Description:** • Generate a Software interrupt on selected EXTI line. **Return value:** • None.

PWR Flag

PWR_FLAG_WU

PWR_FLAG_SB

PWR_FLAG_PVDO

PWR_FLAG_VREFINTRDY

PWR_FLAG_VOS

PWR_FLAG_REGLP

PWR PVD detection level

PWR_PVDLEVEL_0

PWR_PVDLEVEL_1

PWR_PVDLEVEL_2

PWR_PVDLEVEL_3

PWR_PVDLEVEL_4

PWR_PVDLEVEL_5

PWR_PVDLEVEL_6

PWR_PVDLEVEL_7

PWR PVD 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 Register alias address

PWR_OFFSET

PWR_CR_OFFSET

PWR_CSR_OFFSET

PWR_CR_OFFSET_BB

PWR_CSR_OFFSET_BB

PWR Regulator state in SLEEP/STOP mode

PWR_MAINREGULATOR_ON

PWR_LOWPOWERREGULATOR_ON

PWR Regulator Voltage Scale

PWR_REGULATOR_VOLTAGE_SCALE1

PWR_REGULATOR_VOLTAGE_SCALE2

PWR_REGULATOR_VOLTAGE_SCALE3

PWR SLEEP mode entry

PWR_SLEEPENTRY_WFI

PWR_SLEEPENTRY_WFE

PWR STOP mode entry

PWR_STOPENTRY_WFI

PWR_STOPENTRY_WFE

33 HAL PWR Extension Driver

33.1 PWREx Firmware driver API description

33.1.1 Peripheral extended features functions

This section contains the following APIs:

- ***HAL_PWREx_GetVoltageRange()***
- ***HAL_PWREx_EnableFastWakeUp()***
- ***HAL_PWREx_DisableFastWakeUp()***
- ***HAL_PWREx_EnableUltraLowPower()***
- ***HAL_PWREx_DisableUltraLowPower()***
- ***HAL_PWREx_EnableLowPowerRunMode()***
- ***HAL_PWREx_DisableLowPowerRunMode()***

33.1.2 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, PWR_REGULATOR_VOLTAGE_SCALE2 or PWR_REGULATOR_VOLTAGE_SCALE3)

HAL_PWREx_EnableFastWakeUp

Function name **void HAL_PWREx_EnableFastWakeUp (void)**

Function description Enables the Fast WakeUp from Ultra Low Power mode.

Return values
- **None:**

Notes
- This bit works in conjunction with ULP bit. Means, when ULP = 1 and FWU = 1 :VREFINT startup time is ignored when exiting from low power mode.

HAL_PWREx_DisableFastWakeUp

Function name **void HAL_PWREx_DisableFastWakeUp (void)**

Function description Disables the Fast WakeUp from Ultra Low Power mode.

Return values
- **None:**

HAL_PWREx_EnableUltraLowPower

Function name **void HAL_PWREx_EnableUltraLowPower (void)**

Function description Enables the Ultra Low Power mode.

Return values
- **None:**

HAL_PWREx_DisableUltraLowPower

Function name	**void HAL_PWREx_DisableUltraLowPower (void)**
Function description	Disables the Ultra Low Power mode.
Return values	• **None:**

HAL_PWREx_EnableLowPowerRunMode

Function name	**void HAL_PWREx_EnableLowPowerRunMode (void)**
Function description	Enters the Low Power Run mode.
Return values	• **None:**
Notes	• Low power run mode can only be entered when VCORE is in range 2. In addition, the dynamic voltage scaling must not be used when Low power run mode is selected. Only Stop and Sleep modes with regulator configured in Low power mode is allowed when Low power run mode is selected. • In Low power run mode, all I/O pins keep the same state as in Run mode.

HAL_PWREx_DisableLowPowerRunMode

Function name	**HAL_StatusTypeDef HAL_PWREx_DisableLowPowerRunMode (void)**
Function description	Exits the Low Power Run mode.
Return values	• **None:**

33.2 PWREx Firmware driver defines

33.2.1 PWREx

PWREx Wakeup Pins

PWR_WAKEUP_PIN1

PWR_WAKEUP_PIN2

PWR_WAKEUP_PIN3

IS_PWR_WAKEUP_PIN

34 HAL RCC Generic Driver

34.1 RCC Firmware driver registers structures

34.1.1 RCC_PLLInitTypeDef

Data Fields

- ***uint32_t PLLState***
- ***uint32_t PLLSource***
- ***uint32_t PLLMUL***
- ***uint32_t PLLDIV***

Field Documentation

- ***uint32_t RCC_PLLInitTypeDef::PLLState***
  PLLState: The new state of the PLL. This parameter can be a value of ***RCC_PLL_Config***
- ***uint32_t RCC_PLLInitTypeDef::PLLSource***
  PLLSource: PLL entry clock source. This parameter must be a value of ***RCC_PLL_Clock_Source***
- ***uint32_t RCC_PLLInitTypeDef::PLLMUL***
  PLLMUL: Multiplication factor for PLL VCO input clock This parameter must be a value of ***RCC_PLL_Multiplication_Factor***
- ***uint32_t RCC_PLLInitTypeDef::PLLDIV***
  PLLDIV: Division factor for PLL VCO input clock This parameter must be a value of ***RCC_PLL_Division_Factor***

34.1.2 RCC_OscInitTypeDef

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***
- ***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 HSI calibration trimming value (default is RCC_HSICALIBRATION_DEFAULT).
  This parameter must be a number between Min_Data = 0x00 and Max_Data = 0x1FU
- ***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 MSI calibration trimming value. (default is RCC_MSICALIBRATION_DEFAULT).
  This parameter must be a number between Min_Data = 0x00 and Max_Data = 0xFFU
- ***uint32_t RCC_OscInitTypeDef::MSIClockRange***
  The MSI frequency range. This parameter can be a value of ***RCC_MSI_Clock_Range***
- ***RCC_PLLInitTypeDef RCC_OscInitTypeDef::PLL***
  PLL structure parameters

34.1.3 RCC_ClkInitTypeDef

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 (SYSCLKS) used as system clock. 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***

34.2 RCC Firmware driver API description

34.2.1 RCC specific features

After reset the device is running from multispeed internal oscillator clock (MSI 2.097MHz) with Flash 0 wait state and Flash prefetch buffer is disabled, and all peripherals are off except internal SRAM, Flash and JTAG.

- There is no prescaler on High speed (AHB) and Low speed (APB) buses; all peripherals mapped on these buses are running at MSI speed.
- The clock for all peripherals is switched off, except the SRAM and FLASH.
- All GPIOs are in input floating state, 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 buses prescalers
- Enable the clock for the peripheral(s) to be used
- Configure the clock source(s) for peripherals whose clocks are not derived from the System clock (I2S, RTC, ADC, USB OTG FS/SDIO/RNG) (*) SDIO only for STM32L1xxxD devices

34.2.2 RCC Limitations

A delay between an RCC peripheral clock enable and the effective peripheral enabling should be taken into account in order to manage the peripheral read/write from/to registers.

- This delay depends on the peripheral mapping.
  - AHB & APB peripherals, 1 dummy read is necessary

Workarounds:

1. For AHB & APB peripherals, a dummy read to the peripheral register has been inserted in each __HAL_RCC_PPP_CLK_ENABLE() macro.

34.2.3 Initialization and de-initialization functions

This section provides functions allowing to configure the internal/external oscillators (MSI, HSE, HSI, LSE, LSI, PLL, CSS and MCO) and the System buses clocks (SYSCLK, AHB, APB1 and APB2).

Internal/external clock and PLL configuration

1. MSI (Multispeed internal), Seven frequency ranges are available: 65.536 kHz, 131.072 kHz, 262.144 kHz, 524.288 kHz, 1.048 MHz, 2.097 MHz (default value) and 4.194 MHz.
2. HSI (high-speed internal), 16 MHz factory-trimmed RC used directly or through the PLL as System clock source.
3. LSI (low-speed internal), ~37 KHz low consumption RC used as IWDG and/or RTC clock source.
4. HSE (high-speed external), 1 to 24 MHz crystal oscillator used directly or through the PLL as System clock source. Can be used also as RTC clock source.
5. LSE (low-speed external), 32 KHz oscillator used as RTC clock source.
6. PLL (clocked by HSI or HSE), featuring different output clocks:
   - The first output is used to generate the high speed system clock (up to 32 MHz)
   - The second output is used to generate the clock for the USB OTG FS (48 MHz)
7. CSS (Clock security system), once enable using the macro __HAL_RCC_CSS_ENABLE() and if a HSE clock failure occurs(HSE used directly or through PLL as System clock source), the System clocks automatically switched to MSI and an interrupt is generated if enabled. The interrupt is linked to the Cortex-M3 NMI (Non-Maskable Interrupt) exception vector.
8. MCO1 (microcontroller clock output), used to output SYSCLK, HSI, LSI, MSI, LSE, HSE or PLL clock (through a configurable prescaler) on PA8 pin.

System, AHB and APB buses clocks configuration

1. Several clock sources can be used to drive the System clock (SYSCLK): MSI, HSI, HSE and 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 buses. You can use "@ref HAL_RCC_GetSysClockFreq()" function to retrieve the frequencies of these clocks. All the peripheral clocks are derived from the System clock (SYSCLK) except: RTC: RTC clock can be derived either from the LSI, LSE or HSE clock divided by 2 to 16. You have to use @ref __HAL_RCC_RTC_CONFIG() and @ref __HAL_RCC_RTC_ENABLE() macros to configure this clock. LCD: LCD clock can be derived either from the LSI, LSE or HSE clock divided by 2 to 16. You have to use @ref __HAL_RCC_LCD_CONFIG() macros to configure this clock. USB OTG FS: USB OTG FS require a frequency equal to 48 MHz to work correctly. This clock is derived of the main PLL through PLL Multiplier. IWDG clock which is always the LSI clock.

2. The maximum frequency of the SYSCLK and HCLK is 32 MHz, PCLK2 32 MHz and PCLK1 32 MHz. Depending on the device voltage range, the maximum frequency should be adapted accordingly.

This section contains the following APIs:

- ***HAL_RCC_DeInit()***
- ***HAL_RCC_OscConfig()***
- ***HAL_RCC_ClockConfig()***

34.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the RCC Clocks frequencies.

This section contains the following APIs:

- ***HAL_RCC_MCOConfig()***
- ***HAL_RCC_EnableCSS()***
- ***HAL_RCC_DisableCSS()***
- ***HAL_RCC_GetSysClockFreq()***
- ***HAL_RCC_GetHCLKFreq()***
- ***HAL_RCC_GetPCLK1Freq()***
- ***HAL_RCC_GetPCLK2Freq()***
- ***HAL_RCC_GetOscConfig()***
- ***HAL_RCC_GetClockConfig()***
- ***HAL_RCC_NMI_IRQHandler()***
- ***HAL_RCC_CSSCallback()***

34.2.5 Detailed description of functions

HAL_RCC_DeInit

Function name	**void HAL_RCC_DeInit (void)**
Function description	Resets the RCC clock configuration to the default reset state.
Return values	• **None:**
Notes	• The default reset state of the clock configuration is given below: MSI ON and used as system clock sourceHSI, HSE and PLL OFFAHB, APB1 and APB2 prescaler set to 1.CSS and MCO1 OFFAll interrupts disabled • This function does not modify the configuration of the Peripheral clocksLSI, LSE and RTC clocks

HAL_RCC_OscConfig

Function name
HAL_StatusTypeDef HAL_RCC_OscConfig (RCC_OscInitTypeDef * RCC_OscInitStruct)

Function description
Initializes 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
Initializes the CPU, AHB and APB buses 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 The value of this parameter depend on device used within the same series

Return values
- **HAL:** status

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 (enabled by hardware) as system clock source after start-up from Reset, wake-up 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).
- A switch from one clock source to another occurs only if the target clock source is ready (clock stable after start-up delay or PLL locked). If a clock source which is not yet ready is selected, the switch will occur when the clock source will be 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 Selects the clock source to output on MCO pin.

Parameters
- **RCC_MCOx:** specifies the output direction for the clock source. This parameter can be one of the following values:
  - 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 No clock selected as MCO clock
  - RCC_MCO1SOURCE_SYSCLK System clock selected as MCO clock
  - RCC_MCO1SOURCE_HSI HSI selected as MCO clock
  - RCC_MCO1SOURCE_HSE HSE selected as MCO clock
  - RCC_MCO1SOURCE_MSI MSI oscillator clock selected as MCO clock
  - RCC_MCO1SOURCE_PLLCLK PLL clock selected as MCO clock
  - RCC_MCO1SOURCE_LSI LSI clock selected as MCO clock
  - RCC_MCO1SOURCE_LSE LSE clock selected as MCO clock
- **RCC_MCODiv:** specifies the MCO DIV. 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
- MCO pin should be configured in alternate function mode.

HAL_RCC_EnableCSS

Function name **void HAL_RCC_EnableCSS (void)**

Function description Enables 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-M3 NMI (Non-Maskable Interrupt) exception vector.

HAL_RCC_NMI_IRQHandler

Function name **void HAL_RCC_NMI_IRQHandler (void)**

Function description	This function handles the RCC CSS 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:**

HAL_RCC_DisableCSS

Function name	**void HAL_RCC_DisableCSS (void)**
Function description	Disables the Clock Security System.
Return values	• **None:**

HAL_RCC_GetSysClockFreq

Function name	**uint32_t HAL_RCC_GetSysClockFreq (void)**
Function description	Returns 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 a value 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 a value based on HSE_VALUE(**) • If SYSCLK source is PLL, function returns a value based on HSE_VALUE(**) or HSI_VALUE(*) multiplied/divided by the PLL factors. • (*) HSI_VALUE is a constant defined in stm32l1xx_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 stm32l1xx_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 baud-rate 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 Returns the HCLK frequency.

Return values
- **HCLK:** frequency

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 and updated within this function

HAL_RCC_GetPCLK1Freq

Function name **uint32_t HAL_RCC_GetPCLK1Freq (void)**

Function description Returns the PCLK1 frequency.

Return values
- **PCLK1:** frequency

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 Returns the PCLK2 frequency.

Return values
- **PCLK2:** frequency

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 Configures 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 Get the RCC_ClkInitStruct according to the internal RCC configuration registers.

Parameters
- **RCC_ClkInitStruct:** pointer to an RCC_ClkInitTypeDef structure that contains the current clock configuration.

- **pFLatency:** Pointer on the Flash Latency.

Return values

- **None:**

34.3 RCC Firmware driver defines

34.3.1 RCC

AHB Peripheral Clock Sleep Enable Disable 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_GPIOH_IS_CLK_SLEEP_ENABLED

__HAL_RCC_CRC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_FLITF_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMA1_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_GPIOH_IS_CLK_SLEEP_DISABLED

__HAL_RCC_CRC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_FLITF_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMA1_IS_CLK_SLEEP_DISABLED

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

AHB Peripheral Clock Enable Disable 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_GPIOH_IS_CLK_ENABLED

__HAL_RCC_CRC_IS_CLK_ENABLED

__HAL_RCC_FLITF_IS_CLK_ENABLED

__HAL_RCC_DMA1_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_GPIOH_IS_CLK_DISABLED

__HAL_RCC_CRC_IS_CLK_DISABLED

__HAL_RCC_FLITF_IS_CLK_DISABLED

__HAL_RCC_DMA1_IS_CLK_DISABLED

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 Clock Enable Disable

__HAL_RCC_TIM2_CLK_ENABLE

__HAL_RCC_TIM3_CLK_ENABLE

__HAL_RCC_TIM4_CLK_ENABLE

__HAL_RCC_TIM6_CLK_ENABLE

__HAL_RCC_TIM7_CLK_ENABLE

__HAL_RCC_WWDG_CLK_ENABLE

__HAL_RCC_SPI2_CLK_ENABLE

__HAL_RCC_USART2_CLK_ENABLE

__HAL_RCC_USART3_CLK_ENABLE

__HAL_RCC_I2C1_CLK_ENABLE

__HAL_RCC_I2C2_CLK_ENABLE

__HAL_RCC_USB_CLK_ENABLE

__HAL_RCC_PWR_CLK_ENABLE

__HAL_RCC_DAC_CLK_ENABLE

__HAL_RCC_COMP_CLK_ENABLE

__HAL_RCC_TIM2_CLK_DISABLE

__HAL_RCC_TIM3_CLK_DISABLE
__HAL_RCC_TIM4_CLK_DISABLE
__HAL_RCC_TIM6_CLK_DISABLE
__HAL_RCC_TIM7_CLK_DISABLE
__HAL_RCC_WWDG_CLK_DISABLE
__HAL_RCC_SPI2_CLK_DISABLE
__HAL_RCC_USART2_CLK_DISABLE
__HAL_RCC_USART3_CLK_DISABLE
__HAL_RCC_I2C1_CLK_DISABLE
__HAL_RCC_I2C2_CLK_DISABLE
__HAL_RCC_USB_CLK_DISABLE
__HAL_RCC_PWR_CLK_DISABLE
__HAL_RCC_DAC_CLK_DISABLE
__HAL_RCC_COMP_CLK_DISABLE

APB1 Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_TIM2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM4_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM6_IS_CLK_SLEEP_ENABLED
__HAL_RCC_TIM7_IS_CLK_SLEEP_ENABLED
__HAL_RCC_WWDG_IS_CLK_SLEEP_ENABLED
__HAL_RCC_SPI2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USART2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USART3_IS_CLK_SLEEP_ENABLED
__HAL_RCC_I2C1_IS_CLK_SLEEP_ENABLED
__HAL_RCC_I2C2_IS_CLK_SLEEP_ENABLED
__HAL_RCC_USB_IS_CLK_SLEEP_ENABLED
__HAL_RCC_PWR_IS_CLK_SLEEP_ENABLED
__HAL_RCC_DAC_IS_CLK_SLEEP_ENABLED
__HAL_RCC_COMP_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_TIM6_IS_CLK_SLEEP_DISABLED
__HAL_RCC_TIM7_IS_CLK_SLEEP_DISABLED
__HAL_RCC_WWDG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SPI2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USART2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USART3_IS_CLK_SLEEP_DISABLED
__HAL_RCC_I2C1_IS_CLK_SLEEP_DISABLED
__HAL_RCC_I2C2_IS_CLK_SLEEP_DISABLED
__HAL_RCC_USB_IS_CLK_SLEEP_DISABLED
__HAL_RCC_PWR_IS_CLK_SLEEP_DISABLED
__HAL_RCC_DAC_IS_CLK_SLEEP_DISABLED
__HAL_RCC_COMP_IS_CLK_SLEEP_DISABLED

APB1 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_TIM6_FORCE_RESET
__HAL_RCC_TIM7_FORCE_RESET
__HAL_RCC_WWDG_FORCE_RESET
__HAL_RCC_SPI2_FORCE_RESET
__HAL_RCC_USART2_FORCE_RESET
__HAL_RCC_USART3_FORCE_RESET
__HAL_RCC_I2C1_FORCE_RESET
__HAL_RCC_I2C2_FORCE_RESET
__HAL_RCC_USB_FORCE_RESET
__HAL_RCC_PWR_FORCE_RESET
__HAL_RCC_DAC_FORCE_RESET
__HAL_RCC_COMP_FORCE_RESET
__HAL_RCC_APB1_RELEASE_RESET
__HAL_RCC_TIM2_RELEASE_RESET
__HAL_RCC_TIM3_RELEASE_RESET
__HAL_RCC_TIM4_RELEASE_RESET
__HAL_RCC_TIM6_RELEASE_RESET
__HAL_RCC_TIM7_RELEASE_RESET
__HAL_RCC_WWDG_RELEASE_RESET
__HAL_RCC_SPI2_RELEASE_RESET
__HAL_RCC_USART2_RELEASE_RESET
__HAL_RCC_USART3_RELEASE_RESET

__HAL_RCC_I2C1_RELEASE_RESET

__HAL_RCC_I2C2_RELEASE_RESET

__HAL_RCC_USB_RELEASE_RESET

__HAL_RCC_PWR_RELEASE_RESET

__HAL_RCC_DAC_RELEASE_RESET

__HAL_RCC_COMP_RELEASE_RESET

APB1 Peripheral Clock Enable Disable Status

__HAL_RCC_TIM2_IS_CLK_ENABLED

__HAL_RCC_TIM3_IS_CLK_ENABLED

__HAL_RCC_TIM4_IS_CLK_ENABLED

__HAL_RCC_TIM6_IS_CLK_ENABLED

__HAL_RCC_TIM7_IS_CLK_ENABLED

__HAL_RCC_WWDG_IS_CLK_ENABLED

__HAL_RCC_SPI2_IS_CLK_ENABLED

__HAL_RCC_USART2_IS_CLK_ENABLED

__HAL_RCC_USART3_IS_CLK_ENABLED

__HAL_RCC_I2C1_IS_CLK_ENABLED

__HAL_RCC_I2C2_IS_CLK_ENABLED

__HAL_RCC_USB_IS_CLK_ENABLED

__HAL_RCC_PWR_IS_CLK_ENABLED

__HAL_RCC_DAC_IS_CLK_ENABLED

__HAL_RCC_COMP_IS_CLK_ENABLED

__HAL_RCC_TIM2_IS_CLK_DISABLED

__HAL_RCC_TIM3_IS_CLK_DISABLED

__HAL_RCC_TIM4_IS_CLK_DISABLED

__HAL_RCC_TIM6_IS_CLK_DISABLED

__HAL_RCC_TIM7_IS_CLK_DISABLED

__HAL_RCC_WWDG_IS_CLK_DISABLED

__HAL_RCC_SPI2_IS_CLK_DISABLED

__HAL_RCC_USART2_IS_CLK_DISABLED

__HAL_RCC_USART3_IS_CLK_DISABLED

__HAL_RCC_I2C1_IS_CLK_DISABLED

__HAL_RCC_I2C2_IS_CLK_DISABLED

__HAL_RCC_USB_IS_CLK_DISABLED

__HAL_RCC_PWR_IS_CLK_DISABLED

__HAL_RCC_DAC_IS_CLK_DISABLED

__HAL_RCC_COMP_IS_CLK_DISABLED

APB2 Clock Enable Disable

__HAL_RCC_SYSCFG_CLK_ENABLE

__HAL_RCC_TIM9_CLK_ENABLE

__HAL_RCC_TIM10_CLK_ENABLE

__HAL_RCC_TIM11_CLK_ENABLE

__HAL_RCC_ADC1_CLK_ENABLE

__HAL_RCC_SPI1_CLK_ENABLE

__HAL_RCC_USART1_CLK_ENABLE

__HAL_RCC_SYSCFG_CLK_DISABLE

__HAL_RCC_TIM9_CLK_DISABLE

__HAL_RCC_TIM10_CLK_DISABLE

__HAL_RCC_TIM11_CLK_DISABLE

__HAL_RCC_ADC1_CLK_DISABLE

__HAL_RCC_SPI1_CLK_DISABLE

__HAL_RCC_USART1_CLK_DISABLE

APB2 Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_SYSCFG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM9_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM10_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM11_IS_CLK_SLEEP_ENABLED

__HAL_RCC_ADC1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SPI1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_USART1_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SYSCFG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM9_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM10_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM11_IS_CLK_SLEEP_DISABLED

__HAL_RCC_ADC1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SPI1_IS_CLK_SLEEP_DISABLED

__HAL_RCC_USART1_IS_CLK_SLEEP_DISABLED

APB2 Force Release Reset

__HAL_RCC_APB2_FORCE_RESET

__HAL_RCC_SYSCFG_FORCE_RESET

__HAL_RCC_TIM9_FORCE_RESET

__HAL_RCC_TIM10_FORCE_RESET

__HAL_RCC_TIM11_FORCE_RESET

__HAL_RCC_ADC1_FORCE_RESET

__HAL_RCC_SPI1_FORCE_RESET

__HAL_RCC_USART1_FORCE_RESET

__HAL_RCC_APB2_RELEASE_RESET

__HAL_RCC_SYSCFG_RELEASE_RESET

__HAL_RCC_TIM9_RELEASE_RESET

__HAL_RCC_TIM10_RELEASE_RESET

__HAL_RCC_TIM11_RELEASE_RESET

__HAL_RCC_ADC1_RELEASE_RESET

__HAL_RCC_SPI1_RELEASE_RESET

__HAL_RCC_USART1_RELEASE_RESET

APB2 Peripheral Clock Enable Disable Status

__HAL_RCC_SYSCFG_IS_CLK_ENABLED

__HAL_RCC_TIM9_IS_CLK_ENABLED

__HAL_RCC_TIM10_IS_CLK_ENABLED

__HAL_RCC_TIM11_IS_CLK_ENABLED

__HAL_RCC_ADC1_IS_CLK_ENABLED

__HAL_RCC_SPI1_IS_CLK_ENABLED

__HAL_RCC_USART1_IS_CLK_ENABLED

__HAL_RCC_SYSCFG_IS_CLK_DISABLED

__HAL_RCC_TIM9_IS_CLK_DISABLED

__HAL_RCC_TIM10_IS_CLK_DISABLED

__HAL_RCC_TIM11_IS_CLK_DISABLED

__HAL_RCC_ADC1_IS_CLK_DISABLED

__HAL_RCC_SPI1_IS_CLK_DISABLED

__HAL_RCC_USART1_IS_CLK_DISABLED

BitAddress AliasRegion

RCC_CR_OFFSET_BB

RCC_CFGR_OFFSET_BB

RCC_CIR_OFFSET_BB

RCC_CSR_OFFSET_BB

RCC_HSION_BIT_NUMBER

RCC_CR_HSION_BB

RCC_MSION_BIT_NUMBER

RCC_CR_MSION_BB

RCC_HSEON_BIT_NUMBER

RCC_CR_HSEON_BB

RCC_CSSON_BIT_NUMBER

RCC_CR_CSSON_BB

RCC_PLLON_BIT_NUMBER

RCC_CR_PLLON_BB

RCC_LSION_BIT_NUMBER

RCC_CSR_LSION_BB

RCC_RMVF_BIT_NUMBER

RCC_CSR_RMVF_BB

RCC_LSEON_BIT_NUMBER

RCC_CSR_LSEON_BB

RCC_LSEBYP_BIT_NUMBER

RCC_CSR_LSEBYP_BB

RCC_RTCEN_BIT_NUMBER

RCC_CSR_RTCEN_BB

RCC_RTCRST_BIT_NUMBER

RCC_CSR_RTCRST_BB

Flags

RCC_FLAG_HSIRDY	Internal High Speed clock ready flag
RCC_FLAG_MSIRDY	MSI clock ready flag
RCC_FLAG_HSERDY	External High Speed clock ready flag
RCC_FLAG_PLLRDY	PLL clock ready flag
RCC_FLAG_LSIRDY	Internal Low Speed oscillator Ready
RCC_FLAG_LSECSS	CSS on LSE failure Detection
RCC_FLAG_OBLRST	Options bytes loading reset flag
RCC_FLAG_PINRST	PIN reset flag
RCC_FLAG_PORRST	POR/PDR 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_LSERDY	External Low Speed oscillator Ready

Flags Interrupts Management

__HAL_RCC_ENABLE_IT **Description:**

- Enable RCC interrupt.

Parameters:

- __INTERRUPT__: specifies the RCC interrupt sources 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_HSIRDY HSI ready interrupt
  - RCC_IT_HSERDY HSE ready interrupt
  - RCC_IT_PLLRDY main PLL ready interrupt
  - RCC_IT_MSIRDY MSI ready interrupt
  - RCC_IT_LSECSS LSE CSS interrupt (not available for STM32L100xB || STM32L151xB || STM32L152xB devices)

__HAL_RCC_DISABLE_IT

Description:

- Disable RCC interrupt.

Parameters:

- __INTERRUPT__: specifies the RCC interrupt sources 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_HSIRDY HSI ready interrupt
  - RCC_IT_HSERDY HSE ready interrupt
  - RCC_IT_PLLRDY main PLL ready interrupt
  - RCC_IT_MSIRDY MSI ready interrupt
  - RCC_IT_LSECSS LSE CSS interrupt (not available for STM32L100xB || STM32L151xB || STM32L152xB devices)

__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_HSIRDY HSI ready interrupt.
  - RCC_IT_HSERDY HSE ready interrupt.
  - RCC_IT_PLLRDY Main PLL ready interrupt.
  - RCC_IT_MSIRDY MSI ready interrupt
  - RCC_IT_LSECSS LSE CSS interrupt

(not available for STM32L100xB || STM32L151xB || STM32L152xB devices)
- RCC_IT_CSS Clock Security System interrupt

__HAL_RCC_GET_IT

Description:

- Check the RCC's 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_HSIRDY HSI ready interrupt.
  - RCC_IT_HSERDY HSE ready interrupt.
  - RCC_IT_PLLRDY Main PLL ready interrupt.
  - RCC_IT_MSIRDY MSI ready interrupt
  - RCC_IT_LSECSS LSE CSS interrupt (not available for STM32L100xB || STM32L151xB || STM32L152xB devices)
  - RCC_IT_CSS Clock Security System interrupt

Return value:

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

__HAL_RCC_CLEAR_RESET_FLAGS

The reset flags are RCC_FLAG_PINRST, RCC_FLAG_PORRST, RCC_FLAG_SFTRST, RCC_FLAG_IWDGRST, RCC_FLAG_WWDGRST, RCC_FLAG_LPWRRST

__HAL_RCC_GET_FLAG

Description:

- Check RCC flag is set or not.

Parameters:

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - RCC_FLAG_HSIRDY HSI oscillator clock ready.
  - RCC_FLAG_MSIRDY MSI oscillator clock ready.
  - RCC_FLAG_HSERDY HSE oscillator clock ready.
  - RCC_FLAG_PLLRDY Main PLL clock ready.
  - RCC_FLAG_LSERDY LSE oscillator

clock ready.
- RCC_FLAG_LSECSS CSS on LSE failure Detection (*)
- RCC_FLAG_LSIRDY LSI oscillator clock ready.
- RCC_FLAG_OBLRST Option Byte Load reset
- RCC_FLAG_PINRST Pin reset.
- RCC_FLAG_PORRST POR/PDR 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).

Notes:

- (*) This bit is available in high and medium+ density devices only.

Get Clock source

__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.

__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

RTC HSE Prescaler

RCC_RTC_HSE_DIV_2	HSE is divided by 2 for RTC clock
RCC_RTC_HSE_DIV_4	HSE is divided by 4 for RTC clock
RCC_RTC_HSE_DIV_8	HSE is divided by 8 for RTC clock
RCC_RTC_HSE_DIV_16	HSE is divided by 16 for RTC clock

HSE Config

RCC_HSE_OFF	HSE clock deactivation
RCC_HSE_ON	HSE clock activation
RCC_HSE_BYPASS	External clock source for HSE clock

HSE Configuration

__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

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.

HSI Config

RCC_HSI_OFF	HSI clock deactivation

RCC_HSI_ON	HSI clock activation
RCC_HSICALIBRATION_DEFAULT	

HSI Configuration

__HAL_RCC_HSI_ENABLE

Notes:

- The HSI is stopped by hardware when entering STOP and STANDBY modes. 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. 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 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.

Notes:

- The calibration is used to compensate for the variations in voltage and temperature that influence the frequency of the internal HSI RC.

Interrupts

RCC_IT_LSIRDY	LSI Ready Interrupt flag
RCC_IT_LSERDY	LSE Ready Interrupt flag
RCC_IT_HSIRDY	HSI Ready Interrupt flag
RCC_IT_HSERDY	HSE Ready Interrupt flag
RCC_IT_PLLRDY	PLL Ready Interrupt flag

RCC_IT_MSIRDY	MSI Ready Interrupt flag
RCC_IT_LSECSS	LSE Clock Security System Interrupt flag
RCC_IT_CSS	Clock Security System Interrupt flag

LSE Config

RCC_LSE_OFF	LSE clock deactivation
RCC_LSE_ON	LSE clock activation
RCC_LSE_BYPASS	External clock source for LSE clock

LSE Configuration

__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.

Notes:

- Transitions LSE Bypass to LSE On and LSE On to LSE Bypass are not supported by this macro. 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.

LSI Config

RCC_LSI_OFF	LSI clock deactivation
RCC_LSI_ON	LSI clock activation

LSI Configuration

__HAL_RCC_LSI_ENABLE **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.

__HAL_RCC_LSI_DISABLE **Notes:**

- 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.

MCO1 Clock Source

RCC_MCO1SOURCE_NOCLOCK

RCC_MCO1SOURCE_SYSCLK

RCC_MCO1SOURCE_MSI

RCC_MCO1SOURCE_HSI

RCC_MCO1SOURCE_LSE

RCC_MCO1SOURCE_LSI

RCC_MCO1SOURCE_HSE

RCC_MCO1SOURCE_PLLCLK

MCO Clock Prescaler

RCC_MCODIV_1

RCC_MCODIV_2

RCC_MCODIV_4

RCC_MCODIV_8

RCC_MCODIV_16

MCO Index

RCC_MCO1

RCC_MCO MCO1 to be compliant with other families with 2 MCOs

MSI Clock Range

RCC_MSIRANGE_0 MSI = 65.536 KHz

RCC_MSIRANGE_1 MSI = 131.072 KHz

RCC_MSIRANGE_2 MSI = 262.144 KHz

RCC_MSIRANGE_3 MSI = 524.288 KHz

RCC_MSIRANGE_4 MSI = 1.048 MHz

RCC_MSIRANGE_5 MSI = 2.097 MHz

RCC_MSIRANGE_6 MSI = 4.194 MHz

MSI Config

RCC_MSI_OFF

RCC_MSI_ON

RCC_MSICALIBRATION_DEFAULT

MSI Configuration

__HAL_RCC_MSI_ENABLE

Notes:

- 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.

__HAL_RCC_MSI_DISABLE

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. When the MSI is stopped, MSIRDY flag goes low after 6 MSI oscillator clock cycles.

__HAL_RCC_MSI_CALIBRATIONVALUE_ADJUST

Description:

- Macro adjusts 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 0xFF.

Notes:

- The calibration is used to compensate for the variations in voltage and temperature that influence the frequency of the internal MSI RC.

__HAL_RCC_MSI_RANGE_CONFIG

__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 65.536 KHz
  - RCC_MSIRANGE_1 MSI clock is around 131.072 KHz
  - RCC_MSIRANGE_2 MSI clock is around 262.144 KHz
  - RCC_MSIRANGE_3 MSI clock is around 524.288 KHz
  - RCC_MSIRANGE_4 MSI clock is around 1.048 MHz
  - RCC_MSIRANGE_5 MSI clock is around 2.097 MHz (default after Reset or wake-up from STANDBY)
  - RCC_MSIRANGE_6 MSI clock is around 4.194 MHz

Oscillator Type

RCC_OSCILLATORTYPE_NONE

RCC_OSCILLATORTYPE_HSE

RCC_OSCILLATORTYPE_HSI

RCC_OSCILLATORTYPE_LSE

RCC_OSCILLATORTYPE_LSI

RCC_OSCILLATORTYPE_MSI

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_GPIOH_CLK_ENABLE

__HAL_RCC_CRC_CLK_ENABLE

__HAL_RCC_FLITF_CLK_ENABLE

__HAL_RCC_DMA1_CLK_ENABLE

__HAL_RCC_GPIOA_CLK_DISABLE

__HAL_RCC_GPIOB_CLK_DISABLE

__HAL_RCC_GPIOC_CLK_DISABLE

__HAL_RCC_GPIOD_CLK_DISABLE

__HAL_RCC_GPIOH_CLK_DISABLE

__HAL_RCC_CRC_CLK_DISABLE

__HAL_RCC_FLITF_CLK_DISABLE

__HAL_RCC_DMA1_CLK_DISABLE

RCC Peripheral Clock Force Release

__HAL_RCC_AHB_FORCE_RESET

__HAL_RCC_GPIOA_FORCE_RESET

__HAL_RCC_GPIOB_FORCE_RESET

__HAL_RCC_GPIOC_FORCE_RESET

__HAL_RCC_GPIOD_FORCE_RESET

__HAL_RCC_GPIOH_FORCE_RESET

__HAL_RCC_CRC_FORCE_RESET

__HAL_RCC_FLITF_FORCE_RESET

__HAL_RCC_DMA1_FORCE_RESET

__HAL_RCC_AHB_RELEASE_RESET

__HAL_RCC_GPIOA_RELEASE_RESET

__HAL_RCC_GPIOB_RELEASE_RESET

__HAL_RCC_GPIOC_RELEASE_RESET

__HAL_RCC_GPIOD_RELEASE_RESET

__HAL_RCC_GPIOH_RELEASE_RESET

__HAL_RCC_CRC_RELEASE_RESET

__HAL_RCC_FLITF_RELEASE_RESET

__HAL_RCC_DMA1_RELEASE_RESET

RCC 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_GPIOH_CLK_SLEEP_ENABLE

__HAL_RCC_CRC_CLK_SLEEP_ENABLE

__HAL_RCC_FLITF_CLK_SLEEP_ENABLE

__HAL_RCC_DMA1_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_GPIOH_CLK_SLEEP_DISABLE

__HAL_RCC_CRC_CLK_SLEEP_DISABLE

__HAL_RCC_FLITF_CLK_SLEEP_DISABLE

__HAL_RCC_DMA1_CLK_SLEEP_DISABLE

__HAL_RCC_TIM2_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM3_CLK_SLEEP_ENABLE

__HAL_RCC_TIM4_CLK_SLEEP_ENABLE

__HAL_RCC_TIM6_CLK_SLEEP_ENABLE

__HAL_RCC_TIM7_CLK_SLEEP_ENABLE

__HAL_RCC_WWDG_CLK_SLEEP_ENABLE

__HAL_RCC_SPI2_CLK_SLEEP_ENABLE

__HAL_RCC_USART2_CLK_SLEEP_ENABLE

__HAL_RCC_USART3_CLK_SLEEP_ENABLE

__HAL_RCC_I2C1_CLK_SLEEP_ENABLE

__HAL_RCC_I2C2_CLK_SLEEP_ENABLE

__HAL_RCC_USB_CLK_SLEEP_ENABLE

__HAL_RCC_PWR_CLK_SLEEP_ENABLE

__HAL_RCC_DAC_CLK_SLEEP_ENABLE

__HAL_RCC_COMP_CLK_SLEEP_ENABLE

__HAL_RCC_TIM2_CLK_SLEEP_DISABLE

__HAL_RCC_TIM3_CLK_SLEEP_DISABLE

__HAL_RCC_TIM4_CLK_SLEEP_DISABLE

__HAL_RCC_TIM6_CLK_SLEEP_DISABLE

__HAL_RCC_TIM7_CLK_SLEEP_DISABLE

__HAL_RCC_WWDG_CLK_SLEEP_DISABLE

__HAL_RCC_SPI2_CLK_SLEEP_DISABLE

__HAL_RCC_USART2_CLK_SLEEP_DISABLE

__HAL_RCC_USART3_CLK_SLEEP_DISABLE

__HAL_RCC_I2C1_CLK_SLEEP_DISABLE

__HAL_RCC_I2C2_CLK_SLEEP_DISABLE

__HAL_RCC_USB_CLK_SLEEP_DISABLE

__HAL_RCC_PWR_CLK_SLEEP_DISABLE

__HAL_RCC_DAC_CLK_SLEEP_DISABLE

__HAL_RCC_COMP_CLK_SLEEP_DISABLE

__HAL_RCC_SYSCFG_CLK_SLEEP_ENABLE **Notes:**

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM9_CLK_SLEEP_ENABLE

__HAL_RCC_TIM10_CLK_SLEEP_ENABLE

__HAL_RCC_TIM11_CLK_SLEEP_ENABLE

__HAL_RCC_ADC1_CLK_SLEEP_ENABLE

__HAL_RCC_SPI1_CLK_SLEEP_ENABLE

__HAL_RCC_USART1_CLK_SLEEP_ENABLE

__HAL_RCC_SYSCFG_CLK_SLEEP_DISABLE

__HAL_RCC_TIM9_CLK_SLEEP_DISABLE

__HAL_RCC_TIM10_CLK_SLEEP_DISABLE

__HAL_RCC_TIM11_CLK_SLEEP_DISABLE

__HAL_RCC_ADC1_CLK_SLEEP_DISABLE

__HAL_RCC_SPI1_CLK_SLEEP_DISABLE

__HAL_RCC_USART1_CLK_SLEEP_DISABLE

PLL 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 is not configured

RCC_PLL_OFF PLL deactivation

RCC_PLL_ON PLL activation

PLL Configuration

__HAL_RCC_PLL_ENABLE **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 is disabled by hardware when entering STOP and STANDBY modes.

__HAL_RCC_PLL_DISABLE

Notes:

- The main PLL can not be disabled if it is used as system clock source

__HAL_RCC_PLL_CONFIG

Description:

- Macro to configure the main PLL clock source, multiplication and division factors.

Parameters:

- __RCC_PLLSOURCE__: specifies the PLL entry clock source. This parameter can be one of the following values:
  - RCC_PLLSOURCE_HSI HSI oscillator clock selected as PLL clock entry
  - RCC_PLLSOURCE_HSE HSE oscillator clock selected as PLL clock entry
- __PLLMUL__: specifies the multiplication factor for PLL VCO output clock This parameter can be one of the following values:
  - RCC_PLL_MUL3 PLLVCO = PLL clock entry x 3
  - RCC_PLL_MUL4 PLLVCO = PLL clock entry x 4
  - RCC_PLL_MUL6 PLLVCO = PLL clock entry x 6
  - RCC_PLL_MUL8 PLLVCO = PLL clock entry x 8
  - RCC_PLL_MUL12 PLLVCO = PLL clock entry x 12
  - RCC_PLL_MUL16 PLLVCO = PLL clock entry x 16
  - RCC_PLL_MUL24 PLLVCO = PLL clock entry x 24
  - RCC_PLL_MUL32 PLLVCO = PLL clock entry x 32
  - RCC_PLL_MUL48 PLLVCO = PLL clock entry x 48
- __PLLDIV__: specifies the division factor for PLL VCO input clock This parameter can be one of the following values:
  - RCC_PLL_DIV2 PLL clock output = PLLVCO / 2
  - RCC_PLL_DIV3 PLL clock output = PLLVCO / 3
  - RCC_PLL_DIV4 PLL clock output = PLLVCO / 4

Notes:

- This function must be used only when the

main PLL is disabled.
- The PLL VCO clock frequency must not exceed 96 MHz when the product is in Range 1, 48 MHz when the product is in Range 2 and 24 MHz when the product is in Range 3.

__HAL_RCC_GET_PLL_OSCSOURCE

Description:

- Get oscillator clock selected as PLL input clock.

Return value:

- The: clock source used for PLL entry. The returned value can be one of the following:
  - RCC_PLLSOURCE_HSI HSI oscillator clock selected as PLL input clock
  - RCC_PLLSOURCE_HSE HSE oscillator clock selected as PLL input clock

PLL Division Factor

RCC_PLL_DIV2

RCC_PLL_DIV3

RCC_PLL_DIV4

PLL Multiplication Factor

RCC_PLL_MUL3

RCC_PLL_MUL4

RCC_PLL_MUL6

RCC_PLL_MUL8

RCC_PLL_MUL12

RCC_PLL_MUL16

RCC_PLL_MUL24

RCC_PLL_MUL32

RCC_PLL_MUL48

Register offsets

RCC_OFFSET

RCC_CR_OFFSET

RCC_CFGR_OFFSET

RCC_CIR_OFFSET

RCC_CSR_OFFSET

RCC RTC Clock Configuration

__HAL_RCC_RTC_CLKPRESCALER

Description:

- Macro 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_NO_CLK 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_DIV2 HSE divided by 2 selected as RTC clock
  - RCC_RTCCLKSOURCE_HSE_DIV4 HSE divided by 4 selected as RTC clock
  - RCC_RTCCLKSOURCE_HSE_DIV8 HSE divided by 8 selected as RTC clock
  - RCC_RTCCLKSOURCE_HSE_DIV16 HSE divided by 16 selected as RTC clock

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). RTC prescaler cannot be modified if HSE is enabled (HSEON = 1).
- 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_RTC_CONFIG

__HAL_RCC_GET_RTC_SOURCE

Description:

- Macro to get the RTC clock source.

Return value:

- The: clock source can be one of the following values:

- RCC_RTCCLKSOURCE_NO_CLK 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_DIVX HSE divided by X selected as RTC clock (X can be retrieved thanks to __HAL_RCC_GET_RTC_HSE_PRESCALER()

__HAL_RCC_GET_RTC_HSE_PRESCALER

Description:

- Get the RTC and LCD HSE clock divider (RTCCLK / LCDCLK).

Return value:

- Returned: value can be one of the following values:
  - RCC_RTC_HSE_DIV_2 HSE divided by 2 selected as RTC clock
  - RCC_RTC_HSE_DIV_4 HSE divided by 4 selected as RTC clock
  - RCC_RTC_HSE_DIV_8 HSE divided by 8 selected as RTC clock
  - RCC_RTC_HSE_DIV_16 HSE divided by 16 selected as RTC clock

__HAL_RCC_RTC_ENABLE

Notes:

- These macros must be used only after the RTC clock source was selected.

__HAL_RCC_RTC_DISABLE

Notes:

- These macros must be used only after the RTC clock source was selected.

__HAL_RCC_BACKUPRESET_FORCE

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

RTC LCD Clock Source

RCC_RTCCLKSOURCE_NO_CLK	No clock
RCC_RTCCLKSOURCE_LSE	LSE oscillator clock used as RTC clock

RCC_RTCCLKSOURCE_LSI	LSI oscillator clock used as RTC clock
RCC_RTCCLKSOURCE_HSE_DIVX	HSE oscillator clock divided by X used as RTC clock
RCC_RTCCLKSOURCE_HSE_DIV2	HSE oscillator clock divided by 2 used as RTC clock
RCC_RTCCLKSOURCE_HSE_DIV4	HSE oscillator clock divided by 4 used as RTC clock
RCC_RTCCLKSOURCE_HSE_DIV8	HSE oscillator clock divided by 8 used as RTC clock
RCC_RTCCLKSOURCE_HSE_DIV16	HSE oscillator clock divided by 16 used as RTC clock

System Clock Source

RCC_SYSCLKSOURCE_MSI	MSI selected as system clock
RCC_SYSCLKSOURCE_HSI	HSI selected as system clock
RCC_SYSCLKSOURCE_HSE	HSE selected as system clock
RCC_SYSCLKSOURCE_PLLCLK	PLL selected 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

RCC Timeout

RCC_DBP_TIMEOUT_VALUE

RCC_LSE_TIMEOUT_VALUE

CLOCKSWITCH_TIMEOUT_VALUE

HSE_TIMEOUT_VALUE

MSI_TIMEOUT_VALUE

HSI_TIMEOUT_VALUE

LSI_TIMEOUT_VALUE

PLL_TIMEOUT_VALUE

35 HAL RCC Extension Driver

35.1 RCCEx Firmware driver registers structures

35.1.1 RCC_PeriphCLKInitTypeDef

Data Fields

- ***uint32_t PeriphClockSelection***
- ***uint32_t RTCClockSelection***
- ***uint32_t LCDClockSelection***

Field Documentation

- ***uint32_t RCC_PeriphCLKInitTypeDef::PeriphClockSelection***
  The Extended Clock to be configured. This parameter can be a value of ***RCCEx_Periph_Clock_Selection***
- ***uint32_t RCC_PeriphCLKInitTypeDef::RTCClockSelection***
  specifies the RTC clock source. This parameter can be a value of ***RCC_RTC_LCD_Clock_Source***
- ***uint32_t RCC_PeriphCLKInitTypeDef::LCDClockSelection***
  specifies the LCD clock source. This parameter can be a value of ***RCC_RTC_LCD_Clock_Source***

35.2 RCCEx Firmware driver API description

35.2.1 Extended Peripheral Control functions

This subsection provides a set of functions allowing to control the RCC Clocks frequencies.

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()***
- ***HAL_RCCEx_EnableLSECSS()***
- ***HAL_RCCEx_DisableLSECSS()***
- ***HAL_RCCEx_EnableLSECSS_IT()***
- ***HAL_RCCEx_LSECSS_IRQHandler()***
- ***HAL_RCCEx_LSECSS_Callback()***

35.2.2 Detailed description of functions

HAL_RCCEx_PeriphCLKConfig

Function name **HAL_StatusTypeDef HAL_RCCEx_PeriphCLKConfig (RCC_PeriphCLKInitTypeDef * PeriphClkInit)**

Function description	Initializes the RCC extended peripherals clocks according to the specified parameters in the RCC_PeriphCLKInitTypeDef.
Parameters	• **PeriphClkInit:** pointer to an RCC_PeriphCLKInitTypeDef structure that contains the configuration information for the Extended Peripherals clocks(RTC/LCD clock).
Return values	• **HAL:** status
Notes	• If HAL_ERROR returned, first switch-OFF HSE clock oscillator with HAL_RCC_OscConfig() to possibly update HSE divider.

HAL_RCCEx_GetPeriphCLKConfig

Function name	**void HAL_RCCEx_GetPeriphCLKConfig (RCC_PeriphCLKInitTypeDef * PeriphClkInit)**
Function description	Get the PeriphClkInit 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(RTC/LCD clocks).
Return values	• **None:**

HAL_RCCEx_GetPeriphCLKFreq

Function name	**uint32_t HAL_RCCEx_GetPeriphCLKFreq (uint32_t PeriphClk)**
Function description	Return the peripheral clock frequency.
Parameters	• **PeriphClk:** Peripheral clock identifier This parameter can be one of the following values: – RCC_PERIPHCLK_RTC RTC peripheral clock – RCC_PERIPHCLK_LCD LCD peripheral clock (*)
Return values	• **Frequency:** in Hz (0: means that no available frequency for the peripheral)
Notes	• Return 0 if peripheral clock is unknown • (*) means that this peripheral is not present on all the devices

HAL_RCCEx_EnableLSECSS

Function name	**void HAL_RCCEx_EnableLSECSS (void)**
Function description	Enables the LSE Clock Security System.
Return values	• **None:**
Notes	• If a failure is detected on the external 32 kHz oscillator, the LSE clock is no longer supplied to the RTC but no hardware action is made to the registers. In Standby mode a wakeup is generated. In other modes an interrupt can be sent to wakeup the software (see Section 5.3.4: Clock interrupt register (RCC_CIR) on page 104). The software MUST then disable the LSECSSON bit, stop the defective 32 kHz oscillator (disabling LSEON), and can change the RTC clock source

(no clock or LSI or HSE, with RTCSEL), or take any required action to secure the application.
- LSE CSS available only for high density and medium+ devices

HAL_RCCEx_DisableLSECSS

Function name	**void HAL_RCCEx_DisableLSECSS (void)**
Function description	Disables the LSE Clock Security System.
Return values	• **None:**
Notes	• Once enabled this bit cannot be disabled, except after an LSE failure detection (LSECSSD=1). In that case the software MUST disable the LSECSSON bit. Reset by power on reset and RTC software reset (RTCRST bit). • LSE CSS available only for high density and medium+ devices

HAL_RCCEx_EnableLSECSS_IT

Function name	**void HAL_RCCEx_EnableLSECSS_IT (void)**
Function description	Enable the LSE Clock Security System IT & corresponding EXTI line.
Return values	• **None:**
Notes	• LSE Clock Security System IT 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:**

35.3 RCCEx Firmware driver defines

35.3.1 RCCEx

RCCEx Exported Macros

__HAL_RCC_LSECSS_EXTI_ENABLE_IT

Description:

- Enable interrupt on RCC LSE CSS EXTI Line 19.

Return value:

- None

__HAL_RCC_LSECSS_EXTI_DISABLE_IT

Description:

- Disable interrupt on RCC LSE CSS EXTI Line 19.

Return value:

- None

__HAL_RCC_LSECSS_EXTI_ENABLE_EVENT

Description:

- Enable event on RCC LSE CSS EXTI Line 19.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_DISABLE_EVENT

Description:

- Disable event on RCC LSE CSS EXTI Line 19.

Return value:

- None.

__HAL_RCC_LSECSS_EXTI_ENABLE_FALLING_EDGE

Description:

- RCC LSE CSS EXTI line configuration: set falling edge 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:

- RCC LSE CSS EXTI line configuration: set rising edge 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:

- RCC LSE CSS EXTI line configuration: set rising & falling edge 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 selected EXTI line.

Return value:

- None.

RCC LSE CSS external interrupt line

RCC_EXTI_LINE_LSECSS External interrupt line 19 connected to the LSE CSS EXTI Line

RCCEx Force Release Peripheral Reset

__HAL_RCC_GPIOE_FORCE_RESET

__HAL_RCC_GPIOE_RELEASE_RESET

__HAL_RCC_GPIOF_FORCE_RESET

__HAL_RCC_GPIOG_FORCE_RESET

__HAL_RCC_GPIOF_RELEASE_RESET

__HAL_RCC_GPIOG_RELEASE_RESET
__HAL_RCC_DMA2_FORCE_RESET
__HAL_RCC_DMA2_RELEASE_RESET
__HAL_RCC_CRYP_FORCE_RESET
__HAL_RCC_CRYP_RELEASE_RESET
__HAL_RCC_FSMC_FORCE_RESET
__HAL_RCC_FSMC_RELEASE_RESET
__HAL_RCC_LCD_FORCE_RESET
__HAL_RCC_LCD_RELEASE_RESET
__HAL_RCC_TIM5_FORCE_RESET
__HAL_RCC_TIM5_RELEASE_RESET
__HAL_RCC_SPI3_FORCE_RESET
__HAL_RCC_SPI3_RELEASE_RESET
__HAL_RCC_UART4_FORCE_RESET
__HAL_RCC_UART5_FORCE_RESET
__HAL_RCC_UART4_RELEASE_RESET
__HAL_RCC_UART5_RELEASE_RESET
__HAL_RCC_OPAMP_FORCE_RESET
__HAL_RCC_OPAMP_RELEASE_RESET
__HAL_RCC_SDIO_FORCE_RESET
__HAL_RCC_SDIO_RELEASE_RESET

LCD Configuration

__HAL_RCC_LCD_CONFIG

Description:

- Macro to configures LCD clock (LCDCLK).

Parameters:

- __LCD_CLKSOURCE__: specifies the LCD clock source. This parameter can be one of the following values:
  - RCC_RTCCLKSOURCE_LSE LSE selected as LCD clock
  - RCC_RTCCLKSOURCE_LSI LSI selected as LCD clock
  - RCC_RTCCLKSOURCE_HSE_DIV2 HSE divided by 2 selected as LCD clock
  - RCC_RTCCLKSOURCE_HSE_DIV4 HSE divided by 4 selected as LCD clock
  - RCC_RTCCLKSOURCE_HSE_DIV8 HSE divided by 8 selected as LCD clock
  - RCC_RTCCLKSOURCE_HSE_DIV1

6 HSE divided by 16 selected as LCD clock

Notes:

- LCD and RTC use the same configuration LCD can however be used in the Stop low power mode if the LSE or LSI is used as the LCD clock source.

__HAL_RCC_GET_LCD_SOURCE

__HAL_RCC_GET_LCD_HSE_PRESCALER

RCC Extended MCOx Clock Config

__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 No clock selected as MCO clock
  - RCC_MCO1SOURCE_SYSCLK System Clock selected as MCO clock
  - RCC_MCO1SOURCE_HSI HSI oscillator clock selected as MCO clock
  - RCC_MCO1SOURCE_MSI MSI oscillator clock selected as MCO clock
  - RCC_MCO1SOURCE_HSE HSE oscillator clock selected as MCO clock
  - RCC_MCO1SOURCE_PLLCLK PLL clock selected as MCO clock
  - RCC_MCO1SOURCE_LSI LSI clock selected as MCO clock
  - RCC_MCO1SOURCE_LSE LSE clock selected as MCO clock
- __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

RCCEx_Peripheral_Clock_Enable_Disable

__HAL_RCC_GPIOE_CLK_ENABLE

__HAL_RCC_GPIOE_CLK_DISABLE

__HAL_RCC_GPIOF_CLK_ENABLE

__HAL_RCC_GPIOG_CLK_ENABLE

__HAL_RCC_GPIOF_CLK_DISABLE

__HAL_RCC_GPIOG_CLK_DISABLE

__HAL_RCC_DMA2_CLK_ENABLE

__HAL_RCC_DMA2_CLK_DISABLE

__HAL_RCC_CRYP_CLK_ENABLE

__HAL_RCC_CRYP_CLK_DISABLE

__HAL_RCC_FSMC_CLK_ENABLE

__HAL_RCC_FSMC_CLK_DISABLE

__HAL_RCC_LCD_CLK_ENABLE

__HAL_RCC_LCD_CLK_DISABLE

__HAL_RCC_TIM5_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_TIM5_CLK_DISABLE

__HAL_RCC_SPI3_CLK_ENABLE

__HAL_RCC_SPI3_CLK_DISABLE

__HAL_RCC_UART4_CLK_ENABLE

__HAL_RCC_UART5_CLK_ENABLE

__HAL_RCC_UART4_CLK_DISABLE

__HAL_RCC_UART5_CLK_DISABLE

__HAL_RCC_OPAMP_CLK_ENABLE

__HAL_RCC_OPAMP_CLK_DISABLE

__HAL_RCC_SDIO_CLK_ENABLE

Notes:

- After reset, the peripheral clock (used for registers read/write access) is disabled and the application software has to enable this clock before using it.

__HAL_RCC_SDIO_CLK_DISABLE

Peripheral Clock Enable Disable Status

__HAL_RCC_GPIOE_IS_CLK_ENABLED

__HAL_RCC_GPIOE_IS_CLK_DISABLED

__HAL_RCC_GPIOF_IS_CLK_ENABLED

__HAL_RCC_GPIOG_IS_CLK_ENABLED

__HAL_RCC_GPIOF_IS_CLK_DISABLED

__HAL_RCC_GPIOG_IS_CLK_DISABLED

__HAL_RCC_DMA2_IS_CLK_ENABLED

__HAL_RCC_DMA2_IS_CLK_DISABLED

__HAL_RCC_CRYP_IS_CLK_ENABLED

__HAL_RCC_CRYP_IS_CLK_DISABLED

__HAL_RCC_FSMC_IS_CLK_ENABLED

__HAL_RCC_FSMC_IS_CLK_DISABLED

__HAL_RCC_LCD_IS_CLK_ENABLED

__HAL_RCC_LCD_IS_CLK_DISABLED

__HAL_RCC_TIM5_IS_CLK_ENABLED

__HAL_RCC_TIM5_IS_CLK_DISABLED

__HAL_RCC_SPI3_IS_CLK_ENABLED

__HAL_RCC_SPI3_IS_CLK_DISABLED

__HAL_RCC_UART4_IS_CLK_ENABLED

__HAL_RCC_UART5_IS_CLK_ENABLED

__HAL_RCC_UART4_IS_CLK_DISABLED

__HAL_RCC_UART5_IS_CLK_DISABLED

__HAL_RCC_OPAMP_IS_CLK_ENABLED

__HAL_RCC_OPAMP_IS_CLK_DISABLED

__HAL_RCC_SDIO_IS_CLK_ENABLED

__HAL_RCC_SDIO_IS_CLK_DISABLED

RCCEx Peripheral Clock Sleep Enable Disable

__HAL_RCC_GPIOE_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOE_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOF_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOG_CLK_SLEEP_ENABLE

__HAL_RCC_GPIOF_CLK_SLEEP_DISABLE

__HAL_RCC_GPIOG_CLK_SLEEP_DISABLE

__HAL_RCC_DMA2_CLK_SLEEP_ENABLE

__HAL_RCC_DMA2_CLK_SLEEP_DISABLE

__HAL_RCC_CRYP_CLK_SLEEP_ENABLE

__HAL_RCC_CRYP_CLK_SLEEP_DISABLE

__HAL_RCC_FSMC_CLK_SLEEP_ENABLE

__HAL_RCC_FSMC_CLK_SLEEP_DISABLE

__HAL_RCC_LCD_CLK_SLEEP_ENABLE

__HAL_RCC_LCD_CLK_SLEEP_DISABLE

__HAL_RCC_TIM5_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_TIM5_CLK_SLEEP_DISABLE

__HAL_RCC_SPI3_CLK_SLEEP_ENABLE

__HAL_RCC_SPI3_CLK_SLEEP_DISABLE

__HAL_RCC_UART4_CLK_SLEEP_ENABLE

__HAL_RCC_UART5_CLK_SLEEP_ENABLE

__HAL_RCC_UART4_CLK_SLEEP_DISABLE

__HAL_RCC_UART5_CLK_SLEEP_DISABLE

__HAL_RCC_OPAMP_CLK_SLEEP_ENABLE

__HAL_RCC_OPAMP_CLK_SLEEP_DISABLE

__HAL_RCC_SDIO_CLK_SLEEP_ENABLE

Notes:

- Peripheral clock gating in SLEEP mode can be used to further reduce power consumption. After wakeup from SLEEP mode, the peripheral clock is enabled again. By default, all peripheral clocks are enabled during SLEEP mode.

__HAL_RCC_SDIO_CLK_SLEEP_DISABLE

Peripheral Clock Sleep Enable Disable Status

__HAL_RCC_GPIOE_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOE_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOF_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOG_IS_CLK_SLEEP_ENABLED

__HAL_RCC_GPIOF_IS_CLK_SLEEP_DISABLED

__HAL_RCC_GPIOG_IS_CLK_SLEEP_DISABLED

__HAL_RCC_DMA2_IS_CLK_SLEEP_ENABLED

__HAL_RCC_DMA2_IS_CLK_SLEEP_DISABLED

__HAL_RCC_CRYP_IS_CLK_SLEEP_ENABLED

__HAL_RCC_CRYP_IS_CLK_SLEEP_DISABLED

__HAL_RCC_FSMC_IS_CLK_SLEEP_ENABLED

__HAL_RCC_FSMC_IS_CLK_SLEEP_DISABLED

__HAL_RCC_LCD_IS_CLK_SLEEP_ENABLED

__HAL_RCC_LCD_IS_CLK_SLEEP_DISABLED

__HAL_RCC_TIM5_IS_CLK_SLEEP_ENABLED

__HAL_RCC_TIM5_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SPI3_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SPI3_IS_CLK_SLEEP_DISABLED

__HAL_RCC_UART4_IS_CLK_SLEEP_ENABLED

__HAL_RCC_UART5_IS_CLK_SLEEP_ENABLED

__HAL_RCC_UART4_IS_CLK_SLEEP_DISABLED

__HAL_RCC_UART5_IS_CLK_SLEEP_DISABLED

__HAL_RCC_OPAMP_IS_CLK_SLEEP_ENABLED

__HAL_RCC_OPAMP_IS_CLK_SLEEP_DISABLED

__HAL_RCC_SDIO_IS_CLK_SLEEP_ENABLED

__HAL_RCC_SDIO_IS_CLK_SLEEP_DISABLED

RCCEx Periph Clock Selection

RCC_PERIPHCLK_RTC

RCC_PERIPHCLK_LCD

36 HAL RTC Generic Driver

36.1 RTC Firmware driver registers structures

36.1.1 RTC_InitTypeDef

Data Fields

- ***uint32_t HourFormat***
- ***uint32_t AsynchPrediv***
- ***uint32_t SynchPrediv***
- ***uint32_t OutPut***
- ***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::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***

36.1.2 RTC_DateTypeDef

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

36.1.3 RTC_HandleTypeDef

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

36.2 RTC Firmware driver API description

36.2.1 Backup Domain 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.

To allow the RTC operating even when the main digital supply (VDD) is turned off, the VBAT pin powers the following blocks:

1. The RTC
2. The LSE oscillator
3. PC13 to PC15 I/Os (when available)

When the backup domain is supplied by VDD (analog switch connected to VDD), the following pins are available:

1. PC14 and PC15 can be used as either GPIO or LSE pins
2. PC13 can be used as a GPIO or as the RTC_AF1 pin

When the backup domain is supplied by VBAT (analog switch connected to VBAT because VDD is not present), the following pins are available:

1. PC14 and PC15 can be used as LSE pins only
2. PC13 can be used as the RTC_AF1 pin

36.2.2 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.

36.2.3 Backup Domain Access

After reset, the backup domain (RTC registers, RTC backup data registers and backup SRAM) 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.

36.2.4 How to use this 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.

36.2.5 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.

36.2.6 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 13-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()***
- ***HAL_RTC_SetTime()***
- ***HAL_RTC_GetTime()***
- ***HAL_RTC_SetDate()***
- ***HAL_RTC_GetDate()***

36.2.7 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_SetDate()***
- ***HAL_RTC_GetDate()***
- ***HAL_RTC_GetTime()***
- ***HAL_RTC_SetAlarm()***
- ***HAL_RTC_SetAlarm_IT()***
- ***HAL_RTC_DeactivateAlarm()***
- ***HAL_RTC_GetAlarm()***
- ***HAL_RTC_AlarmIRQHandler()***
- ***HAL_RTC_PollForAlarmAEvent()***
- ***HAL_RTC_AlarmAEventCallback()***

36.2.8 RTC Alarm functions

This section provides functions allowing to configure Alarm feature

This section contains the following APIs:

- ***HAL_RTC_DeactivateAlarm()***
- ***HAL_RTC_AlarmIRQHandler()***
- ***HAL_RTC_AlarmAEventCallback()***
- ***HAL_RTC_PollForAlarmAEvent()***
- ***HAL_RTC_SetAlarm()***

- *HAL_RTC_SetAlarm_IT()*
- *HAL_RTC_GetAlarm()*
- *HAL_RTC_WaitForSynchro()*

36.2.9 Peripheral State functions

This subsection provides functions allowing to

- Get RTC state

This section contains the following APIs:

- *HAL_RTC_GetState()*

36.2.10 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()*

36.2.11 Detailed description of functions

HAL_RTC_Init

Function name **HAL_StatusTypeDef HAL_RTC_Init (RTC_HandleTypeDef * hrtc)**

Function description Initializes the RTC peripheral.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** status

HAL_RTC_DeInit

Function name **HAL_StatusTypeDef HAL_RTC_DeInit (RTC_HandleTypeDef * hrtc)**

Function description DeInitializes the RTC peripheral.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** status
- **HAL:** status

Notes
- This function doesn't reset the RTC Backup Data registers.
- This function does not reset the RTC Backup Data registers.

HAL_RTC_MspInit

Function name **void HAL_RTC_MspInit (RTC_HandleTypeDef * hrtc)**

Function description Initializes the RTC MSP.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTC_MspDeInit

Function name **void HAL_RTC_MspDeInit (RTC_HandleTypeDef * hrtc)**

Function description DeInitializes the RTC MSP.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTC_SetTime

Function name **HAL_StatusTypeDef HAL_RTC_SetTime (RTC_HandleTypeDef * hrtc, RTC_TimeTypeDef * sTime, uint32_t Format)**

Function description Sets RTC current time.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **sTime:** Pointer to Time structure with Hours, Minutes and Seconds fields returned with input format (BIN or BCD), also SubSeconds field (if availabale) 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
- If available, 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 Sets RTC current date.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 Gets RTC current date.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 Sets the specified RTC Alarm.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 Sets the specified RTC Alarm with Interrupt.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 Deactive the specified RTC Alarm.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 Gets the RTC Alarm value and masks.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 This function handles Alarm interrupt request.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTC_PollForAlarmAEvent

Function name **HAL_StatusTypeDef HAL_RTC_PollForAlarmAEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles AlarmA Polling request.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_RTC_AlarmAEventCallback

Function name **void HAL_RTC_AlarmAEventCallback (RTC_HandleTypeDef * hrtc)**

Function description Alarm A callback.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTC_WaitForSynchro

Function name **HAL_StatusTypeDef HAL_RTC_WaitForSynchro (RTC_HandleTypeDef * hrtc)**

Function description Waits until the RTC Time and Date registers (RTC_TR and RTC_DR) are synchronized with RTC APB clock.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that

contains the configuration information for RTC.

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 Returns the RTC state.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** state

RTC_EnterInitMode

Function name **HAL_StatusTypeDef RTC_EnterInitMode (RTC_HandleTypeDef * hrtc)**

Function description Enters the RTC Initialization mode.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** status

Notes
- The RTC Initialization mode is write protected, use the __HAL_RTC_WRITEPROTECTION_DISABLE() before calling this function.

RTC_ByteToBcd2

Function name **uint8_t RTC_ByteToBcd2 (uint8_t Value)**

Function description Converts 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 Converts from 2 digit BCD to Binary.

Parameters
- **Value:** BCD value to be converted

Return values
- **Converted:** word

36.3 RTC Firmware driver defines

36.3.1 RTC

AlarmDateWeekDay Definitions

RTC_ALARMDATEWEEKDAYSEL_DATE

RTC_ALARMDATEWEEKDAYSEL_WEEKDAY

IS_RTC_ALARM_DATE_WEEKDAY_SEL

Alarm Mask Definitions

RTC_ALARMMASK_NONE

RTC_ALARMMASK_DATEWEEKDAY

RTC_ALARMMASK_HOURS

RTC_ALARMMASK_MINUTES

RTC_ALARMMASK_SECONDS

RTC_ALARMMASK_ALL

IS_RTC_ALARM_MASK

Alarms Definitions

RTC_ALARM_A

RTC_ALARM_B

IS_RTC_ALARM

Alarm Definitions

IS_RTC_ALARM_DATE_WEEKDAY_DATE

IS_RTC_ALARM_DATE_WEEKDAY_WEEKDAY

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.

IS_RTC_ALARM_SUB_SECOND_MASK

Alarm Sub Seconds Value

IS_RTC_ALARM_SUB_SECOND_VALUE

AM PM Definitions

RTC_HOURFORMAT12_AM

RTC_HOURFORMAT12_PM

IS_RTC_HOURFORMAT12

Asynchronous Predivider

IS_RTC_ASYNCH_PREDIV

DayLightSaving

RTC_DAYLIGHTSAVING_SUB1H

RTC_DAYLIGHTSAVING_ADD1H

RTC_DAYLIGHTSAVING_NONE

IS_RTC_DAYLIGHT_SAVING

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_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.

Flags Definitions

RTC_FLAG_RECALPF

RTC_FLAG_TAMP3F

RTC_FLAG_TAMP2F

RTC_FLAG_TAMP1F

RTC_FLAG_TSOVF

RTC_FLAG_TSF

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

Hour Formats

RTC_HOURFORMAT_24

RTC_HOURFORMAT_12

IS_RTC_HOUR_FORMAT

Input Parameter Format

RTC_FORMAT_BIN

RTC_FORMAT_BCD

IS_RTC_FORMAT

Interrupts Definitions

RTC_IT_TS

RTC_IT_WUT

RTC_IT_ALRB

RTC_IT_ALRA

RTC_IT_TAMP1

RTC_IT_TAMP2

RTC_IT_TAMP3

Masks Definitions

RTC_TR_RESERVED_MASK

RTC_DR_RESERVED_MASK

RTC_INIT_MASK

RTC_RSF_MASK

RTC_FLAGS_MASK

Month Definitions

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

IS_RTC_MONTH

IS_RTC_DATE

Outpout Polarity

RTC_OUTPUT_POLARITY_HIGH

RTC_OUTPUT_POLARITY_LOW

IS_RTC_OUTPUT_POL

Alarm Output Type

RTC_OUTPUT_TYPE_OPENDRAIN

RTC_OUTPUT_TYPE_PUSHPULL

IS_RTC_OUTPUT_TYPE

StoreOperation

RTC_STOREOPERATION_RESET

RTC_STOREOPERATION_SET

IS_RTC_STORE_OPERATION

Synchronous Predivider

IS_RTC_SYNCH_PREDIV

Default Timeout Value

RTC_TIMEOUT_VALUE

Time Definitions

IS_RTC_HOUR12

IS_RTC_HOUR24

IS_RTC_MINUTES

IS_RTC_SECONDS

WeekDay Definitions

RTC_WEEKDAY_MONDAY

RTC_WEEKDAY_TUESDAY

RTC_WEEKDAY_WEDNESDAY

RTC_WEEKDAY_THURSDAY

RTC_WEEKDAY_FRIDAY

RTC_WEEKDAY_SATURDAY

RTC_WEEKDAY_SUNDAY

IS_RTC_WEEKDAY

Year Definitions

IS_RTC_YEAR

37 HAL RTC Extension Driver

37.1 RTCEx Firmware driver registers structures

37.1.1 RTC_TamperTypeDef

Data Fields

- ***uint32_t Tamper***
- ***uint32_t Trigger***
- ***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::Trigger***
  Specifies the Tamper Trigger. This parameter can be a value of ***RTCEx_Tamper_Trigger_Definitions***
- ***uint32_t RTC_TamperTypeDef::Filter***
  Specifies the RTC 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***

37.1.2 RTC_TimeTypeDef

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***

37.1.3 RTC_AlarmTypeDef

Data Fields

- ***RTC_TimeTypeDef AlarmTime***
- ***uint32_t AlarmMask***
- ***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::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***

37.2 RTCEx Firmware driver API description

37.2.1 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.

TimeStamp configuration

- Configure the RTC_AFx trigger and 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.
- The TIMESTAMP alternate function can be mapped to RTC_AF1 (PC13).

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, 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 TAMPER1 alternate function can be mapped to RTC_AF1 (PC13).

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.

37.2.2 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_GetTimeStamp()***

- ***HAL_RTCEx_SetTamper()***
- ***HAL_RTCEx_SetTamper_IT()***
- ***HAL_RTCEx_DeactivateTamper()***
- ***HAL_RTCEx_TamperTimeStampIRQHandler()***
- ***HAL_RTCEx_TimeStampEventCallback()***
- ***HAL_RTCEx_Tamper1EventCallback()***
- ***HAL_RTCEx_Tamper2EventCallback()***
- ***HAL_RTCEx_Tamper3EventCallback()***
- ***HAL_RTCEx_PollForTimeStampEvent()***
- ***HAL_RTCEx_PollForTamper1Event()***
- ***HAL_RTCEx_PollForTamper2Event()***
- ***HAL_RTCEx_PollForTamper3Event()***

37.2.3 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()***

37.2.4 Extension Peripheral Control functions

This subsection provides functions allowing to

- Writes a data in a specified RTC Backup data register
- Read a data in a specified RTC Backup data register
- Sets the Coarse calibration parameters.
- Deactivates the Coarse calibration parameters
- Sets the Smooth calibration parameters.
- Configures the Synchronization Shift Control Settings.
- Configures the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
- Deactivates the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).
- Enables the RTC reference clock detection.
- Disable the RTC reference clock detection.
- Enables the Bypass Shadow feature.
- Disables the Bypass Shadow feature.

This section contains the following APIs:

- ***HAL_RTCEx_BKUPWrite()***
- ***HAL_RTCEx_BKUPRead()***
- ***HAL_RTCEx_SetCoarseCalib()***
- ***HAL_RTCEx_DeactivateCoarseCalib()***
- ***HAL_RTCEx_SetSmoothCalib()***
- ***HAL_RTCEx_SetSynchroShift()***
- ***HAL_RTCEx_SetCalibrationOutPut()***
- ***HAL_RTCEx_DeactivateCalibrationOutPut()***
- ***HAL_RTCEx_SetRefClock()***
- ***HAL_RTCEx_DeactivateRefClock()***

- ***HAL_RTCEx_EnableBypassShadow()***
- ***HAL_RTCEx_DisableBypassShadow()***

37.2.5 Extended features functions

This section provides functions allowing to:

- RTC Alram B callback
- RTC Poll for Alarm B request

This section contains the following APIs:

- ***HAL_RTCEx_AlarmBEventCallback()***
- ***HAL_RTCEx_PollForAlarmBEvent()***

37.2.6 Detailed description of functions

HAL_RTCEx_SetTimeStamp

Function name
HAL_StatusTypeDef HAL_RTCEx_SetTimeStamp (RTC_HandleTypeDef * hrtc, uint32_t TimeStampEdge)

Function description
Sets TimeStamp.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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.

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)

Function description
Sets TimeStamp with Interrupt.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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.

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	Deactivates TimeStamp.
Parameters	• **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
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	Gets the RTC TimeStamp value.
Parameters	• **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • **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_SetTamper

Function name	**HAL_StatusTypeDef HAL_RTCEx_SetTamper (RTC_HandleTypeDef * hrtc, RTC_TamperTypeDef * sTamper)**
Function description	Sets Tamper.
Parameters	• **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • **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	Sets Tamper with interrupt.
Parameters	• **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • **sTamper:** Pointer to RTC Tamper.
Return values	• **HAL:** status

Notes
- By calling this API we force the tamper interrupt for all tampers.

HAL_RTCEx_DeactivateTamper

Function name **HAL_StatusTypeDef HAL_RTCEx_DeactivateTamper (RTC_HandleTypeDef * hrtc, uint32_t Tamper)**

Function description Deactivates Tamper.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Tamper:** Selected tamper pin. This parameter can be a value of Tamper Pins Definitions

Return values
- **HAL:** status

HAL_RTCEx_TamperTimeStampIRQHandler

Function name **void HAL_RTCEx_TamperTimeStampIRQHandler (RTC_HandleTypeDef * hrtc)**

Function description This function handles TimeStamp interrupt request.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTCEx_Tamper1EventCallback

Function name **void HAL_RTCEx_Tamper1EventCallback (RTC_HandleTypeDef * hrtc)**

Function description Tamper 1 callback.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTCEx_Tamper2EventCallback

Function name **void HAL_RTCEx_Tamper2EventCallback (RTC_HandleTypeDef * hrtc)**

Function description Tamper 2 callback.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

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_TimeStampEventCallback

Function name **void HAL_RTCEx_TimeStampEventCallback (RTC_HandleTypeDef * hrtc)**

Function description TimeStamp callback.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTCEx_PollForTimeStampEvent

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForTimeStampEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles TimeStamp polling request.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_RTCEx_PollForTamper1Event

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForTamper1Event (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles Tamper1 Polling.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 This function handles Tamper2 Polling.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 This function handles Tamper3 Polling.

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

Return values
- **HAL:** status

HAL_RTCEx_DeactivateWakeUpTimer

Function name **uint32_t HAL_RTCEx_DeactivateWakeUpTimer (RTC_HandleTypeDef * hrtc)**

Function description Deactivates wake up timer counter.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** status

HAL_RTCEx_GetWakeUpTimer

Function name **uint32_t HAL_RTCEx_GetWakeUpTimer (RTC_HandleTypeDef * hrtc)**

Function description Gets wake up timer counter.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **Counter:** value

HAL_RTCEx_WakeUpTimerIRQHandler

Function name **void HAL_RTCEx_WakeUpTimerIRQHandler (RTC_HandleTypeDef * hrtc)**

Function description This function handles Wake Up Timer interrupt request.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTCEx_WakeUpTimerEventCallback

Function name **void HAL_RTCEx_WakeUpTimerEventCallback (RTC_HandleTypeDef * hrtc)**

Function description Wake Up Timer callback.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **None:**

HAL_RTCEx_PollForWakeUpTimerEvent

Function name **HAL_StatusTypeDef HAL_RTCEx_PollForWakeUpTimerEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**

Function description This function handles Wake Up Timer Polling.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_RTCEx_BKUPWrite

Function name **void HAL_RTCEx_BKUPWrite (RTC_HandleTypeDef * hrtc, uint32_t BackupRegister, uint32_t Data)**

Function description Writes a data in a specified RTC Backup data register.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **BackupRegister:** RTC Backup data Register number. This parameter can be: RTC_BKP_DRx where x can be from 0 to 19 to specify the register.
- **Data:** Data to be written in the specified RTC Backup data register.

Return values
- **None:**

HAL_RTCEx_BKUPRead

Function name **uint32_t HAL_RTCEx_BKUPRead (RTC_HandleTypeDef * hrtc, uint32_t BackupRegister)**

Function description Reads data from the specified RTC Backup data Register.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **BackupRegister:** RTC Backup data Register number. This parameter can be: RTC_BKP_DRx where x can be from 0 to 19 to specify the register.

Return values
- **Read:** value

HAL_RTCEx_SetCoarseCalib

Function name **HAL_StatusTypeDef HAL_RTCEx_SetCoarseCalib (RTC_HandleTypeDef * hrtc, uint32_t CalibSign, uint32_t Value)**

Function description Sets the Coarse calibration parameters.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **CalibSign:** Specifies the sign of the coarse calibration value. This parameter can be one of the following values :
  - RTC_CALIBSIGN_POSITIVE: The value sign is positive
  - RTC_CALIBSIGN_NEGATIVE: The value sign is negative
- **Value:** value of coarse calibration expressed in ppm (coded on 5 bits).

Return values
- **HAL:** status

Notes
- This Calibration value should be between 0 and 63 when using negative sign with a 2-ppm step.
- This Calibration value should be between 0 and 126 when using positive sign with a 4-ppm step.

HAL_RTCEx_DeactivateCoarseCalib

Function name **HAL_StatusTypeDef HAL_RTCEx_DeactivateCoarseCalib (RTC_HandleTypeDef * hrtc)**

Function description Deactivates the Coarse calibration parameters.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

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 Sets the Smooth calibration parameters.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **SmoothCalibPeriod:** Select the Smooth Calibration Period. This parameter can be can be one of the following values :
  - RTC_SMOOTHCALIB_PERIOD_32SEC: The smooth

calibration periode is 32s.
  - RTC_SMOOTHCALIB_PERIOD_16SEC: The smooth calibration periode is 16s.
  - RTC_SMOOTHCALIB_PERIOD_8SEC: The smooth calibartion periode 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 puls 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 mut 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
Configures the Synchronization Shift Control Settings.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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
Configures the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
- **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 Deactivates the Calibration Pinout (RTC_CALIB) Selection (1Hz or 512Hz).

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** status

HAL_RTCEx_SetRefClock

Function name **HAL_StatusTypeDef HAL_RTCEx_SetRefClock (RTC_HandleTypeDef * hrtc)**

Function description Enables the RTC reference clock detection.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

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:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

Return values
- **HAL:** status

HAL_RTCEx_EnableBypassShadow

Function name **HAL_StatusTypeDef HAL_RTCEx_EnableBypassShadow (RTC_HandleTypeDef * hrtc)**

Function description Enables the Bypass Shadow feature.

Parameters
- **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.

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	Disables the Bypass Shadow feature.
Parameters	• **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
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:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC.
Return values	• **None:**

HAL_RTCEx_PollForAlarmBEvent

Function name	**HAL_StatusTypeDef HAL_RTCEx_PollForAlarmBEvent (RTC_HandleTypeDef * hrtc, uint32_t Timeout)**
Function description	This function handles AlarmB Polling request.
Parameters	• **hrtc:** pointer to a RTC_HandleTypeDef structure that contains the configuration information for RTC. • **Timeout:** Timeout duration
Return values	• **HAL:** status

37.3 RTCEx Firmware driver defines

37.3.1 RTCEx

Add 1 Second Parameter Definitions

RTC_SHIFTADD1S_RESET

RTC_SHIFTADD1S_SET

IS_RTC_SHIFT_ADD1S

Backup 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
IS_RTC_BKP

Calib Output Selection Definitions

RTC_CALIBOUTPUT_512HZ
RTC_CALIBOUTPUT_1HZ
IS_RTC_CALIB_OUTPUT

Digital Calibration Definitions

RTC_CALIBSIGN_POSITIVE
RTC_CALIBSIGN_NEGATIVE
IS_RTC_CALIB_SIGN

IS_RTC_CALIB_VALUE

RTCEx Exported Macros

__HAL_RTC_WAKEUPTIMER_ENABLE

Description:

- Enable the RTC WakeUp Timer peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_TIMESTAMP_ENABLE

Description:

- Enable the RTC TimeStamp 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_TIMESTAMP_DISABLE

Description:

- Disable the RTC TimeStamp peripheral.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__HAL_RTC_COARSE_CALIB_ENABLE

Description:

- Enable the Coarse calibration process.

Parameters:

- __HANDLE__: specifies the

RTC handle.

Return value:

- None

__HAL_RTC_COARSE_CALIB_DISABLE

Description:

- Disable the Coarse calibration process.

Parameters:

- __HANDLE__: specifies the RTC handle.

Return value:

- None

__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_TIMESTAMP_ENABLE_IT

Description:

- Enable the RTC TimeStamp interrupt.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __INTERRUPT__: specifies the RTC TimeStamp interrupt sources to be enabled or disabled. This parameter can be:
  - RTC_IT_TS: TimeStamp interrupt

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 or disabled. This parameter can be:
  - RTC_IT_WUT: WakeUpTimer A 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 sources to be enabled or disabled. This parameter can be:

- RTC_IT_TS: TimeStamp 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 enabled or disabled. This parameter can be:
  - RTC_IT_WUT: WakeUpTimer A interrupt

Return value:

- None

__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_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_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt
  - RTC_IT_TAMP3:

Tamper3 interrupt

Return value:

- None

__HAL_RTC_TAMPER_ENABLE_IT

Description:

- Enable the RTC 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_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt (*)
  - RTC_IT_TAMP3: Tamper3 interrupt (*)

Return value:

- None

Notes:

- (*) Available only on devices STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L100xC, STM32L151xC, STM32L152xC, STM32L162xC, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD, STM32L151xE, STM32L152xE, STM32L162xE STM32L151xDX, STM32L152xDX, STM32L162xDX

__HAL_RTC_TAMPER_DISABLE_IT

Description:

- Disable the RTC 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_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2: Tamper2 interrupt (*)
  - RTC_IT_TAMP3: Tamper3 interrupt (*)

Return value:

- None

Notes:

- (*) Available only on devices STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L100xC, STM32L151xC, STM32L152xC, STM32L162xC, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD, STM32L151xE, STM32L152xE, STM32L162xE STM32L151xDX, STM32L152xDX, STM32L162xDX

__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_TAMP1: Tamper1 interrupt
  - RTC_IT_TAMP2:

Tamper2 interrupt (*)
- RTC_IT_TAMP3: Tamper3 interrupt (*)

Return value:

- None

Notes:

- (*) Available only on devices STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L100xC, STM32L151xC, STM32L152xC, STM32L162xC, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD, STM32L151xE, STM32L152xE, STM32L162xE STM32L151xDX, STM32L152xDX, STM32L162xDX

__HAL_RTC_WAKEUPTIMER_GET_IT

Description:

- Check whether the specified RTC WakeUpTimer interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC WakeUpTimer interrupt sources to be enabled or disabled. This parameter can be:
  - RTC_IT_WUT: WakeUpTimer A 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_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 sources to be enabled or disabled. 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 sources to be enabled or disabled. This parameter can be:
  - RTC_FLAG_TSF
  - RTC_FLAG_TSOVF

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 sources to be enabled or disabled. This parameter can be:
  - RTC_FLAG_WUTF
  - RTC_FLAG_WUTWF

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 sources to be enabled or disabled. This parameter can be:
  - RTC_FLAG_TAMP1F
  - RTC_FLAG_TAMP2F (*)
  - RTC_FLAG_TAMP3F (*)

Return value:

- None

Notes:

- (*) Available only on devices STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L100xC, STM32L151xC,

STM32L152xC,
STM32L162xC,
STM32L151xCA,
STM32L151xD,
STM32L152xCA,
STM32L152xD,
STM32L162xCA,
STM32L162xD,
STM32L151xE,
STM32L152xE,
STM32L162xE
STM32L151xDX,
STM32L152xDX,
STM32L162xDX

__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

__HAL_RTC_TIMESTAMP_CLEAR_FLAG

Description:

- Clear the RTC Time Stamp's pending flags.

Parameters:

- __HANDLE__: specifies the RTC handle.
- __FLAG__: specifies the RTC Alarm Flag sources to be enabled or disabled. This parameter can be:
  - RTC_FLAG_TSF

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 sources to be enabled or disabled. This parameter can be:
- RTC_FLAG_TAMP1F
- RTC_FLAG_TAMP2F (*)
- RTC_FLAG_TAMP3F (*)

Return value:

- None

Notes:

- (*) Available only on devices STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L100xC, STM32L151xC, STM32L152xC, STM32L162xC, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD, STM32L151xE, STM32L152xE, STM32L162xE STM32L151xDX, STM32L152xDX, STM32L162xDX

__HAL_RTC_WAKEUPTIMER_CLEAR_FLAG

Description:

- Clear the RTC Wake Up timer's 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.

__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.

Output selection Definitions

RTC_OUTPUT_DISABLE

RTC_OUTPUT_ALARMA

RTC_OUTPUT_ALARMB

RTC_OUTPUT_WAKEUP

IS_RTC_OUTPUT

Smooth Calib Minus Pulses Definitions

IS_RTC_SMOOTH_CALIB_MINUS

Smooth Calib Period Definitions

RTC_SMOOTHCALIB_PERIOD_32SEC	If RTCCLK = 32768 Hz, Smooth calibation period is 32s, else 2exp20 RTCCLK seconds
RTC_SMOOTHCALIB_PERIOD_16SEC	If RTCCLK = 32768 Hz, Smooth calibation period is 16s, else 2exp19 RTCCLK seconds
RTC_SMOOTHCALIB_PERIOD_8SEC	If RTCCLK = 32768 Hz, Smooth calibation period is 8s, else 2exp18 RTCCLK seconds

IS_RTC_SMOOTH_CALIB_PERIOD

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]

IS_RTC_SMOOTH_CALIB_PLUS

Substract Fraction Of Second Value

IS_RTC_SHIFT_SUBFS

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.

IS_RTC_TAMPER_FILTER

Tamper Pins Definitions

RTC_TAMPER_1

RTC_TAMPER_2

RTC_TAMPER_3

IS_RTC_TAMPER

Tamper Pin Precharge Duration

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

IS_RTC_TAMPER_PRECHARGE_DURATION

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

IS_RTC_TAMPER_PULLUP_STATE

Tamper Sampling Frequencies

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

IS_RTC_TAMPER_SAMPLING_FREQ

TimeStampOnTamperDetection Definitions

RTC_TIMESTAMPONTAMPERDETECTION_ENABLE	TimeStamp on Tamper Detection event saved
RTC_TIMESTAMPONTAMPERDETECTION_DISABLE	TimeStamp on Tamper Detection event is not saved

IS_RTC_TAMPER_TIMESTAMPONTAMPER_DETECTION

Tamper Trigger Definitions

RTC_TAMPERTRIGGER_RISINGEDGE

RTC_TAMPERTRIGGER_FALLINGEDGE

RTC_TAMPERTRIGGER_LOWLEVEL

RTC_TAMPERTRIGGER_HIGHLEVEL

IS_RTC_TAMPER_TRIGGER

Time Stamp Edges Definitions

RTC_TIMESTAMPEDGE_RISING

RTC_TIMESTAMPEDGE_FALLING

IS_TIMESTAMP_EDGE

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

IS_RTC_WAKEUP_CLOCK

IS_RTC_WAKEUP_COUNTER

38 HAL SD Generic Driver

38.1 SD Firmware driver registers structures

38.1.1 SD_HandleTypeDef

Data Fields

- ***SD_TypeDef * Instance***
- ***SD_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***uint32_t CardType***
- ***uint32_t RCA***
- ***uint32_t CSD***
- ***uint32_t CID***
- ***__IO uint32_t SdTransferCplt***
- ***__IO uint32_t SdTransferErr***
- ***__IO uint32_t DmaTransferCplt***
- ***__IO uint32_t SdOperation***
- ***DMA_HandleTypeDef * hdmarx***
- ***DMA_HandleTypeDef * hdmatx***

Field Documentation

- ***SD_TypeDef* SD_HandleTypeDef::Instance***
  SDIO register base address
- ***SD_InitTypeDef SD_HandleTypeDef::Init***
  SD required parameters
- ***HAL_LockTypeDef SD_HandleTypeDef::Lock***
  SD locking object
- ***uint32_t SD_HandleTypeDef::CardType***
  SD card type
- ***uint32_t SD_HandleTypeDef::RCA***
  SD relative card address
- ***uint32_t SD_HandleTypeDef::CSD[4]***
  SD card specific data table
- ***uint32_t SD_HandleTypeDef::CID[4]***
  SD card identification number table
- ***__IO uint32_t SD_HandleTypeDef::SdTransferCplt***
  SD transfer complete flag in non blocking mode
- ***__IO uint32_t SD_HandleTypeDef::SdTransferErr***
  SD transfer error flag in non blocking mode
- ***__IO uint32_t SD_HandleTypeDef::DmaTransferCplt***
  SD DMA transfer complete flag
- ***__IO uint32_t SD_HandleTypeDef::SdOperation***
  SD transfer operation (read/write)
- ***DMA_HandleTypeDef* SD_HandleTypeDef::hdmarx***
  SD Rx DMA handle parameters
- ***DMA_HandleTypeDef* SD_HandleTypeDef::hdmatx***
  SD Tx DMA handle parameters

38.1.2 HAL_SD_CSDTypedef

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 FileFormatGrouop***
- ***__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_CSDTypedef::CSDStruct***
  CSD structure
- ***__IO uint8_t HAL_SD_CSDTypedef::SysSpecVersion***
  System specification version
- ***__IO uint8_t HAL_SD_CSDTypedef::Reserved1***
  Reserved
- ***__IO uint8_t HAL_SD_CSDTypedef::TAAC***
  Data read access time 1
- ***__IO uint8_t HAL_SD_CSDTypedef::NSAC***
  Data read access time 2 in CLK cycles

- ***__IO uint8_t HAL_SD_CSDTypedef::MaxBusClkFrec***
  Max. bus clock frequency
- ***__IO uint16_t HAL_SD_CSDTypedef::CardComdClasses***
  Card command classes
- ***__IO uint8_t HAL_SD_CSDTypedef::RdBlockLen***
  Max. read data block length
- ***__IO uint8_t HAL_SD_CSDTypedef::PartBlockRead***
  Partial blocks for read allowed
- ***__IO uint8_t HAL_SD_CSDTypedef::WrBlockMisalign***
  Write block misalignment
- ***__IO uint8_t HAL_SD_CSDTypedef::RdBlockMisalign***
  Read block misalignment
- ***__IO uint8_t HAL_SD_CSDTypedef::DSRImpl***
  DSR implemented
- ***__IO uint8_t HAL_SD_CSDTypedef::Reserved2***
  Reserved
- ***__IO uint32_t HAL_SD_CSDTypedef::DeviceSize***
  Device Size
- ***__IO uint8_t HAL_SD_CSDTypedef::MaxRdCurrentVDDMin***
  Max. read current @ VDD min
- ***__IO uint8_t HAL_SD_CSDTypedef::MaxRdCurrentVDDMax***
  Max. read current @ VDD max
- ***__IO uint8_t HAL_SD_CSDTypedef::MaxWrCurrentVDDMin***
  Max. write current @ VDD min
- ***__IO uint8_t HAL_SD_CSDTypedef::MaxWrCurrentVDDMax***
  Max. write current @ VDD max
- ***__IO uint8_t HAL_SD_CSDTypedef::DeviceSizeMul***
  Device size multiplier
- ***__IO uint8_t HAL_SD_CSDTypedef::EraseGrSize***
  Erase group size
- ***__IO uint8_t HAL_SD_CSDTypedef::EraseGrMul***
  Erase group size multiplier
- ***__IO uint8_t HAL_SD_CSDTypedef::WrProtectGrSize***
  Write protect group size
- ***__IO uint8_t HAL_SD_CSDTypedef::WrProtectGrEnable***
  Write protect group enable
- ***__IO uint8_t HAL_SD_CSDTypedef::ManDeflECC***
  Manufacturer default ECC
- ***__IO uint8_t HAL_SD_CSDTypedef::WrSpeedFact***
  Write speed factor
- ***__IO uint8_t HAL_SD_CSDTypedef::MaxWrBlockLen***
  Max. write data block length
- ***__IO uint8_t HAL_SD_CSDTypedef::WriteBlockPaPartial***
  Partial blocks for write allowed
- ***__IO uint8_t HAL_SD_CSDTypedef::Reserved3***
  Reserved
- ***__IO uint8_t HAL_SD_CSDTypedef::ContentProtectAppli***
  Content protection application
- ***__IO uint8_t HAL_SD_CSDTypedef::FileFormatGrouop***
  File format group
- ***__IO uint8_t HAL_SD_CSDTypedef::CopyFlag***
  Copy flag (OTP)
- ***__IO uint8_t HAL_SD_CSDTypedef::PermWrProtect***
  Permanent write protection

- ***__IO uint8_t HAL_SD_CSDTypedef::TempWrProtect***
  Temporary write protection
- ***__IO uint8_t HAL_SD_CSDTypedef::FileFormat***
  File format
- ***__IO uint8_t HAL_SD_CSDTypedef::ECC***
  ECC code
- ***__IO uint8_t HAL_SD_CSDTypedef::CSD_CRC***
  CSD CRC
- ***__IO uint8_t HAL_SD_CSDTypedef::Reserved4***
  Always 1

38.1.3 HAL_SD_CIDTypedef

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_CIDTypedef::ManufacturerID***
  Manufacturer ID
- ***__IO uint16_t HAL_SD_CIDTypedef::OEM_AppliID***
  OEM/Application ID
- ***__IO uint32_t HAL_SD_CIDTypedef::ProdName1***
  Product Name part1
- ***__IO uint8_t HAL_SD_CIDTypedef::ProdName2***
  Product Name part2
- ***__IO uint8_t HAL_SD_CIDTypedef::ProdRev***
  Product Revision
- ***__IO uint32_t HAL_SD_CIDTypedef::ProdSN***
  Product Serial Number
- ***__IO uint8_t HAL_SD_CIDTypedef::Reserved1***
  Reserved1
- ***__IO uint16_t HAL_SD_CIDTypedef::ManufactDate***
  Manufacturing Date
- ***__IO uint8_t HAL_SD_CIDTypedef::CID_CRC***
  CID CRC
- ***__IO uint8_t HAL_SD_CIDTypedef::Reserved2***
  Always 1

38.1.4 HAL_SD_CardStatusTypedef

Data Fields

- ***__IO uint8_t DAT_BUS_WIDTH***
- ***__IO uint8_t SECURED_MODE***
- ***__IO uint16_t SD_CARD_TYPE***
- ***__IO uint32_t SIZE_OF_PROTECTED_AREA***

- *__IO uint8_t SPEED_CLASS*
- *__IO uint8_t PERFORMANCE_MOVE*
- *__IO uint8_t AU_SIZE*
- *__IO uint16_t ERASE_SIZE*
- *__IO uint8_t ERASE_TIMEOUT*
- *__IO uint8_t ERASE_OFFSET*

Field Documentation

- *__IO uint8_t HAL_SD_CardStatusTypedef::DAT_BUS_WIDTH*
  Shows the currently defined data bus width
- *__IO uint8_t HAL_SD_CardStatusTypedef::SECURED_MODE*
  Card is in secured mode of operation
- *__IO uint16_t HAL_SD_CardStatusTypedef::SD_CARD_TYPE*
  Carries information about card type
- *__IO uint32_t HAL_SD_CardStatusTypedef::SIZE_OF_PROTECTED_AREA*
  Carries information about the capacity of protected area
- *__IO uint8_t HAL_SD_CardStatusTypedef::SPEED_CLASS*
  Carries information about the speed class of the card
- *__IO uint8_t HAL_SD_CardStatusTypedef::PERFORMANCE_MOVE*
  Carries information about the card's performance move
- *__IO uint8_t HAL_SD_CardStatusTypedef::AU_SIZE*
  Carries information about the card's allocation unit size
- *__IO uint16_t HAL_SD_CardStatusTypedef::ERASE_SIZE*
  Determines the number of AUs to be erased in one operation
- *__IO uint8_t HAL_SD_CardStatusTypedef::ERASE_TIMEOUT*
  Determines the timeout for any number of AU erase
- *__IO uint8_t HAL_SD_CardStatusTypedef::ERASE_OFFSET*
  Carries information about the erase offset

38.1.5 HAL_SD_CardInfoTypedef

Data Fields

- *HAL_SD_CSDTypedef SD_csd*
- *HAL_SD_CIDTypedef SD_cid*
- *uint64_t CardCapacity*
- *uint32_t CardBlockSize*
- *uint16_t RCA*
- *uint8_t CardType*

Field Documentation

- *HAL_SD_CSDTypedef HAL_SD_CardInfoTypedef::SD_csd*
  SD card specific data register
- *HAL_SD_CIDTypedef HAL_SD_CardInfoTypedef::SD_cid*
  SD card identification number register
- *uint64_t HAL_SD_CardInfoTypedef::CardCapacity*
  Card capacity
- *uint32_t HAL_SD_CardInfoTypedef::CardBlockSize*
  Card block size
- *uint16_t HAL_SD_CardInfoTypedef::RCA*
  SD relative card address
- *uint8_t HAL_SD_CardInfoTypedef::CardType*
  SD card type

38.2 SD Firmware driver API description

38.2.1 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 (SDIO 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 SDIO memories which uses the HAL SDIO driver functions to interface with SD and uSD cards devices. It is used as follows:

1. Initialize the SDIO low level resources by implement the HAL_SD_MspInit() API:
   a. Enable the SDIO interface clock using __HAL_RCC_SDIO_CLK_ENABLE();
   b. SDIO pins configuration for SD card
      – Enable the clock for the SDIO GPIOs using the functions __HAL_RCC_GPIOx_CLK_ENABLE();
      – Configure these SDIO pins as alternate function pull-up using HAL_GPIO_Init() and according to your pin assignment;
   c. 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.
   d. NVIC configuration if you need to use interrupt process when using DMA transfer.
      – Configure the SDIO and DMA interrupt priorities using functions HAL_NVIC_SetPriority(); DMA priority is superior to SDIO's priority
      – Enable the NVIC DMA and SDIO IRQs using function HAL_NVIC_EnableIRQ()
      – SDIO interrupts are managed using the macros __HAL_SD_SDIO_ENABLE_IT() and __HAL_SD_SDIO_DISABLE_IT() inside the communication process.
      – SDIO interrupts pending bits are managed using the macros __HAL_SD_SDIO_GET_IT() and __HAL_SD_SDIO_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 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 (SDIO_CK) is computed as follows: SDIO_CK = SDIOCLK / (ClockDiv + 2) In initialization mode and according to the SD Card standard, make sure that the SDIO_CK frequency doesn't exceed 400KHz.
2. Get the SD CID and CSD data. All these information are managed by the SDCardInfo structure. This structure provide also ready computed SD Card capacity and Block size. These information are stored in SD handle structure in case of future use.
3. Configure the SD Card Data transfer frequency. By Default, the card transfer frequency is set to 48MHz / (SDIO_TRANSFER_CLK_DIV + 2) = 8MHz. You can change or adapt this frequency by adjusting the "ClockDiv" field. The SD Card

frequency (SDIO_CK) is computed as follows: SDIO_CK = SDIOCLK / (ClockDiv + 2) In transfer mode and according to the SD Card standard, make sure that the SDIO_CK frequency doesn't exceed 25MHz and 50MHz in High-speed mode switch. To be able to use a frequency higher than 24MHz, you should use the SDIO peripheral in bypass mode. Refer to the corresponding reference manual for more details.

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.
- 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 call the function HAL_SD_CheckReadOperation(), to insure that the read transfer is done correctly in both DMA and SD sides.

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.
- 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 byte). You can choose either one block read operation or multiple block read operation by adjusting the "NumberOfBlocks" parameter. After this, you have to call the function HAL_SD_CheckWriteOperation(), to insure that the write transfer is done correctly in both DMA and SD sides.

SD card status

- At any time, you can check the SD Card status and get the SD card state by using the HAL_SD_GetStatus() function. This function checks first if the SD card is still connected and then get the internal SD Card transfer state.
- You can also get the SD card SD Status register by using the HAL_SD_SendSDStatus() function.

SD HAL driver macros list

You can refer to the SD HAL driver header file for more useful macros

38.2.2 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_DeInit()***
- ***HAL_SD_MspInit()***
- ***HAL_SD_MspDeInit()***

38.2.3 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_DMA()***
- ***HAL_SD_WriteBlocks_DMA()***
- ***HAL_SD_CheckReadOperation()***
- ***HAL_SD_CheckWriteOperation()***
- ***HAL_SD_Erase()***
- ***HAL_SD_IRQHandler()***
- ***HAL_SD_XferCpltCallback()***
- ***HAL_SD_XferErrorCallback()***
- ***HAL_SD_DMA_RxCpltCallback()***
- ***HAL_SD_DMA_RxErrorCallback()***
- ***HAL_SD_DMA_TxCpltCallback()***
- ***HAL_SD_DMA_TxErrorCallback()***

38.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the SD card operations.

This section contains the following APIs:

- ***HAL_SD_Get_CardInfo()***
- ***HAL_SD_WideBusOperation_Config()***
- ***HAL_SD_StopTransfer()***
- ***HAL_SD_HighSpeed()***

38.2.5 Peripheral State functions

This subsection permits to get in runtime the status of the peripheral and the data flow.

This section contains the following APIs:

- ***HAL_SD_SendSDStatus()***
- ***HAL_SD_GetStatus()***
- ***HAL_SD_GetCardStatus()***

38.2.6 Detailed description of functions

HAL_SD_Init

Function name	**HAL_SD_ErrorTypedef HAL_SD_Init (SD_HandleTypeDef * hsd, HAL_SD_CardInfoTypedef * SDCardInfo)**
Function description	Initializes the SD card according to the specified parameters in the SD_HandleTypeDef and create the associated handle.
Parameters	• **hsd:** SD handle

- **SDCardInfo:** HAL_SD_CardInfoTypedef structure for SD card information

Return values
- **HAL:** SD error state

HAL_SD_DeInit

Function name **HAL_StatusTypeDef HAL_SD_DeInit (SD_HandleTypeDef * hsd)**

Function description De-Initializes the SD card.

Parameters
- **hsd:** 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:** 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:** SD handle

Return values
- **None:**

HAL_SD_ReadBlocks

Function name **HAL_SD_ErrorTypedef HAL_SD_ReadBlocks (SD_HandleTypeDef * hsd, uint32_t * pReadBuffer, uint64_t ReadAddr, uint32_t BlockSize, uint32_t NumberOfBlocks)**

Function description Reads block(s) from a specified address in a card.

Parameters
- **hsd:** SD handle
- **pReadBuffer:** pointer to the buffer that will contain the received data
- **ReadAddr:** Address from where data is to be read
- **BlockSize:** SD card Data block size
- **NumberOfBlocks:** Number of SD blocks to read

Return values
- **SD:** Card error state

Notes
- BlockSize must be 512 bytes.

HAL_SD_WriteBlocks

Function name **HAL_SD_ErrorTypedef HAL_SD_WriteBlocks (SD_HandleTypeDef * hsd, uint32_t * pWriteBuffer, uint64_t WriteAddr, uint32_t BlockSize, uint32_t NumberOfBlocks)**

Function description	Allows to write block(s) to a specified address in a card.
Parameters	• **hsd:** SD handle • **pWriteBuffer:** pointer to the buffer that will contain the data to transmit • **WriteAddr:** Address from where data is to be written • **BlockSize:** SD card Data block size • **NumberOfBlocks:** Number of SD blocks to write
Return values	• **SD:** Card error state
Notes	• BlockSize must be 512 bytes.

HAL_SD_Erase

Function name	**HAL_SD_ErrorTypedef HAL_SD_Erase (SD_HandleTypeDef * hsd, uint64_t startaddr, uint64_t endaddr)**
Function description	Erases the specified memory area of the given SD card.
Parameters	• **hsd:** SD handle • **startaddr:** Start byte address • **endaddr:** End byte address
Return values	• **SD:** Card error state

HAL_SD_IRQHandler

Function name	**void HAL_SD_IRQHandler (SD_HandleTypeDef * hsd)**
Function description	This function handles SD card interrupt request.
Parameters	• **hsd:** SD handle
Return values	• **None:**

HAL_SD_DMA_RxCpltCallback

Function name	**void HAL_SD_DMA_RxCpltCallback (DMA_HandleTypeDef * hdma)**
Function description	SD Transfer complete Rx callback in non blocking mode.
Parameters	• **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.
Return values	• **None:**

HAL_SD_DMA_RxErrorCallback

Function name	**void HAL_SD_DMA_RxErrorCallback (DMA_HandleTypeDef * hdma)**
Function description	SD DMA transfer complete Rx error callback.
Parameters	• **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values
- **None:**

HAL_SD_DMA_TxCpltCallback

Function name **void HAL_SD_DMA_TxCpltCallback (DMA_HandleTypeDef * hdma)**

Function description SD Transfer complete Tx callback in non blocking mode.

Parameters
- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values
- **None:**

HAL_SD_DMA_TxErrorCallback

Function name **void HAL_SD_DMA_TxErrorCallback (DMA_HandleTypeDef * hdma)**

Function description SD DMA transfer complete error Tx callback.

Parameters
- **hdma:** pointer to a DMA_HandleTypeDef structure that contains the configuration information for the specified DMA module.

Return values
- **None:**

HAL_SD_XferCpltCallback

Function name **void HAL_SD_XferCpltCallback (SD_HandleTypeDef * hsd)**

Function description SD end of transfer callback.

Parameters
- **hsd:** SD handle

Return values
- **None:**

HAL_SD_XferErrorCallback

Function name **void HAL_SD_XferErrorCallback (SD_HandleTypeDef * hsd)**

Function description SD Transfer Error callback.

Parameters
- **hsd:** SD handle

Return values
- **None:**

HAL_SD_ReadBlocks_DMA

Function name **HAL_SD_ErrorTypedef HAL_SD_ReadBlocks_DMA (SD_HandleTypeDef * hsd, uint32_t * pReadBuffer, uint64_t ReadAddr, uint32_t BlockSize, uint32_t NumberOfBlocks)**

Function description Reads block(s) from a specified address in a card.

Parameters
- **hsd:** SD handle
- **pReadBuffer:** Pointer to the buffer that will contain the received data
- **ReadAddr:** Address from where data is to be read
- **BlockSize:** SD card Data block size

- **NumberOfBlocks:** Number of blocks to read.

Return values
- **SD:** Card error state

Notes
- This API should be followed by the function HAL_SD_CheckReadOperation() to check the completion of the read process
- BlockSize must be 512 bytes.

HAL_SD_WriteBlocks_DMA

Function name **HAL_SD_ErrorTypedef HAL_SD_WriteBlocks_DMA (SD_HandleTypeDef * hsd, uint32_t * pWriteBuffer, uint64_t WriteAddr, uint32_t BlockSize, uint32_t NumberOfBlocks)**

Function description Writes block(s) to a specified address in a card.

Parameters
- **hsd:** SD handle
- **pWriteBuffer:** pointer to the buffer that will contain the data to transmit
- **WriteAddr:** Address from where data is to be read
- **BlockSize:** the SD card Data block size
- **NumberOfBlocks:** Number of blocks to write

Return values
- **SD:** Card error state

Notes
- This API should be followed by the function HAL_SD_CheckWriteOperation() to check the completion of the write process (by SD current status polling).
- BlockSize must be 512 bytes.

HAL_SD_CheckWriteOperation

Function name **HAL_SD_ErrorTypedef HAL_SD_CheckWriteOperation (SD_HandleTypeDef * hsd, uint32_t Timeout)**

Function description This function waits until the SD DMA data write transfer is finished.

Parameters
- **hsd:** SD handle
- **Timeout:** Timeout duration

Return values
- **SD:** Card error state

HAL_SD_CheckReadOperation

Function name **HAL_SD_ErrorTypedef HAL_SD_CheckReadOperation (SD_HandleTypeDef * hsd, uint32_t Timeout)**

Function description This function waits until the SD DMA data read transfer is finished.

Parameters
- **hsd:** SD handle
- **Timeout:** Timeout duration

Return values
- **SD:** Card error state

HAL_SD_Get_CardInfo

Function name **HAL_SD_ErrorTypedef HAL_SD_Get_CardInfo (SD_HandleTypeDef * hsd, HAL_SD_CardInfoTypedef ***

pCardInfo)

Function description: Returns information about specific card.

Parameters:
- **hsd:** SD handle
- **pCardInfo:** Pointer to a HAL_SD_CardInfoTypedef structure that contains all SD cardinformation

Return values:
- **SD:** Card error state

HAL_SD_WideBusOperation_Config

Function name: **HAL_SD_ErrorTypedef HAL_SD_WideBusOperation_Config (SD_HandleTypeDef * hsd, uint32_t WideMode)**

Function description: Enables wide bus operation for the requested card if supported by card.

Parameters:
- **hsd:** SD handle
- **WideMode:** Specifies the SD card wide bus mode This parameter can be one of the following values:
  - SDIO_BUS_WIDE_8B: 8-bit data transfer (Only for MMC)
  - SDIO_BUS_WIDE_4B: 4-bit data transfer
  - SDIO_BUS_WIDE_1B: 1-bit data transfer

Return values:
- **SD:** Card error state

HAL_SD_StopTransfer

Function name: **HAL_SD_ErrorTypedef HAL_SD_StopTransfer (SD_HandleTypeDef * hsd)**

Function description: Aborts an ongoing data transfer.

Parameters:
- **hsd:** SD handle

Return values:
- **SD:** Card error state

HAL_SD_HighSpeed

Function name: **HAL_SD_ErrorTypedef HAL_SD_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 SDIOCK clock between 67 and 75 MHz

HAL_SD_SendSDStatus

Function name: **HAL_SD_ErrorTypedef HAL_SD_SendSDStatus (SD_HandleTypeDef * hsd, uint32_t * pSDstatus)**

Function description: Returns the current SD card's status.

Parameters:
- **hsd:** SD handle

- **pSDstatus:** Pointer to the buffer that will contain the SD card status SD Status register)

Return values
- **SD:** Card error state

HAL_SD_GetCardStatus

Function name **HAL_SD_ErrorTypedef HAL_SD_GetCardStatus (SD_HandleTypeDef * hsd, HAL_SD_CardStatusTypedef * pCardStatus)**

Function description Gets the SD card status.

Parameters
- **hsd:** SD handle
- **pCardStatus:** Pointer to the HAL_SD_CardStatusTypedef structure that will contain the SD card status information

Return values
- **SD:** Card error state

HAL_SD_GetStatus

Function name **HAL_SD_TransferStateTypedef HAL_SD_GetStatus (SD_HandleTypeDef * hsd)**

Function description Gets the current sd card data status.

Parameters
- **hsd:** SD handle

Return values
- **Data:** Transfer state

38.3 SD Firmware driver defines

38.3.1 SD

SD Exported Constants

SD_CMD_GO_IDLE_STATE	Resets the SD memory card.
SD_CMD_SEND_OP_COND	Sends host capacity support information and activates the card's initialization process.
SD_CMD_ALL_SEND_CID	Asks any card connected to the host to send the CID numbers on the CMD line.
SD_CMD_SET_REL_ADDR	Asks the card to publish a new relative address (RCA).
SD_CMD_SET_DSR	Programs the DSR of all cards.
SD_CMD_SDIO_SEN_OP_COND	Sends host capacity support information (HCS) and asks the accessed card to send its operating condition register (OCR) content in the response on the CMD

	line.
SD_CMD_HS_SWITCH	Checks switchable function (mode 0) and switch card function (mode 1).
SD_CMD_SEL_DESEL_CARD	Selects the card by its own relative address and gets deselected by any other address
SD_CMD_HS_SEND_EXT_CSD	Sends SD Memory Card interface condition, which includes host supply voltage information and asks the card whether card supports voltage.
SD_CMD_SEND_CSD	Addressed card sends its card specific data (CSD) on the CMD line.
SD_CMD_SEND_CID	Addressed card sends its card identification (CID) on the CMD line.
SD_CMD_READ_DAT_UNTIL_STOP	SD card doesn't support it.
SD_CMD_STOP_TRANSMISSION	Forces the card to stop transmission.
SD_CMD_SEND_STATUS	Addressed card sends its status register.
SD_CMD_HS_BUSTEST_READ	
SD_CMD_GO_INACTIVE_STATE	Sends an addressed card into the inactive state.
SD_CMD_SET_BLOCKLEN	Sets the block length (in bytes for SDSC) for all following block commands (read, write, lock). Default block length is fixed to 512 Bytes. Not effective for SDHS and SDXC.
SD_CMD_READ_SINGLE_BLOCK	Reads single block of size selected by SET_BLOCKLEN in case of SDSC, and a block of fixed 512 bytes in case of SDHC and SDXC.
SD_CMD_READ_MULT_BLOCK	Continuously transfers data blocks from card to host until interrupted by STOP_TRANSMISSION command.
SD_CMD_HS_BUSTEST_WRITE	64 bytes tuning pattern is sent for SDR50 and

	SDR104.
SD_CMD_WRITE_DAT_UNTIL_STOP	Speed class control command.
SD_CMD_SET_BLOCK_COUNT	Specify block count for CMD18 and CMD25.
SD_CMD_WRITE_SINGLE_BLOCK	Writes single block of size selected by SET_BLOCKLEN in case of SDSC, and a block of fixed 512 bytes in case of SDHC and SDXC.
SD_CMD_WRITE_MULT_BLOCK	Continuously writes blocks of data until a STOP_TRANSMISSION follows.
SD_CMD_PROG_CID	Reserved for manufacturers.
SD_CMD_PROG_CSD	Programming of the programmable bits of the CSD.
SD_CMD_SET_WRITE_PROT	Sets the write protection bit of the addressed group.
SD_CMD_CLR_WRITE_PROT	Clears the write protection bit of the addressed group.
SD_CMD_SEND_WRITE_PROT	Asks the card to send the status of the write protection bits.
SD_CMD_SD_ERASE_GRP_START	Sets the address of the first write block to be erased. (For SD card only).
SD_CMD_SD_ERASE_GRP_END	Sets the address of the last write block of the continuous range to be erased.
SD_CMD_ERASE_GRP_START	Sets the address of the first write block to be erased. Reserved for each command system set by switch function command (CMD6).
SD_CMD_ERASE_GRP_END	Sets the address of the last write block of the continuous range to be erased. Reserved for each command system set by switch function command (CMD6).
SD_CMD_ERASE	Reserved for SD security applications.

SD_CMD_FAST_IO	SD card doesn't support it (Reserved).
SD_CMD_GO_IRQ_STATE	SD card doesn't support it (Reserved).
SD_CMD_LOCK_UNLOCK	Sets/resets the password or lock/unlock the card. The size of the data block is set by the SET_BLOCK_LEN command.
SD_CMD_APP_CMD	Indicates to the card that the next command is an application specific command rather than a standard command.
SD_CMD_GEN_CMD	Used either to transfer a data block to the card or to get a data block from the card for general purpose/application specific commands.
SD_CMD_NO_CMD	
SD_CMD_APP_SD_SET_BUSWIDTH	SDIO_APP_CMD should be sent before sending these commands. (ACMD6) Defines the data bus width to be used for data transfer. The allowed data bus widths are given in SCR register.
SD_CMD_SD_APP_STATUS	(ACMD13) Sends the SD status.
SD_CMD_SD_APP_SEND_NUM_WRITE_BLOCKS	(ACMD22) Sends the number of the written (without errors) write blocks. Responds with 32bit+CRC data block.
SD_CMD_SD_APP_OP_COND	(ACMD41) Sends host capacity support information (HCS) and asks the accessed card to send its operating condition register (OCR) content in the response on the CMD line.
SD_CMD_SD_APP_SET_CLR_CARD_DETECT	(ACMD42) Connects/Disconnects the 50 KOhm pull-up resistor on CD/DAT3 (pin 1) of the card.
SD_CMD_SD_APP_SEND_SCR	Reads the SD Configuration Register (SCR).
SD_CMD_SDIO_RW_DIRECT	For SD I/O card only,

	reserved for security specification.
SD_CMD_SDIO_RW_EXTENDED	For SD I/O card only, reserved for security specification.
SD_CMD_SD_APP_GET_MKB	SD_CMD_APP_CMD should be sent before sending these commands. For SD card only
SD_CMD_SD_APP_GET_MID	For SD card only
SD_CMD_SD_APP_SET_CER_RN1	For SD card only
SD_CMD_SD_APP_GET_CER_RN2	For SD card only
SD_CMD_SD_APP_SET_CER_RES2	For SD card only
SD_CMD_SD_APP_GET_CER_RES1	For SD card only
SD_CMD_SD_APP_SECURE_READ_MULTIPLE_BLOCK	For SD card only
SD_CMD_SD_APP_SECURE_WRITE_MULTIPLE_BLOCK	For SD card only
SD_CMD_SD_APP_SECURE_ERASE	For SD card only
SD_CMD_SD_APP_CHANGE_SECURE_AREA	For SD card only
SD_CMD_SD_APP_SECURE_WRITE_MKB	For SD card only
STD_CAPACITY_SD_CARD_V1_1	
STD_CAPACITY_SD_CARD_V2_0	
HIGH_CAPACITY_SD_CARD	
MULTIMEDIA_CARD	
SECURE_DIGITAL_IO_CARD	
HIGH_SPEED_MULTIMEDIA_CARD	
SECURE_DIGITAL_IO_COMBO_CARD	
HIGH_CAPACITY_MMC_CARD	

SD Exported Macros

__HAL_SD_SDIO_ENABLE	**Description:** • Enable the SD device. **Return value:** • None
__HAL_SD_SDIO_DISABLE	**Description:** • Disable the SD device. **Return value:** • None
__HAL_SD_SDIO_DMA_ENABLE	**Description:** • Enable the SDIO DMA transfer.

Return value:

- None

__HAL_SD_SDIO_DMA_DISABLE

Description:

- Disable the SDIO DMA transfer.

Return value:

- None

__HAL_SD_SDIO_ENABLE_IT

Description:

- Enable the SD device interrupt.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDIO interrupt sources to be enabled. This parameter can be one or a combination of the following values:
  - SDIO_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDIO_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDIO_IT_CTIMEOUT: Command response timeout interrupt
  - SDIO_IT_DTIMEOUT: Data timeout interrupt
  - SDIO_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDIO_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDIO_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDIO_IT_CMDSENT: Command sent (no response required) interrupt
  - SDIO_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
  - SDIO_IT_STBITERR: Start bit not detected on all data signals in wide bus mode interrupt
  - SDIO_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDIO_IT_CMDACT: Command transfer in progress interrupt
  - SDIO_IT_TXACT: Data transmit in progress interrupt
  - SDIO_IT_RXACT: Data receive in progress interrupt
  - SDIO_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDIO_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDIO_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDIO_IT_RXFIFOF: Receive FIFO full

interrupt
- SDIO_IT_TXFIFOE: Transmit FIFO empty interrupt
- SDIO_IT_RXFIFOE: Receive FIFO empty interrupt
- SDIO_IT_TXDAVL: Data available in transmit FIFO interrupt
- SDIO_IT_RXDAVL: Data available in receive FIFO interrupt
- SDIO_IT_SDIOIT: SD I/O interrupt received interrupt
- SDIO_IT_CEATAEND: CE-ATA command completion signal received for CMD61 interrupt

Return value:

- None

__HAL_SD_SDIO_DISABLE_IT

Description:

- Disable the SD device interrupt.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDIO interrupt sources to be disabled. This parameter can be one or a combination of the following values:
  - SDIO_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDIO_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDIO_IT_CTIMEOUT: Command response timeout interrupt
  - SDIO_IT_DTIMEOUT: Data timeout interrupt
  - SDIO_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDIO_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDIO_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDIO_IT_CMDSENT: Command sent (no response required) interrupt
  - SDIO_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
  - SDIO_IT_STBITERR: Start bit not detected on all data signals in wide bus mode interrupt
  - SDIO_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDIO_IT_CMDACT: Command transfer in progress interrupt
  - SDIO_IT_TXACT: Data transmit in progress interrupt
  - SDIO_IT_RXACT: Data receive in progress

interrupt
  - SDIO_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
  - SDIO_IT_RXFIFOHF: Receive FIFO Half Full interrupt
  - SDIO_IT_TXFIFOF: Transmit FIFO full interrupt
  - SDIO_IT_RXFIFOF: Receive FIFO full interrupt
  - SDIO_IT_TXFIFOE: Transmit FIFO empty interrupt
  - SDIO_IT_RXFIFOE: Receive FIFO empty interrupt
  - SDIO_IT_TXDAVL: Data available in transmit FIFO interrupt
  - SDIO_IT_RXDAVL: Data available in receive FIFO interrupt
  - SDIO_IT_SDIOIT: SD I/O interrupt received interrupt
  - SDIO_IT_CEATAEND: CE-ATA command completion signal received for CMD61 interrupt

Return value:

- None

__HAL_SD_SDIO_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:
  - SDIO_FLAG_CCRCFAIL: Command response received (CRC check failed)
  - SDIO_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
  - SDIO_FLAG_CTIMEOUT: Command response timeout
  - SDIO_FLAG_DTIMEOUT: Data timeout
  - SDIO_FLAG_TXUNDERR: Transmit FIFO underrun error
  - SDIO_FLAG_RXOVERR: Received FIFO overrun error
  - SDIO_FLAG_CMDREND: Command response received (CRC check passed)
  - SDIO_FLAG_CMDSENT: Command sent (no response required)
  - SDIO_FLAG_DATAEND: Data end (data counter, SDIDCOUNT, is zero)
  - SDIO_FLAG_STBITERR: Start bit not detected on all data signals in wide bus mode.

- SDIO_FLAG_DBCKEND: Data block sent/received (CRC check passed)
- SDIO_FLAG_CMDACT: Command transfer in progress
- SDIO_FLAG_TXACT: Data transmit in progress
- SDIO_FLAG_RXACT: Data receive in progress
- SDIO_FLAG_TXFIFOHE: Transmit FIFO Half Empty
- SDIO_FLAG_RXFIFOHF: Receive FIFO Half Full
- SDIO_FLAG_TXFIFOF: Transmit FIFO full
- SDIO_FLAG_RXFIFOF: Receive FIFO full
- SDIO_FLAG_TXFIFOE: Transmit FIFO empty
- SDIO_FLAG_RXFIFOE: Receive FIFO empty
- SDIO_FLAG_TXDAVL: Data available in transmit FIFO
- SDIO_FLAG_RXDAVL: Data available in receive FIFO
- SDIO_FLAG_SDIOIT: SD I/O interrupt received
- SDIO_FLAG_CEATAEND: CE-ATA command completion signal received for CMD61

Return value:

- The: new state of SD FLAG (SET or RESET).

__HAL_SD_SDIO_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:
  - SDIO_FLAG_CCRCFAIL: Command response received (CRC check failed)
  - SDIO_FLAG_DCRCFAIL: Data block sent/received (CRC check failed)
  - SDIO_FLAG_CTIMEOUT: Command response timeout
  - SDIO_FLAG_DTIMEOUT: Data timeout
  - SDIO_FLAG_TXUNDERR: Transmit FIFO underrun error
  - SDIO_FLAG_RXOVERR: Received FIFO overrun error
  - SDIO_FLAG_CMDREND: Command response received (CRC check passed)
  - SDIO_FLAG_CMDSENT: Command sent (no response required)

- SDIO_FLAG_DATAEND: Data end (data counter, SDIDCOUNT, is zero)
- SDIO_FLAG_STBITERR: Start bit not detected on all data signals in wide bus mode
- SDIO_FLAG_DBCKEND: Data block sent/received (CRC check passed)
- SDIO_FLAG_SDIOIT: SD I/O interrupt received
- SDIO_FLAG_CEATAEND: CE-ATA command completion signal received for CMD61

Return value:

- None

__HAL_SD_SDIO_GET_IT

Description:

- Check whether the specified SD interrupt has occurred or not.

Parameters:

- __HANDLE__: SD Handle
- __INTERRUPT__: specifies the SDIO interrupt source to check. This parameter can be one of the following values:
  - SDIO_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDIO_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDIO_IT_CTIMEOUT: Command response timeout interrupt
  - SDIO_IT_DTIMEOUT: Data timeout interrupt
  - SDIO_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDIO_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDIO_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDIO_IT_CMDSENT: Command sent (no response required) interrupt
  - SDIO_IT_DATAEND: Data end (data counter, SDIDCOUNT, is zero) interrupt
  - SDIO_IT_STBITERR: Start bit not detected on all data signals in wide bus mode interrupt
  - SDIO_IT_DBCKEND: Data block sent/received (CRC check passed) interrupt
  - SDIO_IT_CMDACT: Command transfer in progress interrupt
  - SDIO_IT_TXACT: Data transmit in progress interrupt
  - SDIO_IT_RXACT: Data receive in progress interrupt

- SDIO_IT_TXFIFOHE: Transmit FIFO Half Empty interrupt
- SDIO_IT_RXFIFOHF: Receive FIFO Half Full interrupt
- SDIO_IT_TXFIFOF: Transmit FIFO full interrupt
- SDIO_IT_RXFIFOF: Receive FIFO full interrupt
- SDIO_IT_TXFIFOE: Transmit FIFO empty interrupt
- SDIO_IT_RXFIFOE: Receive FIFO empty interrupt
- SDIO_IT_TXDAVL: Data available in transmit FIFO interrupt
- SDIO_IT_RXDAVL: Data available in receive FIFO interrupt
- SDIO_IT_SDIOIT: SD I/O interrupt received interrupt
- SDIO_IT_CEATAEND: CE-ATA command completion signal received for CMD61 interrupt

Return value:

- The: new state of SD IT (SET or RESET).

__HAL_SD_SDIO_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:
  - SDIO_IT_CCRCFAIL: Command response received (CRC check failed) interrupt
  - SDIO_IT_DCRCFAIL: Data block sent/received (CRC check failed) interrupt
  - SDIO_IT_CTIMEOUT: Command response timeout interrupt
  - SDIO_IT_DTIMEOUT: Data timeout interrupt
  - SDIO_IT_TXUNDERR: Transmit FIFO underrun error interrupt
  - SDIO_IT_RXOVERR: Received FIFO overrun error interrupt
  - SDIO_IT_CMDREND: Command response received (CRC check passed) interrupt
  - SDIO_IT_CMDSENT: Command sent (no response required) interrupt
  - SDIO_IT_DATAEND: Data end (data counter, SDIO_DCOUNT, is zero) interrupt
  - SDIO_IT_STBITERR: Start bit not detected on all data signals in wide bus mode interrupt

- SDIO_IT_SDIOIT: SD I/O interrupt received interrupt
- SDIO_IT_CEATAEND: CE-ATA command completion signal received for CMD61

Return value:

- None

SD Handle Structure definition

SD_InitTypeDef

SD_TypeDef

39 HAL SMARTCARD Generic Driver

39.1 SMARTCARD Firmware driver registers structures

39.1.1 SMARTCARD_InitTypeDef

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 Prescaler***
- ***uint32_t GuardTime***
- ***uint32_t NACKState***

Field Documentation

- ***uint32_t SMARTCARD_InitTypeDef::BaudRate***
  This member configures the SmartCard communication baud rate. The baud rate is computed using the following formula:IntegerDivider = ((PCLKx) / (16 * (hsmartcard->Init.BaudRate)))FractionalDivider = ((IntegerDivider - ((uint32_t) IntegerDivider)) * 16) + 0.5
- ***uint32_t SMARTCARD_InitTypeDef::WordLength***
  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***SMARTCARD_Word_Length***
- ***uint32_t SMARTCARD_InitTypeDef::StopBits***
  Specifies the number of stop bits transmitted. This parameter can be a value of ***SMARTCARD_Stop_Bits***
- ***uint32_t SMARTCARD_InitTypeDef::Parity***
  Specifies the parity mode. This parameter can be a value of ***SMARTCARD_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 SMARTCARD_InitTypeDef::Mode***
  Specifies whether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of ***SMARTCARD_Mode***
- ***uint32_t SMARTCARD_InitTypeDef::CLKPolarity***
  Specifies the steady state of the serial clock. This parameter can be a value of ***SMARTCARD_Clock_Polarity***
- ***uint32_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***
- ***uint32_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***
- ***uint32_t SMARTCARD_InitTypeDef::Prescaler***
  Specifies the SmartCard Prescaler value used for dividing the system clock to provide

the smartcard clock. The value given in the register (5 significant bits) is multiplied by 2 to give the division factor of the source clock frequency; This parameter can be a value of ***SMARTCARD_Prescaler***

- ***uint32_t SMARTCARD_InitTypeDef::GuardTime***
  Specifies the SmartCard Guard Time value in terms of number of baud clocks
- ***uint32_t SMARTCARD_InitTypeDef::NACKState***
  Specifies the SmartCard NACK Transmission state This parameter can be a value of ***SMARTCARD_NACK_State***

39.1.2 SMARTCARD_HandleTypeDef

Data Fields

- ***USART_TypeDef * Instance***
- ***SMARTCARD_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***uint16_t TxXferCount***
- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***uint16_t RxXferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SMARTCARD_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* SMARTCARD_HandleTypeDef::Instance***
  USART registers base address
- ***SMARTCARD_InitTypeDef SMARTCARD_HandleTypeDef::Init***
  SmartCard communication parameters
- ***uint8_t* SMARTCARD_HandleTypeDef::pTxBuffPtr***
  Pointer to SmartCard Tx transfer Buffer
- ***uint16_t SMARTCARD_HandleTypeDef::TxXferSize***
  SmartCard Tx Transfer size
- ***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
- ***uint16_t SMARTCARD_HandleTypeDef::RxXferCount***
  SmartCard Rx Transfer Counter
- ***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::State***
  SmartCard communication state
- ***__IO uint32_t SMARTCARD_HandleTypeDef::ErrorCode***
  SmartCard Error code

39.2 SMARTCARD Firmware driver API description

39.2.1 How to use this driver

The SMARTCARD HAL driver can be used as follows:

1. Declare a SMARTCARD_HandleTypeDef handle structure.
2. Initialize the SMARTCARD low level resources by implementing the HAL_SMARTCARD_MspInit() API:
   a. Enable the interface clock of the USARTx associated to the SMARTCARD.
   b. SMARTCARD pins configuration:
      – Enable the clock for the SMARTCARD GPIOs.
      – Configure the SMARTCARD pins as alternate function pull-up.
   c. 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.
   d. 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 initilalized 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.
      – Configure the USARTx interrupt priority and enable the NVIC USART IRQ handle (used for last byte sending completion detection in DMA non circular mode)
3. Program the Baud Rate, Word Length , Stop Bit, Parity, Hardware flow control and Mode(Receiver/Transmitter) in the SMARTCARD Init structure.
4. 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 customed HAL_SMARTCARD_MspInit(&hsc) API. 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.
5. 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_ENABLE: Enable the SMARTCARD peripheral
- __HAL_SMARTCARD_DISABLE: Disable the SMARTCARD peripheral
- __HAL_SMARTCARD_GET_FLAG : Check whether the specified SMARTCARD flag is set or not
- __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 the specified SMARTCARD interrupt has occurred or not

You can refer to the SMARTCARD HAL driver header file for more useful macros

39.2.2 Initialization and Configuration functions

This subsection provides a set of functions allowing to initialize the USART in Smartcard mode.

The Smartcard interface is designed to support asynchronous protocol Smartcards as defined in the ISO 7816-3 standard.

The USART can provide a clock to the smartcard through the SCLK output. In smartcard mode, SCLK is not associated to the communication but is simply derived from the internal peripheral input clock through a 5-bit prescaler.

- For the Smartcard mode only these parameters can be configured:
  - Baud Rate
  - Word Length => Should be 9 bits (8 bits + parity)
  - Stop Bit
  - Parity: => Should be enabled
  - USART polarity
  - USART phase
  - USART LastBit
  - Receiver/transmitter modes
  - Prescaler
  - GuardTime
  - NACKState: The Smartcard NACK state
- Recommended SmartCard interface configuration to get the Answer to Reset from the Card:
  - Word Length = 9 Bits
  - 1.5 Stop Bit
  - Even parity
  - BaudRate = 12096 baud
  - Tx and Rx enabled

It is also possible to choose 0.5 stop bit for receiving but it is recommended to use 1.5 stop bits for both transmitting and receiving to avoid switching between the two configurations.

The HAL_SMARTCARD_Init() function follows the USART SmartCard configuration procedure (details for the procedure are available in reference manual (RM0038)).

This section contains the following APIs:

- ***HAL_SMARTCARD_Init()***
- ***HAL_SMARTCARD_DeInit()***
- ***HAL_SMARTCARD_MspInit()***
- ***HAL_SMARTCARD_MspDeInit()***

39.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the SMARTCARD data transfers.

1. 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.
2. 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.
3. 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, 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.

4. Blocking mode APIs are :
   - HAL_SMARTCARD_Transmit()
   - HAL_SMARTCARD_Receive()
5. Non Blocking mode APIs with Interrupt are :
   - HAL_SMARTCARD_Transmit_IT()
   - HAL_SMARTCARD_Receive_IT()
   - HAL_SMARTCARD_IRQHandler()
6. Non Blocking mode functions with DMA are :
   - HAL_SMARTCARD_Transmit_DMA()
   - HAL_SMARTCARD_Receive_DMA()
7. A set of Transfer Complete Callbacks are provided in non Blocking mode:
   - HAL_SMARTCARD_TxCpltCallback()
   - HAL_SMARTCARD_RxCpltCallback()
   - HAL_SMARTCARD_ErrorCallback()

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_IRQHandler()***
- ***HAL_SMARTCARD_TxCpltCallback()***
- ***HAL_SMARTCARD_RxCpltCallback()***
- ***HAL_SMARTCARD_ErrorCallback()***

39.2.4 Peripheral State and Errors functions

This subsection provides a set of functions allowing to return the State of SmartCard communication process 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() check in run-time errors that could be occurred during communication.

This section contains the following APIs:

- ***HAL_SMARTCARD_GetState()***
- ***HAL_SMARTCARD_GetError()***

39.2.5 Detailed description of functions

HAL_SMARTCARD_Init

Function name	**HAL_StatusTypeDef HAL_SMARTCARD_Init (SMARTCARD_HandleTypeDef * hsc)**
Function description	Initializes the SmartCard mode according to the specified parameters in the SMARTCARD_HandleTypeDef and create the associated handle.

Parameters
- **hsc:** 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 * hsc)**

Function description DeInitializes the SMARTCARD peripheral.

Parameters
- **hsc:** 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 * hsc)**

Function description SMARTCARD MSP Init.

Parameters
- **hsc:** 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 * hsc)**

Function description SMARTCARD MSP DeInit.

Parameters
- **hsc:** 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 * hsc, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Sends an amount of data in blocking mode.

Parameters
- **hsc:** 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:** Specify timeout value

Return values
- **HAL:** status

HAL_SMARTCARD_Receive

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Receive (SMARTCARD_HandleTypeDef * hsc, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Receive an amount of data in blocking mode.

Parameters
- **hsc:** 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:** Specify timeout value

Return values
- **HAL:** status

HAL_SMARTCARD_Transmit_IT

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Transmit_IT (SMARTCARD_HandleTypeDef * hsc, uint8_t * pData, uint16_t Size)**

Function description Sends an amount of data in non-blocking mode.

Parameters
- **hsc:** 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_IT

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Receive_IT (SMARTCARD_HandleTypeDef * hsc, uint8_t * pData, uint16_t Size)**

Function description Receives an amount of data in non-blocking mode.

Parameters
- **hsc:** 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

HAL_SMARTCARD_Transmit_DMA

Function name **HAL_StatusTypeDef HAL_SMARTCARD_Transmit_DMA (SMARTCARD_HandleTypeDef * hsc, uint8_t * pData, uint16_t Size)**

Function description Sends an amount of data in non-blocking mode.

Parameters
- **hsc:** 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 * hsc, uint8_t * pData, uint16_t Size)**

Function description Receive an amount of data in non-blocking mode.

Parameters
- **hsc:** 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 the SMARTCARD parity is enabled (PCE = 1) the data received contain the parity bit.

HAL_SMARTCARD_IRQHandler

Function name **void HAL_SMARTCARD_IRQHandler (SMARTCARD_HandleTypeDef * hsc)**

Function description This function handles SMARTCARD interrupt request.

Parameters
- **hsc:** 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 * hsc)**

Function description Tx Transfer completed callback.

Parameters
- **hsc:** 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 * hsc)**

Function description Rx Transfer completed callback.

Parameters
- **hsc:** 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 * hsc)**

Function description SMARTCARD error callback.

Parameters
- **hsc:** 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 * hsc)**

Function description Returns the SMARTCARD state.

Parameters
- **hsc:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values
- **HAL:** state

HAL_SMARTCARD_GetError

Function name **uint32_t HAL_SMARTCARD_GetError (SMARTCARD_HandleTypeDef * hsc)**

Function description Return the SMARTCARD error code.

Parameters
- **hsc:** Pointer to a SMARTCARD_HandleTypeDef structure that contains the configuration information for the specified SMARTCARD module.

Return values
- **SMARTCARD:** Error Code

39.3 SMARTCARD Firmware driver defines

39.3.1 SMARTCARD

SMARTCARD Clock Phase

SMARTCARD_PHASE_1EDGE

SMARTCARD_PHASE_2EDGE

SMARTCARD Clock Polarity

SMARTCARD_POLARITY_LOW

SMARTCARD_POLARITY_HIGH

SMARTCARD DMA requests

SMARTCARD_DMAREQ_TX

SMARTCARD_DMAREQ_RX

SMARTCARD Error Codes

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

SMARTCARD Exported Macros

__HAL_SMARTCARD_RESET_HANDLE_STATE

Description:

- Reset SMARTCARD handle state.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_FLUSH_DRREGISTER

Description:

- Flush the Smartcard DR register.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_GET_FLAG

Description:

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

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending

on device).

- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - 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

Return value:

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

__HAL_SMARTCARD_CLEAR_FLAG

Description:

- Clear the specified Smartcard pending flags.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - SMARTCARD_FLAG_TC: Transmission Complete flag.
  - SMARTCARD_FLAG_RXNE: Receive data register not empty flag.

Return value:

- None
- None

Notes:

- PE (Parity error), FE (Framing

error), NE (Noise error) and ORE (OverRun error) flags are cleared by software sequence: a read operation to USART_SR register followed by a read operation to USART_DR register. RXNE flag can be also cleared by a read to the USART_DR register. TC flag can be also cleared by software sequence: a read operation to USART_SR register followed by a write operation to USART_DR register. TXE flag is cleared only by a write to the USART_DR register.

__HAL_SMARTCARD_CLEAR_PEFLAG

Description:

- Clear the SMARTCARD PE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_CLEAR_FEFLAG

Description:

- Clear the SMARTCARD FE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_CLEAR_NEFLAG

Description:

- Clear the SMARTCARD NE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_CLEAR_OREFLAG

Description:

- Clear the SMARTCARD ORE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_CLEAR_IDLEFLAG

Description:

- Clear the SMARTCARD IDLE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_ENABLE_IT

Description:

- Enable the specified SmartCard interrupt.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __INTERRUPT__: specifies the SMARTCARD interrupt to enable. This parameter can be one of the following values:
  - SMARTCARD_IT_TXE: Transmit Data Register empty interrupt
  - SMARTCARD_IT_TC: Transmission complete interrupt
  - 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)

Return value:

- None

__HAL_SMARTCARD_DISABLE_IT

Description:

- Disable the specified SmartCard interrupts.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __INTERRUPT__: specifies the SMARTCARD interrupt to disable. This parameter can be one of the following values:
  - SMARTCARD_IT_TXE: Transmit Data Register empty interrupt
  - SMARTCARD_IT_TC: Transmission complete interrupt
  - 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)

__HAL_SMARTCARD_GET_IT_SOURCE

Description:

- Check whether the specified SmartCard interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART

availability and x value depending on device).
- __IT__: specifies the SMARTCARD interrupt source to check. This parameter can be one of the following values:
  - SMARTCARD_IT_TXE: Transmit Data Register empty interrupt
  - SMARTCARD_IT_TC: Transmission complete interrupt
  - SMARTCARD_IT_RXNE: Receive Data register not empty interrupt
  - SMARTCARD_IT_IDLE: Idle line detection interrupt
  - SMARTCARD_IT_ERR: Error interrupt
  - SMARTCARD_IT_PE: Parity Error interrupt

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

__HAL_SMARTCARD_ONE_BIT_SAMPLE_ENABLE

Description:
- Enables the SMARTCARD one bit sample method.

Parameters:
- __HANDLE__: specifies the SMARTCARD Handle.

Return value:
- None

__HAL_SMARTCARD_ONE_BIT_SAMPLE_DISABLE

Description:
- Disables 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. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_DISABLE

Description:

- Disable the USART associated to the SMARTCARD Handle.

Parameters:

- __HANDLE__: specifies the SMARTCARD Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_SMARTCARD_DMA_REQUEST_ENABLE

Description:

- Enable the SmartCard DMA request.

Parameters:

- __HANDLE__: specifies the SmartCard Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __REQUEST__: specifies the SmartCard DMA request. This parameter can be one of the following values:
  - SMARTCARD_DMAREQ_TX: SmartCard DMA transmit request
  - SMARTCARD_DMAREQ_RX : SmartCard DMA receive request

Return value:

- None

__HAL_SMARTCARD_DMA_REQUEST_DISABLE

Description:

- Disable the SmartCard DMA request.

Parameters:

- __HANDLE__: specifies the

SmartCard Handle. SMARTCARD Handle selects the USARTx peripheral (USART availability and x value depending on device).

- __REQUEST__: specifies the SmartCard DMA request. This parameter can be one of the following values:
  - SMARTCARD_DMAREQ_TX: SmartCard DMA transmit request
  - SMARTCARD_DMAREQ_RX : SmartCard DMA receive request

Return value:

- None

SMARTCARD Flags

SMARTCARD_FLAG_TXE

SMARTCARD_FLAG_TC

SMARTCARD_FLAG_RXNE

SMARTCARD_FLAG_IDLE

SMARTCARD_FLAG_ORE

SMARTCARD_FLAG_NE

SMARTCARD_FLAG_FE

SMARTCARD_FLAG_PE

SMARTCARD Interrupts Definition

SMARTCARD_IT_PE

SMARTCARD_IT_TXE

SMARTCARD_IT_TC

SMARTCARD_IT_RXNE

SMARTCARD_IT_IDLE

SMARTCARD_IT_ERR

SMARTCARD Last Bit

SMARTCARD_LASTBIT_DISABLE

SMARTCARD_LASTBIT_ENABLE

SMARTCARD Mode

SMARTCARD_MODE_RX

SMARTCARD_MODE_TX

SMARTCARD_MODE_TX_RX

SMARTCARD NACK State

SMARTCARD_NACK_ENABLE

SMARTCARD_NACK_DISABLE

SMARTCARD One Bit Sampling Method

SMARTCARD_ONE_BIT_SAMPLE_DISABLE

SMARTCARD_ONE_BIT_SAMPLE_ENABLE

SMARTCARD Parity

SMARTCARD_PARITY_EVEN

SMARTCARD_PARITY_ODD

SMARTCARD Prescaler

SMARTCARD_PRESCALER_SYSCLK_DIV2	SYSCLK divided by 2
SMARTCARD_PRESCALER_SYSCLK_DIV4	SYSCLK divided by 4
SMARTCARD_PRESCALER_SYSCLK_DIV6	SYSCLK divided by 6
SMARTCARD_PRESCALER_SYSCLK_DIV8	SYSCLK divided by 8
SMARTCARD_PRESCALER_SYSCLK_DIV10	SYSCLK divided by 10
SMARTCARD_PRESCALER_SYSCLK_DIV12	SYSCLK divided by 12
SMARTCARD_PRESCALER_SYSCLK_DIV14	SYSCLK divided by 14
SMARTCARD_PRESCALER_SYSCLK_DIV16	SYSCLK divided by 16
SMARTCARD_PRESCALER_SYSCLK_DIV18	SYSCLK divided by 18
SMARTCARD_PRESCALER_SYSCLK_DIV20	SYSCLK divided by 20
SMARTCARD_PRESCALER_SYSCLK_DIV22	SYSCLK divided by 22
SMARTCARD_PRESCALER_SYSCLK_DIV24	SYSCLK divided by 24
SMARTCARD_PRESCALER_SYSCLK_DIV26	SYSCLK divided by 26
SMARTCARD_PRESCALER_SYSCLK_DIV28	SYSCLK divided by 28
SMARTCARD_PRESCALER_SYSCLK_DIV30	SYSCLK divided by 30
SMARTCARD_PRESCALER_SYSCLK_DIV32	SYSCLK divided by 32
SMARTCARD_PRESCALER_SYSCLK_DIV34	SYSCLK divided by 34
SMARTCARD_PRESCALER_SYSCLK_DIV36	SYSCLK divided by 36
SMARTCARD_PRESCALER_SYSCLK_DIV38	SYSCLK divided by 38
SMARTCARD_PRESCALER_SYSCLK_DIV40	SYSCLK divided by 40
SMARTCARD_PRESCALER_SYSCLK_DIV42	SYSCLK divided by 42
SMARTCARD_PRESCALER_SYSCLK_DIV44	SYSCLK divided by 44
SMARTCARD_PRESCALER_SYSCLK_DIV46	SYSCLK divided by 46
SMARTCARD_PRESCALER_SYSCLK_DIV48	SYSCLK divided by 48
SMARTCARD_PRESCALER_SYSCLK_DIV50	SYSCLK divided by 50
SMARTCARD_PRESCALER_SYSCLK_DIV52	SYSCLK divided by 52
SMARTCARD_PRESCALER_SYSCLK_DIV54	SYSCLK divided by 54
SMARTCARD_PRESCALER_SYSCLK_DIV56	SYSCLK divided by 56

SMARTCARD_PRESCALER_SYSCLK_DIV58	SYSCLK divided by 58
SMARTCARD_PRESCALER_SYSCLK_DIV60	SYSCLK divided by 60
SMARTCARD_PRESCALER_SYSCLK_DIV62	SYSCLK divided by 62

SMARTCARD Number of Stop Bits

SMARTCARD_STOPBITS_0_5

SMARTCARD_STOPBITS_1_5

SMARTCARD Word Length

SMARTCARD_WORDLENGTH_9B

40 HAL SPI Generic Driver

40.1 SPI Firmware driver registers structures

40.1.1 SPI_InitTypeDef

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***

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 Directional mode state. This parameter can be a value of ***SPI_Direction_mode***
- ***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 a number between Min_Data = 0 and Max_Data = 65535

40.1.2 __SPI_HandleTypeDef

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***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***void(* RxISR***
- ***void(* TxISR***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SPI_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***SPI_TypeDef* __SPI_HandleTypeDef::Instance***
- ***SPI_InitTypeDef __SPI_HandleTypeDef::Init***
- ***uint8_t* __SPI_HandleTypeDef::pTxBuffPtr***
- ***uint16_t __SPI_HandleTypeDef::TxXferSize***
- ***__IO uint16_t __SPI_HandleTypeDef::TxXferCount***
- ***uint8_t* __SPI_HandleTypeDef::pRxBuffPtr***
- ***uint16_t __SPI_HandleTypeDef::RxXferSize***
- ***__IO uint16_t __SPI_HandleTypeDef::RxXferCount***
- ***DMA_HandleTypeDef* __SPI_HandleTypeDef::hdmatx***
- ***DMA_HandleTypeDef* __SPI_HandleTypeDef::hdmarx***
- ***void(* __SPI_HandleTypeDef::RxISR)(struct __SPI_HandleTypeDef *hspi)***
- ***void(* __SPI_HandleTypeDef::TxISR)(struct __SPI_HandleTypeDef *hspi)***
- ***HAL_LockTypeDef __SPI_HandleTypeDef::Lock***
- ***__IO HAL_SPI_StateTypeDef __SPI_HandleTypeDef::State***
- ***__IO uint32_t __SPI_HandleTypeDef::ErrorCode***

40.2 SPI Firmware driver API description

40.2.1 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 Channel
  - Enable the DMAx clock
  - Configure the DMA handle parameters
  - Configure the DMA Tx or Rx Channel
  - Associate the initilalized 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 Channel

3. Program the Mode, Direction , 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 customed 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

40.2.2 Initialization and de-initialization functions

This subsection provides a set of functions allowing to initialize and de-initialiaze 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
- Call the function HAL_SPI_DeInit() to restore the default configuration of the selected SPIx periperal.

This section contains the following APIs:

- ***HAL_SPI_Init()***
- ***HAL_SPI_DeInit()***
- ***HAL_SPI_MspInit()***
- ***HAL_SPI_MspDeInit()***

40.2.3 IO operation functions

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 respectivelly 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_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()***

40.2.4 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()***

40.2.5 Detailed description of functions

HAL_SPI_Init

Function name **HAL_StatusTypeDef HAL_SPI_Init (SPI_HandleTypeDef * hspi)**

Function description Initializes the SPI according to the specified parameters in the SPI_InitTypeDef and create 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 DeInitializes 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 SPI MSP Init.

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 SPI MSP DeInit.

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 sent
- **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 to be
- **Size:** amount of data to be sent
- **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 no-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 no-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 no-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 to be
- **Size:** amount of data to be sent

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 no-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 no-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
- 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 no-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 Pauses 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 Resumes 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 Stops the DMA Transfer.

Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_SPI_IRQHandler

Function name **void HAL_SPI_IRQHandler (SPI_HandleTypeDef * hspi)**

Function description This function handles SPI interrupt request.

Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values
- **HAL:** status

HAL_SPI_TxCpltCallback

Function name **void HAL_SPI_TxCpltCallback (SPI_HandleTypeDef * hspi)**

Function description Tx Transfer completed callbacks.

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 callbacks.

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 callbacks.

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 callbacks.

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 callbacks.

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 callbacks.

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 Transfer completed callbacks.

Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values
- **None:**

HAL_SPI_GetState

Function name **HAL_SPI_StateTypeDef HAL_SPI_GetState (SPI_HandleTypeDef * hspi)**

Function description Return the SPI state.

Parameters
- **hspi:** pointer to a SPI_HandleTypeDef structure that contains the configuration information for SPI module.

Return values
- **HAL:** 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

40.3 SPI Firmware driver defines

40.3.1 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

IS_SPI_BAUDRATE_PRESCALER

SPI Clock Phase

SPI_PHASE_1EDGE

SPI_PHASE_2EDGE

IS_SPI_CPHA

SPI Clock Polarity

SPI_POLARITY_LOW

SPI_POLARITY_HIGH

IS_SPI_CPOL

SPI CRC Calculation

SPI_CRCCALCULATION_DISABLE

SPI_CRCCALCULATION_ENABLE

IS_SPI_CRC_CALCULATION

IS_SPI_CRC_POLYNOMIAL

SPI data size

SPI_DATASIZE_8BIT

SPI_DATASIZE_16BIT

IS_SPI_DATASIZE

SPI Direction mode

SPI_DIRECTION_2LINES

SPI_DIRECTION_2LINES_RXONLY

SPI_DIRECTION_1LINE

IS_SPI_DIRECTION_MODE

IS_SPI_DIRECTION_2LINES_OR_1LINE

IS_SPI_DIRECTION_2LINES

SPI Error Codes

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	Flag: RXNE,TXE, BSY

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 or disable 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 or 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_DISABLE_IT

__HAL_SPI_GET_IT_SOURCE

Description:

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

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

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:

- Enables the SPI.

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:

- Disables the SPI.

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 Flag definition

SPI_FLAG_RXNE

SPI_FLAG_TXE

SPI_FLAG_CRCERR

SPI_FLAG_MODF

SPI_FLAG_OVR

SPI_FLAG_BSY

SPI_FLAG_FRE

SPI Interrupt configuration definition

SPI_IT_TXE

SPI_IT_RXNE

SPI_IT_ERR

SPI mode

SPI_MODE_SLAVE

SPI_MODE_MASTER

IS_SPI_MODE

SPI MSB LSB transmission

SPI_FIRSTBIT_MSB

SPI_FIRSTBIT_LSB

IS_SPI_FIRST_BIT

SPI Slave Select management

SPI_NSS_SOFT

SPI_NSS_HARD_INPUT

SPI_NSS_HARD_OUTPUT

IS_SPI_NSS

SPI TI mode

SPI_TIMODE_DISABLE

SPI_TIMODE_ENABLE

IS_SPI_TIMODE

41 HAL SPI Extension Driver

41.1 SPIEx Firmware driver defines

41.1.1 SPIEx

42 HAL SRAM Generic Driver

42.1 SRAM Firmware driver registers structures

42.1.1 SRAM_HandleTypeDef

Data Fields

- ***FSMC_NORSRAM_TypeDef * Instance***
- ***FSMC_NORSRAM_EXTENDED_TypeDef * Extended***
- ***FSMC_NORSRAM_InitTypeDef Init***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_SRAM_StateTypeDef State***
- ***DMA_HandleTypeDef * hdma***

Field Documentation

- ***FSMC_NORSRAM_TypeDef* SRAM_HandleTypeDef::Instance***
  Register base address
- ***FSMC_NORSRAM_EXTENDED_TypeDef* SRAM_HandleTypeDef::Extended***
  Extended mode register base address
- ***FSMC_NORSRAM_InitTypeDef SRAM_HandleTypeDef::Init***
  SRAM device control configuration parameters
- ***HAL_LockTypeDef SRAM_HandleTypeDef::Lock***
  SRAM locking object
- ***__IO HAL_SRAM_StateTypeDef SRAM_HandleTypeDef::State***
  SRAM device access state
- ***DMA_HandleTypeDef* SRAM_HandleTypeDef::hdma***
  Pointer DMA handler

42.2 SRAM Firmware driver API description

42.2.1 How to use this driver

This driver is a generic layered driver which contains a set of APIs used to control SRAM memories. It uses the FSMC layer functions to interface with SRAM devices. The following sequence should be followed to configure the FSMC to interface with SRAM/PSRAM memories:

1. Declare a SRAM_HandleTypeDef handle structure, for example: SRAM_HandleTypeDef hsram; and:
   - Fill the SRAM_HandleTypeDef handle "Init" field with the allowed values of the structure member.
   - Fill the SRAM_HandleTypeDef handle "Instance" field with a predefined base register instance for NOR or SRAM device
   - Fill the SRAM_HandleTypeDef handle "Extended" field with a predefined base register instance for NOR or SRAM extended mode
2. Declare two FSMC_NORSRAM_TimingTypeDef structures, for both normal and extended mode timings; for example: FSMC_NORSRAM_TimingTypeDef Timing and FSMC_NORSRAM_TimingTypeDef ExTiming; and fill its fields with the allowed values of the structure member.
3. Initialize the SRAM Controller by calling the function HAL_SRAM_Init(). This function performs the following sequence:
   a. MSP hardware layer configuration using the function HAL_SRAM_MspInit()

b. Control register configuration using the FSMC NORSRAM interface function FSMC_NORSRAM_Init()
c. Timing register configuration using the FSMC NORSRAM interface function FSMC_NORSRAM_Timing_Init()
d. Extended mode Timing register configuration using the FSMC NORSRAM interface function FSMC_NORSRAM_Extended_Timing_Init()
e. Enable the SRAM device using the macro __FSMC_NORSRAM_ENABLE()

4. At this stage you can perform read/write accesses from/to the memory connected to the NOR/SRAM Bank. You can perform either polling or DMA transfer using the following APIs:
   - HAL_SRAM_Read()/HAL_SRAM_Write() for polling read/write access
   - HAL_SRAM_Read_DMA()/HAL_SRAM_Write_DMA() for DMA read/write transfer
5. You can also control the SRAM device by calling the control APIs HAL_SRAM_WriteOperation_Enable()/ HAL_SRAM_WriteOperation_Disable() to respectively enable/disable the SRAM write operation
6. You can continuously monitor the SRAM device HAL state by calling the function HAL_SRAM_GetState()

42.2.2 SRAM Initialization and de_initialization functions

This section provides functions allowing to initialize/de-initialize the SRAM memory

This section contains the following APIs:

- ***HAL_SRAM_Init()***
- ***HAL_SRAM_DeInit()***
- ***HAL_SRAM_MspInit()***
- ***HAL_SRAM_MspDeInit()***
- ***HAL_SRAM_DMA_XferCpltCallback()***
- ***HAL_SRAM_DMA_XferErrorCallback()***

42.2.3 SRAM Input and Output functions

This section provides functions allowing to use and control the SRAM memory

This section contains the following APIs:

- ***HAL_SRAM_Read_8b()***
- ***HAL_SRAM_Write_8b()***
- ***HAL_SRAM_Read_16b()***
- ***HAL_SRAM_Write_16b()***
- ***HAL_SRAM_Read_32b()***
- ***HAL_SRAM_Write_32b()***
- ***HAL_SRAM_Read_DMA()***
- ***HAL_SRAM_Write_DMA()***

42.2.4 SRAM Control functions

This subsection provides a set of functions allowing to control dynamically the SRAM interface.

This section contains the following APIs:

- ***HAL_SRAM_WriteOperation_Enable()***
- ***HAL_SRAM_WriteOperation_Disable()***

42.2.5 SRAM State functions

This subsection permits to get in run-time the status of the SRAM controller and the data flow.

This section contains the following APIs:

- ***HAL_SRAM_GetState()***

42.2.6 Detailed description of functions

HAL_SRAM_Init

Function name **HAL_StatusTypeDef HAL_SRAM_Init (SRAM_HandleTypeDef * hsram, FSMC_NORSRAM_TimingTypeDef * Timing, FSMC_NORSRAM_TimingTypeDef * ExtTiming)**

Function description Performs the SRAM device initialization sequence.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **Timing:** Pointer to SRAM control timing structure
- **ExtTiming:** Pointer to SRAM extended mode timing structure

Return values
- **HAL:** status

HAL_SRAM_DeInit

Function name **HAL_StatusTypeDef HAL_SRAM_DeInit (SRAM_HandleTypeDef * hsram)**

Function description Performs the SRAM device De-initialization sequence.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **HAL:** status

HAL_SRAM_MspInit

Function name **void HAL_SRAM_MspInit (SRAM_HandleTypeDef * hsram)**

Function description SRAM MSP Init.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **None:**

HAL_SRAM_MspDeInit

Function name **void HAL_SRAM_MspDeInit (SRAM_HandleTypeDef * hsram)**

Function description SRAM MSP DeInit.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **None:**

HAL_SRAM_DMA_XferCpltCallback

Function name **void HAL_SRAM_DMA_XferCpltCallback (DMA_HandleTypeDef * hdma)**

Function description DMA transfer complete callback.

Parameters
- **hdma:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **None:**

HAL_SRAM_DMA_XferErrorCallback

Function name **void HAL_SRAM_DMA_XferErrorCallback (DMA_HandleTypeDef * hdma)**

Function description DMA transfer complete error callback.

Parameters
- **hdma:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **None:**

HAL_SRAM_Read_8b

Function name **HAL_StatusTypeDef HAL_SRAM_Read_8b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint8_t * pDstBuffer, uint32_t BufferSize)**

Function description Reads 8-bit buffer from SRAM memory.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values
- **HAL:** status

HAL_SRAM_Write_8b

Function name **HAL_StatusTypeDef HAL_SRAM_Write_8b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint8_t * pSrcBuffer, uint32_t BufferSize)**

Function description Writes 8-bit buffer to SRAM memory.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values
- **HAL:** status

HAL_SRAM_Read_16b

Function name **HAL_StatusTypeDef HAL_SRAM_Read_16b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint16_t**

*** pDstBuffer, uint32_t BufferSize)**

Function description — Reads 16-bit buffer from SRAM memory.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values
- **HAL:** status

HAL_SRAM_Write_16b

Function name — **HAL_StatusTypeDef HAL_SRAM_Write_16b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint16_t * pSrcBuffer, uint32_t BufferSize)**

Function description — Writes 16-bit buffer to SRAM memory.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values
- **HAL:** status

HAL_SRAM_Read_32b

Function name — **HAL_StatusTypeDef HAL_SRAM_Read_32b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint32_t * pDstBuffer, uint32_t BufferSize)**

Function description — Reads 32-bit buffer from SRAM memory.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values
- **HAL:** status

HAL_SRAM_Write_32b

Function name — **HAL_StatusTypeDef HAL_SRAM_Write_32b (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint32_t * pSrcBuffer, uint32_t BufferSize)**

Function description — Writes 32-bit buffer to SRAM memory.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values
- **HAL:** status

HAL_SRAM_Read_DMA

Function name **HAL_StatusTypeDef HAL_SRAM_Read_DMA (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint32_t * pDstBuffer, uint32_t BufferSize)**

Function description Reads a Words data from the SRAM memory using DMA transfer.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to read start address
- **pDstBuffer:** Pointer to destination buffer
- **BufferSize:** Size of the buffer to read from memory

Return values
- **HAL:** status

HAL_SRAM_Write_DMA

Function name **HAL_StatusTypeDef HAL_SRAM_Write_DMA (SRAM_HandleTypeDef * hsram, uint32_t * pAddress, uint32_t * pSrcBuffer, uint32_t BufferSize)**

Function description Writes a Words data buffer to SRAM memory using DMA transfer.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.
- **pAddress:** Pointer to write start address
- **pSrcBuffer:** Pointer to source buffer to write
- **BufferSize:** Size of the buffer to write to memory

Return values
- **HAL:** status

HAL_SRAM_WriteOperation_Enable

Function name **HAL_StatusTypeDef HAL_SRAM_WriteOperation_Enable (SRAM_HandleTypeDef * hsram)**

Function description Enables dynamically SRAM write operation.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **HAL:** status

HAL_SRAM_WriteOperation_Disable

Function name **HAL_StatusTypeDef HAL_SRAM_WriteOperation_Disable (SRAM_HandleTypeDef * hsram)**

Function description Disables dynamically SRAM write operation.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **HAL:** status

HAL_SRAM_GetState

Function name **HAL_SRAM_StateTypeDef HAL_SRAM_GetState (SRAM_HandleTypeDef * hsram)**

Function description — Returns the SRAM controller state.

Parameters
- **hsram:** pointer to a SRAM_HandleTypeDef structure that contains the configuration information for SRAM module.

Return values
- **HAL:** state

42.3 SRAM Firmware driver defines

42.3.1 SRAM

SRAM Exported Macros

__HAL_SRAM_RESET_HANDLE_STATE

Description:
- Reset SRAM handle state.

Parameters:
- __HANDLE__: SRAM handle

Return value:
- None

43 HAL TIM Generic Driver

43.1 TIM Firmware driver registers structures

43.1.1 TIM_Base_InitTypeDef

Data Fields

- ***uint32_t Prescaler***
- ***uint32_t CounterMode***
- ***uint32_t Period***
- ***uint32_t ClockDivision***

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***

43.1.2 TIM_OC_InitTypeDef

Data Fields

- ***uint32_t OCMode***
- ***uint32_t Pulse***
- ***uint32_t OCPolarity***
- ***uint32_t OCFastMode***
- ***uint32_t OCIdleState***

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::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***.

43.1.3 TIM_OnePulse_InitTypeDef

Data Fields

- ***uint32_t OCMode***
- ***uint32_t Pulse***
- ***uint32_t OCPolarity***
- ***uint32_t OCIdleState***
- ***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::OCIdleState***
  Specifies the TIM Output Compare pin state during Idle state. This parameter can be a value of ***TIM_Output_Compare_Idle_State***.
- ***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

43.1.4 TIM_IC_InitTypeDef

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

43.1.5 TIM_Encoder_InitTypeDef

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

43.1.6 TIM_ClockConfigTypeDef

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

43.1.7 TIM_ClearInputConfigTypeDef

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 can be a value of ***TIM_ClearInput_Prescaler***
- ***uint32_t TIM_ClearInputConfigTypeDef::ClearInputFilter***
  TIM Clear Input filter This parameter can be a number between Min_Data = 0x0 and Max_Data = 0xF

43.1.8 TIM_SlaveConfigTypeDef

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

43.1.9 TIM_HandleTypeDef

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 ***TIM_DMA_Handle_index***
- ***HAL_LockTypeDef TIM_HandleTypeDef::Lock***
  Locking object
- ***__IO HAL_TIM_StateTypeDef TIM_HandleTypeDef::State***
  TIM operation state

43.2 TIM Firmware driver API description

43.2.1 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 (quadrature) encoder

43.2.2 How to use this driver

1. Initialize the TIM low level resources by implementing the following functions depending from feature used :
   - 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()

43.2.3 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()***

43.2.4 Time Output Compare functions

This section provides functions allowing to:

- Initialize and configure the TIM Output Compare.
- De-initialize the TIM Output Compare.
- Start the Time Output Compare.
- Stop the Time Output Compare.
- Start the Time Output Compare and enable interrupt.
- Stop the Time Output Compare and disable interrupt.
- Start the Time Output Compare and enable DMA transfer.
- Stop the Time 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()***

43.2.5 Time PWM functions

This section provides functions allowing to:

- Initialize and configure the TIM PWM.
- De-initialize the TIM PWM.
- Start the Time PWM.
- Stop the Time PWM.
- Start the Time PWM and enable interrupt.
- Stop the Time PWM and disable interrupt.
- Start the Time PWM and enable DMA transfer.
- Stop the Time 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()***

43.2.6 Time Input Capture functions

This section provides functions allowing to:

- Initialize and configure the TIM Input Capture.
- De-initialize the TIM Input Capture.
- Start the Time Input Capture.
- Stop the Time Input Capture.
- Start the Time Input Capture and enable interrupt.
- Stop the Time Input Capture and disable interrupt.
- Start the Time Input Capture and enable DMA transfer.
- Stop the Time 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()***

43.2.7 Time One Pulse functions

This section provides functions allowing to:

- Initialize and configure the TIM One Pulse.
- De-initialize the TIM One Pulse.
- Start the Time One Pulse.
- Stop the Time One Pulse.
- Start the Time One Pulse and enable interrupt.
- Stop the Time One Pulse and disable interrupt.
- Start the Time One Pulse and enable DMA transfer.
- Stop the Time 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()***

43.2.8 Time Encoder functions

This section provides functions allowing to:

- Initialize and configure the TIM Encoder.
- De-initialize the TIM Encoder.
- Start the Time Encoder.
- Stop the Time Encoder.
- Start the Time Encoder and enable interrupt.
- Stop the Time Encoder and disable interrupt.
- Start the Time Encoder and enable DMA transfer.

- Stop the Time 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()***

43.2.9 IRQ handler management

This section provides Timer IRQ handler function.

This section contains the following APIs:

- ***HAL_TIM_IRQHandler()***

43.2.10 Peripheral Control functions

This section provides functions allowing to:

- Configure The Input Output channels for OC, PWM, IC or One Pulse mode.
- Configure External Clock source.
- Configure Complementary channels, break features and dead time.
- Configure Master and the Slave synchronization.
- Configure the DMA Burst Mode.

This section contains the following APIs:

- ***HAL_TIM_OC_ConfigChannel()***
- ***HAL_TIM_IC_ConfigChannel()***
- ***HAL_TIM_PWM_ConfigChannel()***
- ***HAL_TIM_OnePulse_ConfigChannel()***
- ***HAL_TIM_DMABurst_WriteStart()***
- ***HAL_TIM_DMABurst_WriteStop()***
- ***HAL_TIM_DMABurst_ReadStart()***
- ***HAL_TIM_DMABurst_ReadStop()***
- ***HAL_TIM_GenerateEvent()***
- ***HAL_TIM_ConfigOCrefClear()***
- ***HAL_TIM_ConfigClockSource()***
- ***HAL_TIM_ConfigTI1Input()***
- ***HAL_TIM_SlaveConfigSynchronization()***
- ***HAL_TIM_SlaveConfigSynchronization_IT()***
- ***HAL_TIM_ReadCapturedValue()***

43.2.11 TIM Callbacks functions

This section provides TIM callback functions:

- Timer Period elapsed callback
- Timer Output Compare callback
- Timer Input capture callback

- Timer Trigger callback
- Timer Error callback

This section contains the following APIs:

- ***HAL_TIM_PeriodElapsedCallback()***
- ***HAL_TIM_OC_DelayElapsedCallback()***
- ***HAL_TIM_IC_CaptureCallback()***
- ***HAL_TIM_PWM_PulseFinishedCallback()***
- ***HAL_TIM_TriggerCallback()***
- ***HAL_TIM_ErrorCallback()***

43.2.12 Peripheral State 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_TIM_Base_GetState()***
- ***HAL_TIM_OC_GetState()***
- ***HAL_TIM_PWM_GetState()***
- ***HAL_TIM_IC_GetState()***
- ***HAL_TIM_OnePulse_GetState()***
- ***HAL_TIM_Encoder_GetState()***
- ***TIM_DMAError()***
- ***TIM_DMADelayPulseCplt()***
- ***TIM_DMACaptureCplt()***

43.2.13 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 create the associated handle.
Parameters	• **htim:** TIM Base handle
Return values	• **HAL:** status

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 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 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 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 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 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 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 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 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 create the associated handle.
Parameters	• **htim:** TIM Output Compare handle
Return values	• **HAL:** status

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 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 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

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 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_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 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
  - 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 create the associated handle.
Parameters	• **htim:** TIM handle
Return values	• **HAL:** status

HAL_TIM_PWM_DeInit

Function name	**HAL_StatusTypeDef HAL_TIM_PWM_DeInit (TIM_HandleTypeDef * htim)**
Function description	DeInitializes the TIM peripheral.
Parameters	• **htim:** TIM 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 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 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
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 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_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 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 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 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 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 create the associated handle.

Parameters
- **htim:** TIM Input Capture handle

Return values
- **HAL:** status

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 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 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 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 create the associated handle.

Parameters
- **htim:** TIM OnePulse 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 wil be generated.

Return values
- **HAL:** status

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 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 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 create the associated handle.

Parameters:
- **htim:** TIM Encoder Interface handle
- **sConfig:** TIM Encoder Interface configuration structure

Return values:
- **HAL:** status

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 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 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 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

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

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 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_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 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
- **InputChannel:** : 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_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

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_SlaveConfigSynchronization

Function name
HAL_StatusTypeDef HAL_TIM_SlaveConfigSynchronization (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) and the Slave mode (Disable, Reset, Gated, Trigger, External clock mode 1).

Return values
- **HAL:** status

HAL_TIM_SlaveConfigSynchronization_IT

Function name
HAL_StatusTypeDef HAL_TIM_SlaveConfigSynchronization_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) 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_CCR1
  - TIM_DMABASE_CCR2
  - TIM_DMABASE_CCR3
  - TIM_DMABASE_CCR4
  - TIM_DMABASE_DCR
- **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_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

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 starts 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_CCR1
  - TIM_DMABASE_CCR2
  - TIM_DMABASE_CCR3
  - TIM_DMABASE_CCR4
  - TIM_DMABASE_DCR
- **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_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

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_TRIGGER: Timer Trigger Event source

Return values
- **HAL:** status

Notes
- TIM6 and TIM7 can only generate an update event.

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_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_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_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_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 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 state.

Parameters
- **htim:** TIM Ouput 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 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 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 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 state.
Parameters	• **htim:** TIM Encoder handle
Return values	• **HAL:** state

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_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:**

43.3 TIM Firmware driver defines

43.3.1 TIM

TIM Automatic Output Enable

TIM_AUTOMATICOUTPUT_ENABLE

TIM_AUTOMATICOUTPUT_DISABLE

TIM Channel

TIM_CHANNEL_1

TIM_CHANNEL_2

TIM_CHANNEL_3

TIM_CHANNEL_4

TIM_CHANNEL_ALL

TIM Capture/Compare Channel State

TIM_CCx_ENABLE

TIM_CCx_DISABLE

TIM ClearInput Polarity

TIM_CLEARINPUTPOLARITY_INVERTED	Polarity for ETRx pin
TIM_CLEARINPUTPOLARITY_NONINVERTED	Polarity for ETRx pin

TIM ClearInput 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 ClearInput Source

TIM_CLEARINPUTSOURCE_ETR

TIM_CLEARINPUTSOURCE_OCREFCLR

TIM_CLEARINPUTSOURCE_NONE

TIM ClockDivision

TIM_CLOCKDIVISION_DIV1

TIM_CLOCKDIVISION_DIV2

TIM_CLOCKDIVISION_DIV4

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

TIM_CLOCKSOURCE_INTERNAL

TIM_CLOCKSOURCE_ITR0

TIM_CLOCKSOURCE_ITR1

TIM_CLOCKSOURCE_ITR2

TIM_CLOCKSOURCE_ITR3

TIM_CLOCKSOURCE_TI1ED

TIM_CLOCKSOURCE_TI1

TIM_CLOCKSOURCE_TI2

TIM_CLOCKSOURCE_ETRMODE1

TIM Counter Mode

TIM_COUNTERMODE_UP

TIM_COUNTERMODE_DOWN

TIM_COUNTERMODE_CENTERALIGNED1

TIM_COUNTERMODE_CENTERALIGNED2

TIM_COUNTERMODE_CENTERALIGNED3

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_CCR1
TIM_DMABASE_CCR2
TIM_DMABASE_CCR3
TIM_DMABASE_CCR4
TIM_DMABASE_DCR
TIM_DMABASE_OR

TIM DMA Burst Length

TIM_DMABURSTLENGTH_1TRANSFER
TIM_DMABURSTLENGTH_2TRANSFERS
TIM_DMABURSTLENGTH_3TRANSFERS
TIM_DMABURSTLENGTH_4TRANSFERS
TIM_DMABURSTLENGTH_5TRANSFERS
TIM_DMABURSTLENGTH_6TRANSFERS
TIM_DMABURSTLENGTH_7TRANSFERS
TIM_DMABURSTLENGTH_8TRANSFERS
TIM_DMABURSTLENGTH_9TRANSFERS
TIM_DMABURSTLENGTH_10TRANSFERS
TIM_DMABURSTLENGTH_11TRANSFERS
TIM_DMABURSTLENGTH_12TRANSFERS
TIM_DMABURSTLENGTH_13TRANSFERS
TIM_DMABURSTLENGTH_14TRANSFERS
TIM_DMABURSTLENGTH_15TRANSFERS
TIM_DMABURSTLENGTH_16TRANSFERS
TIM_DMABURSTLENGTH_17TRANSFERS
TIM_DMABURSTLENGTH_18TRANSFERS

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_TRIGGER	Index of the DMA handle used for Trigger DMA requests

TIM DMA Sources

TIM_DMA_UPDATE

TIM_DMA_CC1

TIM_DMA_CC2

TIM_DMA_CC3

TIM_DMA_CC4

TIM_DMA_TRIGGER

TIM Encoder Mode

TIM_ENCODERMODE_TI1

TIM_ENCODERMODE_TI2

TIM_ENCODERMODE_TI12

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

TIM_EVENTSOURCE_CC1

TIM_EVENTSOURCE_CC2

TIM_EVENTSOURCE_CC3

TIM_EVENTSOURCE_CC4

TIM_EVENTSOURCE_TRIGGER

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_DISABLE

Description:

- Disable the TIM peripheral.

Parameters:

- __HANDLE__: TIM handle

Return value:

- None

__HAL_TIM_ENABLE_IT

Description:

- Enables 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

Return value:

- None

__HAL_TIM_DISABLE_IT

Description:

- Disables 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

Return value:

- None

__HAL_TIM_ENABLE_DMA

Description:

- Enables 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:

- Disables 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:

- Checks 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_COM: Commutation interrupt flag
  - TIM_FLAG_TRIGGER: Trigger 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:

- Clears 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_COM: Commutation interrupt flag
- TIM_FLAG_TRIGGER: Trigger 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:

- Checks whether the specified TIM interrupt has occurred or not.

Parameters:

- __HANDLE__: TIM handle
- __INTERRUPT__: specifies the TIM interrupt source to check.

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.

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 usefull to get the

counting mode when the timer operates in Center-aligned mode or Encoder mode.

__HAL_TIM_SET_PRESCALER

Description:

- Sets the TIM active prescaler register value on update event.

Parameters:

- __HANDLE__: TIM handle.
- __PRESC__: specifies the active prescaler register new value.

Return value:

- None

__HAL_TIM_SET_COMPARE

Description:

- Sets 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
- __COMPARE__: specifies the Capture Compare register new value.

Return value:

- None

__HAL_TIM_GET_COMPARE

Description:

- Gets 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

Return value:

- None

__HAL_TIM_SET_COUNTER

Description:

- Sets 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:

- Gets the TIM Counter Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

__HAL_TIM_SET_AUTORELOAD

Description:

- Sets 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:

- Gets the TIM Autoreload Register value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

__HAL_TIM_SET_CLOCKDIVISION

Description:

- Sets 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
  - TIM_CLOCKDIVISION_DIV2
  - TIM_CLOCKDIVISION_DIV4

Return value:

- None

__HAL_TIM_GET_CLOCKDIVISION

Description:

- Gets the TIM Clock Division value on runtime.

Parameters:

- __HANDLE__: TIM handle.

Return value:

- None

__HAL_TIM_SET_ICPRESCALER

Description:

- Sets 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:

- Gets 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:

- 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 USR 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 USR 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:

- Sets 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

Notes:

- The polarity TIM_INPUTCHANNELPOLARITY_BOTHEDGE is not authorized for TIM Channel 4.

TIM Flag Definition

TIM_FLAG_UPDATE

TIM_FLAG_CC1

TIM_FLAG_CC2

TIM_FLAG_CC3

TIM_FLAG_CC4

TIM_FLAG_TRIGGER

TIM_FLAG_CC1OF

TIM_FLAG_CC2OF

TIM_FLAG_CC3OF

TIM_FLAG_CC4OF

TIM Input Capture Polarity

TIM_ICPOLARITY_RISING

TIM_ICPOLARITY_FALLING

TIM_ICPOLARITY_BOTHEDGE

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

TIM_IT_CC1

TIM_IT_CC2

TIM_IT_CC3

TIM_IT_CC4

TIM_IT_TRIGGER

TIM Lock level

TIM_LOCKLEVEL_OFF

TIM_LOCKLEVEL_1

TIM_LOCKLEVEL_2

TIM_LOCKLEVEL_3

TIM Master Mode Selection

TIM_TRGO_RESET

TIM_TRGO_ENABLE

TIM_TRGO_UPDATE

TIM_TRGO_OC1

TIM_TRGO_OC1REF

TIM_TRGO_OC2REF

TIM_TRGO_OC3REF

TIM_TRGO_OC4REF

TIM Master Slave Mode

TIM_MASTERSLAVEMODE_ENABLE

TIM_MASTERSLAVEMODE_DISABLE

TIM One Pulse Mode

TIM_OPMODE_SINGLE

TIM_OPMODE_REPETITIVE

TIM OSSI Off State Selection for Idle mode state

TIM_OSSI_ENABLE

TIM_OSSI_DISABLE

TIM OSSR Off State Selection for Run mode state

TIM_OSSR_ENABLE

TIM_OSSR_DISABLE

TIM Output Compare and PWM modes

TIM_OCMODE_TIMING

TIM_OCMODE_ACTIVE

TIM_OCMODE_INACTIVE

TIM_OCMODE_TOGGLE

TIM_OCMODE_PWM1

TIM_OCMODE_PWM2

TIM_OCMODE_FORCED_ACTIVE

TIM_OCMODE_FORCED_INACTIVE

TIM Output Compare Idle State

TIM_OCIDLESTATE_SET

TIM_OCIDLESTATE_RESET

TIM Output Compare Polarity

TIM_OCPOLARITY_HIGH

TIM_OCPOLARITY_LOW

TIM Output Fast State

TIM_OCFAST_DISABLE

TIM_OCFAST_ENABLE

TIM Select

TIM_SELECT_NONE	None selected
TIM_SELECT_TIM2	Timer 2 selected
TIM_SELECT_TIM3	Timer 3 selected
TIM_SELECT_TIM4	Timer 4 selected

IS_RI_TIM

TIM Slave Mode

TIM_SLAVEMODE_DISABLE

TIM_SLAVEMODE_RESET

TIM_SLAVEMODE_GATED

TIM_SLAVEMODE_TRIGGER

TIM_SLAVEMODE_EXTERNAL1

TIM TI1 Input Selection

TIM_TI1SELECTION_CH1

TIM_TI1SELECTION_XORCOMBINATION

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

TIM_TS_ITR1

TIM_TS_ITR2

TIM_TS_ITR3

TIM_TS_TI1F_ED

TIM_TS_TI1FP1

TIM_TS_TI2FP2

TIM_TS_ETRF

TIM_TS_NONE

44 HAL TIM Extension Driver

44.1 TIMEx Firmware driver registers structures

44.1.1 TIM_MasterConfigTypeDef

Data Fields

- ***uint32_t MasterOutputTrigger***
- ***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::MasterSlaveMode***
  Master/slave mode selection This parameter can be a value of ***TIM_Master_Slave_Mode***

44.2 TIMEx Firmware driver API description

44.2.1 TIMER Extended features

The Timer Extension features include:

1. Synchronization circuit to control the timer with external signals and to interconnect several timers together.
2. Timer remapping capabilities configuration

44.2.2 Peripheral Control functions

This section provides functions allowing to:

- Configure Master synchronization.
- Configure timer remapping capabilities.

This section contains the following APIs:

- ***HAL_TIMEx_MasterConfigSynchronization()***
- ***HAL_TIMEx_RemapConfig()***

44.2.3 Detailed description of functions

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_RemapConfig

Function name **HAL_StatusTypeDef HAL_TIMEx_RemapConfig (TIM_HandleTypeDef * htim, uint32_t Remap)**

Function description Configures the TIM2/TIM3/TIM9/TIM10/TIM11 Remapping input capabilities.

Parameters
- **htim:** TIM handle.
- **Remap:** specifies the TIM remapping source. This parameter is a combination of the following values depending on TIM instance.

Return values
- **HAL:** status

Notes
- For TIM2, the parameter can have the following values: TIM_TIM2_ITR1_TIM10_OC: TIM2 ITR1 input is connected to TIM10 OC TIM_TIM2_ITR1_TIM5_TGO: TIM2 ITR1 input is connected to TIM5 TGO
- For TIM3, the parameter can have the following values: TIM_TIM3_ITR2_TIM11_OC: TIM3 ITR2 input is connected to TIM11 OC TIM_TIM3_ITR2_TIM5_TGO: TIM3 ITR2 input is connected to TIM5 TGO
- For TIM9, the parameter is a combination of 2 fields (field1 | field2):
- For TIM9, the field1 can have the following values: TIM_TIM9_ITR1_TIM3_TGO: TIM9 ITR1 input is connected to TIM3 TGO TIM_TIM9_ITR1_TS: TIM9 ITR1 input is connected to touch sensing I/O
- For TIM9, the field2 can have the following values: TIM_TIM9_GPIO: TIM9 Channel1 is connected to GPIO TIM_TIM9_LSE: TIM9 Channel1 is connected to LSE internal clock TIM_TIM9_GPIO1: TIM9 Channel1 is connected to GPIO TIM_TIM9_GPIO2: TIM9 Channel1 is connected to GPIO
- For TIM10, the parameter is a combination of 3 fields (field1 | field2 | field3):
- For TIM10, the field1 can have the following values: TIM_TIM10_TI1RMP: TIM10 Channel 1 depends on TI1_RMP TIM_TIM10_RI: TIM10 Channel 1 is connected to RI
- For TIM10, the field2 can have the following values: TIM_TIM10_ETR_LSE: TIM10 ETR input is connected to LSE clock TIM_TIM10_ETR_TIM9_TGO: TIM10 ETR input is connected to TIM9 TGO
- For TIM10, the field3 can have the following values: TIM_TIM10_GPIO: TIM10 Channel1 is connected to GPIO TIM_TIM10_LSI: TIM10 Channel1 is connected to LSI internal clock TIM_TIM10_LSE: TIM10 Channel1 is connected to LSE internal clock TIM_TIM10_RTC: TIM10 Channel1 is connected to RTC wakeup interrupt
- For TIM11, the parameter is a combination of 3 fields (field1 | field2 | field3):
- For TIM11, the field1 can have the following values:

TIM_TIM11_TI1RMP: TIM11 Channel 1 depends on TI1_RMP TIM_TIM11_RI: TIM11 Channel 1 is connected to RI

- For TIM11, the field2 can have the following values: TIM_TIM11_ETR_LSE: TIM11 ETR input is connected to LSE clock TIM_TIM11_ETR_TIM9_TGO: TIM11 ETR input is connected to TIM9 TGO
- For TIM11, the field3 can have the following values: TIM_TIM11_GPIO: TIM11 Channel1 is connected to GPIO TIM_TIM11_MSI: TIM11 Channel1 is connected to MSI internal clock TIM_TIM11_HSE_RTC: TIM11 Channel1 is connected to HSE_RTC clock TIM_TIM11_GPIO1: TIM11 Channel1 is connected to GPIO

44.3 TIMEx Firmware driver defines

44.3.1 TIMEx

TIMEx Remap

TIM_TIM2_ITR1_TIM10_OC	TIM2 ITR1 input is connected to TIM10 OC
TIM_TIM2_ITR1_TIM5_TGO	TIM2 ITR1 input is connected to TIM5 TGO
TIM_TIM3_ITR2_TIM11_OC	TIM3 ITR2 input is connected to TIM11 OC
TIM_TIM3_ITR2_TIM5_TGO	TIM3 ITR2 input is connected to TIM5 TGO
TIM_TIM9_ITR1_TIM3_TGO	TIM9 ITR1 input is connected to TIM3 TGO
TIM_TIM9_ITR1_TS	TIM9 ITR1 input is connected to touch sensing I/O
TIM_TIM9_GPIO	TIM9 Channel1 is connected to GPIO
TIM_TIM9_LSE	TIM9 Channel1 is connected to LSE internal clock
TIM_TIM9_GPIO1	TIM9 Channel1 is connected to GPIO
TIM_TIM9_GPIO2	TIM9 Channel1 is connected to GPIO
TIM_TIM10_TI1RMP	TIM10 Channel 1 depends on TI1_RMP
TIM_TIM10_RI	TIM10 Channel 1 is connected to RI
TIM_TIM10_ETR_LSE	TIM10 ETR input is connected to LSE clock
TIM_TIM10_ETR_TIM9_TGO	TIM10 ETR input is connected to TIM9 TGO
TIM_TIM10_GPIO	TIM10 Channel1 is connected to GPIO
TIM_TIM10_LSI	TIM10 Channel1 is connected to LSI internal clock
TIM_TIM10_LSE	TIM10 Channel1 is connected to LSE internal clock
TIM_TIM10_RTC	TIM10 Channel1 is connected to RTC wakeup interrupt
TIM_TIM11_TI1RMP	TIM11 Channel 1 depends on TI1_RMP
TIM_TIM11_RI	TIM11 Channel 1 is connected to RI
TIM_TIM11_ETR_LSE	TIM11 ETR input is connected to LSE clock
TIM_TIM11_ETR_TIM9_TGO	TIM11 ETR input is connected to TIM9 TGO
TIM_TIM11_GPIO	TIM11 Channel1 is connected to GPIO

TIM_TIM11_MSI	TIM11 Channel1 is connected to MSI internal clock
TIM_TIM11_HSE_RTC	TIM11 Channel1 is connected to HSE_RTC clock
TIM_TIM11_GPIO1	TIM11 Channel1 is connected to GPIO

IS_TIM_REMAP

45 HAL UART Generic Driver

45.1 UART Firmware driver registers structures

45.1.1 UART_InitTypeDef

Data Fields

- ***uint32_t BaudRate***
- ***uint32_t WordLength***
- ***uint32_t StopBits***
- ***uint32_t Parity***
- ***uint32_t Mode***
- ***uint32_t HwFlowCtl***
- ***uint32_t OverSampling***

Field Documentation

- ***uint32_t UART_InitTypeDef::BaudRate***
  This member configures the UART communication baud rate. The baud rate is computed using the following formula:IntegerDivider = ((PCLKx) / (8 * (OVR8+1) * (huart->Init.BaudRate)))FractionalDivider = ((IntegerDivider - ((uint32_t) IntegerDivider)) * 8 * (OVR8+1)) + 0.5 Where OVR8 is the "oversampling by 8 mode" configuration bit in the CR1 register.
- ***uint32_t UART_InitTypeDef::WordLength***
  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***UART_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 wether the Receive or Transmit mode is enabled or disabled. This parameter can be a value of ***UART_Mode***
- ***uint32_t UART_InitTypeDef::HwFlowCtl***
  Specifies wether 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 wether the Over sampling 8 is enabled or disabled, to achieve higher speed (up to fPCLK/8). This parameter can be a value of ***UART_Over_Sampling***

45.1.2 UART_HandleTypeDef

Data Fields

- ***USART_TypeDef * Instance***
- ***UART_InitTypeDef Init***
- ***uint8_t * pTxBuffPtr***
- ***uint16_t TxXferSize***
- ***uint16_t TxXferCount***

- ***uint8_t * pRxBuffPtr***
- ***uint16_t RxXferSize***
- ***uint16_t RxXferCount***
- ***DMA_HandleTypeDef * hdmatx***
- ***DMA_HandleTypeDef * hdmarx***
- ***HAL_LockTypeDef Lock***
- ***__IO HAL_UART_StateTypeDef State***
- ***__IO uint32_t ErrorCode***

Field Documentation

- ***USART_TypeDef* UART_HandleTypeDef::Instance***
  UART registers base address
- ***UART_InitTypeDef UART_HandleTypeDef::Init***
  UART communication parameters
- ***uint8_t* UART_HandleTypeDef::pTxBuffPtr***
  Pointer to UART Tx transfer Buffer
- ***uint16_t UART_HandleTypeDef::TxXferSize***
  UART Tx Transfer size
- ***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
- ***uint16_t UART_HandleTypeDef::RxXferCount***
  UART Rx Transfer Counter
- ***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::State***
  UART communication state
- ***__IO uint32_t UART_HandleTypeDef::ErrorCode***
  UART Error code

45.2 UART Firmware driver API description

45.2.1 How to use this driver

The UART HAL driver can be used as follows:

1. Declare a UART_HandleTypeDef handle structure.
2. Initialize the UART low level resources by implementing the HAL_UART_MspInit() API:
   a. Enable the USARTx interface clock.
   b. UART pins configuration:
      – Enable the clock for the UART GPIOs.
      – Configure the UART pins as alternate function pull-up.
   c. 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.

d. 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.
   - Configure the USARTx interrupt priority and enable the NVIC USART IRQ handle (used for last byte sending completion detection in DMA non circular mode)

3. Program the Baud Rate, Word Length, Stop Bit, Parity, Hardware flow control and Mode(Receiver/Transmitter) in the huart Init structure.
4. For the UART asynchronous mode, initialize the UART registers by calling the HAL_UART_Init() API.
5. For the UART Half duplex mode, initialize the UART registers by calling the HAL_HalfDuplex_Init() API.
6. For the LIN mode, initialize the UART registers by calling the HAL_LIN_Init() API.
7. For the Multi-Processor mode, initialize the UART registers by calling the HAL_MultiProcessor_Init() API.

The specific UART interrupts (Transmission complete interrupt, RXNE interrupt and Error Interrupts) will be managed using the macros __HAL_UART_ENABLE_IT() and __HAL_UART_DISABLE_IT() inside the transmit and receive process.

These APIs (HAL_UART_Init() and HAL_HalfDuplex_Init()) configure also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customed HAL_UART_MspInit() API.

Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_UART_Transmit()
- Receive an amount of data in blocking mode using HAL_UART_Receive()

Interrupt mode IO operation

- Send an amount of data in non blocking mode using HAL_UART_Transmit_IT()
- At transmission end of transfer HAL_UART_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_TxCpltCallback
- Receive an amount of data in non blocking mode using HAL_UART_Receive_IT()
- At reception end of transfer HAL_UART_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_RxCpltCallback
- In case of transfer Error, HAL_UART_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_UART_ErrorCallback

DMA mode IO operation

- Send an amount of data in non blocking mode (DMA) using HAL_UART_Transmit_DMA()
- At transmission end of half transfer HAL_UART_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_TxHalfCpltCallback
- At transmission end of transfer HAL_UART_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_TxCpltCallback
- Receive an amount of data in non blocking mode (DMA) using HAL_UART_Receive_DMA()
- At reception end of half transfer HAL_UART_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_RxHalfCpltCallback
- At reception end of transfer HAL_UART_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_UART_RxCpltCallback
- In case of transfer Error, HAL_UART_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_UART_ErrorCallback
- Pause the DMA Transfer using HAL_UART_DMAPause()
- Resume the DMA Transfer using HAL_UART_DMAResume()
- Stop the DMA Transfer using HAL_UART_DMAStop()

UART HAL driver macros list

Below the list of most used macros in UART HAL driver.

- __HAL_UART_ENABLE: Enable the UART peripheral
- __HAL_UART_DISABLE: Disable the UART peripheral
- __HAL_UART_GET_FLAG : Check whether the specified UART flag is set or not
- __HAL_UART_CLEAR_FLAG : Clear the specified UART pending flag
- __HAL_UART_ENABLE_IT: Enable the specified UART interrupt
- __HAL_UART_DISABLE_IT: Disable the specified UART interrupt
- __HAL_UART_GET_IT_SOURCE: Check whether the specified UART interrupt has occurred or not

You can refer to the UART HAL driver header file for more useful macros

45.2.2 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 only these parameters can be configured:
  - Baud Rate
  - Word Length
  - Stop Bit
  - Parity
  - Hardware flow control
  - Receiver/transmitter modes
  - Over Sampling Methode

The HAL_UART_Init(), HAL_HalfDuplex_Init(), HAL_LIN_Init() and HAL_MultiProcessor_Init() APIs follow respectively the UART asynchronous, UART Half

duplex, LIN and Multi-Processor configuration procedures (details for the procedures are available in reference manual (RM0038)).

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()***

45.2.3 IO operation functions

This subsection provides a set of functions allowing to manage the UART asynchronous and Half duplex data transfers.

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 APIs return the HAL status. The end of the data processing will be indicated through the dedicated UART IRQ when using Interrupt mode or the DMA IRQ when using DMA mode. The HAL_UART_TxCpltCallback(), HAL_UART_RxCpltCallback() user callbacks will be executed respectively at the end of the transmit or receive process. The HAL_UART_ErrorCallback() user callback will be executed when a communication error is detected.
2. Blocking mode APIs are:
   - HAL_UART_Transmit()
   - HAL_UART_Receive()
3. Non Blocking mode APIs with Interrupt are:
   - HAL_UART_Transmit_IT()
   - HAL_UART_Receive_IT()
   - HAL_UART_IRQHandler()
4. Non Blocking mode functions with DMA are:
   - HAL_UART_Transmit_DMA()
   - HAL_UART_Receive_DMA()
   - HAL_UART_DMAPause()
   - HAL_UART_DMAResume()
   - HAL_UART_DMAStop()
5. A set of Transfer Complete Callbacks are provided in non blocking mode:
   - HAL_UART_TxHalfCpltCallback()
   - HAL_UART_TxCpltCallback()
   - HAL_UART_RxHalfCpltCallback()
   - HAL_UART_RxCpltCallback()
   - HAL_UART_ErrorCallback()

In the Half duplex communication, it is forbidden to run the transmit and receive process in parallel, the UART state HAL_UART_STATE_BUSY_TX_RX can't be useful.

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_IRQHandler()***
- ***HAL_UART_TxCpltCallback()***
- ***HAL_UART_TxHalfCpltCallback()***
- ***HAL_UART_RxCpltCallback()***
- ***HAL_UART_RxHalfCpltCallback()***
- ***HAL_UART_ErrorCallback()***

45.2.4 Peripheral Control functions

This subsection provides a set of functions allowing to control the UART:

- HAL_LIN_SendBreak() API can be helpful to transmit the break character.
- HAL_MultiProcessor_EnterMuteMode() API can be helpful to enter the UART in mute mode.
- HAL_MultiProcessor_ExitMuteMode() API can be helpful to exit the UART mute mode by software.
- HAL_HalfDuplex_EnableTransmitter() API to enable the UART transmitter and disables the UART receiver in Half Duplex mode
- HAL_HalfDuplex_EnableReceiver() API to enable the UART receiver and disables the UART transmitter in Half Duplex mode

This section contains the following APIs:

- ***HAL_LIN_SendBreak()***
- ***HAL_MultiProcessor_EnterMuteMode()***
- ***HAL_MultiProcessor_ExitMuteMode()***
- ***HAL_HalfDuplex_EnableTransmitter()***
- ***HAL_HalfDuplex_EnableReceiver()***

45.2.5 Peripheral State and Errors functions

This subsection provides a set of functions allowing to return the State of UART communication process, return Peripheral Errors occurred during communication process

- HAL_UART_GetState() API can be helpful to check in run-time the state of the UART peripheral.
- HAL_UART_GetError() check in run-time errors that could be occurred during communication.

This section contains the following APIs:

- ***HAL_UART_GetState()***
- ***HAL_UART_GetError()***

45.2.6 Detailed description of functions

HAL_UART_Init

Function name **HAL_StatusTypeDef HAL_UART_Init (UART_HandleTypeDef * huart)**

Function description Initializes the UART mode according to the specified parameters in the UART_InitTypeDef and create the associated handle.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_HalfDuplex_Init

Function name **HAL_StatusTypeDef HAL_HalfDuplex_Init (UART_HandleTypeDef * huart)**

Function description Initializes the half-duplex mode according to the specified parameters in the UART_InitTypeDef and create the associated handle.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_LIN_Init

Function name **HAL_StatusTypeDef HAL_LIN_Init (UART_HandleTypeDef * huart, uint32_t BreakDetectLength)**

Function description Initializes the LIN mode according to the specified parameters in the UART_InitTypeDef and create the associated handle.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **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 Initializes the Multi-Processor mode according to the specified parameters in the UART_InitTypeDef and create the associated

handle.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **Address:** UART node address
- **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

HAL_UART_DeInit

Function name **HAL_StatusTypeDef HAL_UART_DeInit (UART_HandleTypeDef * huart)**

Function description DeInitializes the UART peripheral.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_UART_MspInit

Function name **void HAL_UART_MspInit (UART_HandleTypeDef * huart)**

Function description UART MSP Init.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_UART_MspDeInit

Function name **void HAL_UART_MspDeInit (UART_HandleTypeDef * huart)**

Function description UART MSP DeInit.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

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 Sends an amount of data in blocking mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_UART_Receive

Function name **HAL_StatusTypeDef HAL_UART_Receive (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size, uint32_t Timeout)**

Function description Receives an amount of data in blocking mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_UART_Transmit_IT

Function name **HAL_StatusTypeDef HAL_UART_Transmit_IT (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)**

Function description Sends an amount of data in non blocking mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values
- **HAL:** status

HAL_UART_Receive_IT

Function name **HAL_StatusTypeDef HAL_UART_Receive_IT (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)**

Function description Receives an amount of data in non blocking mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values
- **HAL:** status

HAL_UART_Transmit_DMA

Function name **HAL_StatusTypeDef HAL_UART_Transmit_DMA (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)**

Function description Sends an amount of data in non blocking mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values
- **HAL:** status

HAL_UART_Receive_DMA

Function name **HAL_StatusTypeDef HAL_UART_Receive_DMA (UART_HandleTypeDef * huart, uint8_t * pData, uint16_t Size)**

Function description Receives an amount of data in non blocking mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.
- **pData:** Pointer to data buffer
- **Size:** Amount of data 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)

HAL_UART_DMAPause

Function name **HAL_StatusTypeDef HAL_UART_DMAPause (UART_HandleTypeDef * huart)**

Function description Pauses the DMA Transfer.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_UART_DMAResume

Function name **HAL_StatusTypeDef HAL_UART_DMAResume (UART_HandleTypeDef * huart)**

Function description Resumes the DMA Transfer.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_UART_DMAStop

Function name **HAL_StatusTypeDef HAL_UART_DMAStop (UART_HandleTypeDef * huart)**

Function description Stops the DMA Transfer.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_UART_IRQHandler

Function name **void HAL_UART_IRQHandler (UART_HandleTypeDef * huart)**

Function description This function handles UART interrupt request.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_UART_TxCpltCallback

Function name **void HAL_UART_TxCpltCallback (UART_HandleTypeDef * huart)**

Function description Tx Transfer completed callbacks.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_UART_TxHalfCpltCallback

Function name **void HAL_UART_TxHalfCpltCallback (UART_HandleTypeDef * huart)**

Function description Tx Half Transfer completed callbacks.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_UART_RxCpltCallback

Function name **void HAL_UART_RxCpltCallback (UART_HandleTypeDef * huart)**

Function description Rx Transfer completed callbacks.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_UART_RxHalfCpltCallback

Function name **void HAL_UART_RxHalfCpltCallback (UART_HandleTypeDef * huart)**

Function description Rx Half Transfer completed callbacks.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_UART_ErrorCallback

Function name **void HAL_UART_ErrorCallback (UART_HandleTypeDef * huart)**

Function description UART error callbacks.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **None:**

HAL_LIN_SendBreak

Function name **HAL_StatusTypeDef HAL_LIN_SendBreak (UART_HandleTypeDef * huart)**

Function description Transmits break characters.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_MultiProcessor_EnterMuteMode

Function name **HAL_StatusTypeDef HAL_MultiProcessor_EnterMuteMode (UART_HandleTypeDef * huart)**

Function description Enters the UART in mute mode.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_MultiProcessor_ExitMuteMode

Function name **HAL_StatusTypeDef HAL_MultiProcessor_ExitMuteMode (UART_HandleTypeDef * huart)**

Function description Exits the UART mute mode: wake up software.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_HalfDuplex_EnableTransmitter

Function name **HAL_StatusTypeDef HAL_HalfDuplex_EnableTransmitter (UART_HandleTypeDef * huart)**

Function description Enables the UART transmitter and disables the UART receiver.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_HalfDuplex_EnableReceiver

Function name **HAL_StatusTypeDef HAL_HalfDuplex_EnableReceiver (UART_HandleTypeDef * huart)**

Function description Enables the UART receiver and disables the UART transmitter.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** status

HAL_UART_GetState

Function name **HAL_UART_StateTypeDef HAL_UART_GetState (UART_HandleTypeDef * huart)**

Function description Returns the UART state.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module.

Return values
- **HAL:** state

HAL_UART_GetError

Function name **uint32_t HAL_UART_GetError (UART_HandleTypeDef * huart)**

Function description Return the UART error code.

Parameters
- **huart:** Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART.

Return values
- **UART:** Error Code

45.3 UART Firmware driver defines

45.3.1 UART

UART Error Codes

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

UART Exported Macros

__HAL_UART_RESET_HANDLE_STATE

Description:

- Reset UART handle state.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_FLUSH_DRREGISTER

Description:

- Flush the UART DR register.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

__HAL_UART_GET_FLAG

Description:

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

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - UART_FLAG_CTS: CTS Change flag (not available for

UART4 and UART5)
  - UART_FLAG_LBD: LIN Break detection flag
  - UART_FLAG_TXE: Transmit data register empty flag
  - UART_FLAG_TC: Transmission Complete flag
  - UART_FLAG_RXNE: Receive data register not empty 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_CLEAR_FLAG

Description:

- Clear the specified UART pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - UART_FLAG_CTS: CTS Change flag (not available for UART4 and UART5).
  - UART_FLAG_LBD: LIN Break detection flag.
  - UART_FLAG_TC: Transmission Complete flag.
  - UART_FLAG_RXNE: Receive data register not empty flag.

Return value:

- None

Notes:

- PE (Parity error), FE (Framing error), NE (Noise error), ORE (OverRun error) and IDLE (Idle line detected)

flags are cleared by software sequence: a read operation to USART_SR register followed by a read operation to USART_DR register. RXNE flag can be also cleared by a read to the USART_DR register. TC flag can be also cleared by software sequence: a read operation to USART_SR register followed by a write operation to USART_DR register. TXE flag is cleared only by a write to the USART_DR register.

__HAL_UART_CLEAR_PEFLAG

Description:

- Clear the UART PE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_CLEAR_FEFLAG

Description:

- Clear the UART FE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_CLEAR_NEFLAG

Description:

- Clear the UART NE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_CLEAR_OREFLAG

Description:

- Clear the UART ORE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_CLEAR_IDLEFLAG

Description:

- Clear the UART IDLE pending flag.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_ENABLE_IT

Description:

- Enable the specified UART interrupt.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __INTERRUPT__: specifies the UART interrupt source to enable. This parameter can be one of the following values:
  - UART_IT_CTS: CTS change interrupt
  - UART_IT_LBD: LIN Break detection interrupt
  - UART_IT_TXE: Transmit Data Register empty interrupt
  - UART_IT_TC: Transmission complete interrupt
  - UART_IT_RXNE: Receive Data register not empty 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. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __INTERRUPT__: specifies the UART interrupt source to disable. This parameter can be one of the following values:
  - UART_IT_CTS: CTS change interrupt
  - UART_IT_LBD: LIN Break detection interrupt
  - UART_IT_TXE: Transmit Data Register empty interrupt
  - UART_IT_TC: Transmission complete interrupt
  - UART_IT_RXNE: Receive Data register not empty 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_SOURCE

Description:

- Check whether the specified UART interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).
- __IT__: specifies the UART interrupt source to check. This parameter can be one of the following values:
  - UART_IT_CTS: CTS change

interrupt (not available for UART4 and UART5)
- UART_IT_LBD: LIN Break detection interrupt
- UART_IT_TXE: Transmit Data Register empty interrupt
- UART_IT_TC: Transmission complete interrupt
- UART_IT_RXNE: Receive Data register not empty interrupt
- UART_IT_IDLE: Idle line detection interrupt
- UART_IT_ERR: Error interrupt

Return value:

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

__HAL_UART_ONE_BIT_SAMPLE_ENABLE

Description:

- macros to enables or disables the UART's one bit sampling method

Parameters:

- __HANDLE__: specifies the UART Handle. This parameter can be USARTx with x: 1, 2 or 3, or UARTy with y:4 or 5 to select the USART or UART peripheral (availability depending on device for UARTy).

Return value:

- None

__HAL_UART_ONE_BIT_SAMPLE_DISABLE

__HAL_UART_HWCONTROL_CTS_ENABLE

Description:

- Enable CTS flow control This macro allows to enable CTS hardware flow control for a given UART instance, without need to call

Parameters:

- __HANDLE__: specifies the UART Handle. This parameter can be any USARTx (supporting the HW Flow control feature). It is used to select the USART peripheral (USART availability and x value depending on device).

Return value:

- None

Notes:

- 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 This macro allows to disable CTS hardware flow control for a given UART instance, without need to call

Parameters:

- __HANDLE__: specifies the UART Handle. This parameter can be any USARTx (supporting the HW Flow control feature). It is used to select the USART peripheral (USART availability and x value depending on device).

Return value:

- None

Notes:

- 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 This macro allows to enable RTS hardware flow control for a given UART instance, without need to call

Parameters:

- __HANDLE__: specifies the UART Handle. This parameter can be any USARTx (supporting the HW Flow control feature). It is used to select the USART peripheral (USART availability and x value depending on device).

Return value:

- None

Notes:

- 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 This macro allows to disable RTS hardware flow control for a given UART instance, without need to call

Parameters:

- __HANDLE__: specifies the UART Handle. This parameter can be any USARTx (supporting the HW Flow control feature). It is used to select the USART peripheral (USART availability and x value depending on device).

Return value:

- None

Notes:

- 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_ENABLE

Description:

- Enable UART.

Parameters:

- __HANDLE__: specifies the UART Handle. UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

__HAL_UART_DISABLE

Description:

- Disable UART UART Handle selects the USARTx or UARTy peripheral (USART,UART availability and x,y values depending on device).

Return value:

- None

UART FLags

UART_FLAG_CTS

UART_FLAG_LBD

UART_FLAG_TXE

UART_FLAG_TC

UART_FLAG_RXNE

UART_FLAG_IDLE

UART_FLAG_ORE

UART_FLAG_NE

UART_FLAG_FE

UART_FLAG_PE

UART Hardware Flow Control

UART_HWCONTROL_NONE

UART_HWCONTROL_RTS

UART_HWCONTROL_CTS

UART_HWCONTROL_RTS_CTS

UART Interrupt Definitions

UART_IT_PE

UART_IT_TXE

UART_IT_TC

UART_IT_RXNE

UART_IT_IDLE

UART_IT_LBD

UART_IT_CTS

UART_IT_ERR

UART LIN Break Detection Length

UART_LINBREAKDETECTLENGTH_10B

UART_LINBREAKDETECTLENGTH_11B

UART Transfer Mode

UART_MODE_RX

UART_MODE_TX

UART_MODE_TX_RX

UART Over Sampling

UART_OVERSAMPLING_16

UART_OVERSAMPLING_8

UART Parity

UART_PARITY_NONE

UART_PARITY_EVEN

UART_PARITY_ODD

UART State

UART_STATE_DISABLE

UART_STATE_ENABLE

UART Number of Stop Bits

UART_STOPBITS_1

UART_STOPBITS_2

UART Wakeup Functions

UART_WAKEUPMETHOD_IDLELINE

UART_WAKEUPMETHOD_ADDRESSMARK

UART Word Length

UART_WORDLENGTH_8B

UART_WORDLENGTH_9B

46 HAL USART Generic Driver

46.1 USART Firmware driver registers structures

46.1.1 USART_InitTypeDef

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***

Field Documentation

- ***uint32_t USART_InitTypeDef::BaudRate***
  This member configures the Usart communication baud rate. The baud rate is computed using the following formula:IntegerDivider = ((PCLKx) / (8 * (husart->Init.BaudRate)))FractionalDivider = ((IntegerDivider - ((uint32_t) IntegerDivider)) * 8) + 0.5
- ***uint32_t USART_InitTypeDef::WordLength***
  Specifies the number of data bits transmitted or received in a frame. This parameter can be a value of ***USART_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***

46.1.2 USART_HandleTypeDef

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***
- ***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
- ***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

46.2 USART Firmware driver API description

46.2.1 How to use this driver

The USART HAL driver can be used as follows:

1. Declare a USART_HandleTypeDef handle structure.
2. Initialize the USART low level resources by implementing the HAL_USART_MspInit() API:
   a. Enable the USARTx interface clock.
   b. USART pins configuration:
      – Enable the clock for the USART GPIOs.
      – Configure the USART pins as alternate function pull-up.

c. 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.

d. 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 initilalized 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.
   - Configure the USARTx interrupt priority and enable the NVIC USART IRQ handle (used for last byte sending completion detection in DMA non circular mode)

3. Program the Baud Rate, Word Length, Stop Bit, Parity, Hardware flow control and Mode(Receiver/Transmitter) in the husart Init structure.
4. Initialize the USART registers by calling the HAL_USART_Init() API:
   - These APIs configures also the low level Hardware GPIO, CLOCK, CORTEX...etc) by calling the customed HAL_USART_MspInit(&husart) API. 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.
5. Three operation modes are available within this driver :

Polling mode IO operation

- Send an amount of data in blocking mode using HAL_USART_Transmit()
- Receive an amount of data in blocking mode using HAL_USART_Receive()

Interrupt mode IO operation

- Send an amount of data in non blocking mode using HAL_USART_Transmit_IT()
- At transmission end of transfer HAL_USART_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_USART_TxCpltCallback
- Receive an amount of data in non blocking mode using HAL_USART_Receive_IT()
- At reception end of transfer HAL_USART_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_USART_RxCpltCallback
- In case of transfer Error, HAL_USART_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_USART_ErrorCallback

DMA mode IO operation

- Send an amount of data in non blocking mode (DMA) using HAL_USART_Transmit_DMA()
- At transmission end of half transfer HAL_USART_TxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_USART_TxHalfCpltCallback

- At transmission end of transfer HAL_USART_TxCpltCallback is executed and user can add his own code by customization of function pointer HAL_USART_TxCpltCallback
- Receive an amount of data in non blocking mode (DMA) using HAL_USART_Receive_DMA()
- At reception end of half transfer HAL_USART_RxHalfCpltCallback is executed and user can add his own code by customization of function pointer HAL_USART_RxHalfCpltCallback
- At reception end of transfer HAL_USART_RxCpltCallback is executed and user can add his own code by customization of function pointer HAL_USART_RxCpltCallback
- In case of transfer Error, HAL_USART_ErrorCallback() function is executed and user can add his own code by customization of function pointer HAL_USART_ErrorCallback
- Pause the DMA Transfer using HAL_USART_DMAPause()
- Resume the DMA Transfer using HAL_USART_DMAResume()
- Stop the DMA Transfer using HAL_USART_DMAStop()

USART HAL driver macros list

Below the list of most used macros in USART HAL driver.

- __HAL_USART_ENABLE: Enable the USART peripheral
- __HAL_USART_DISABLE: Disable the USART peripheral
- __HAL_USART_GET_FLAG : Check whether the specified USART flag is set or not
- __HAL_USART_CLEAR_FLAG : Clear the specified USART pending flag
- __HAL_USART_ENABLE_IT: Enable the specified USART interrupt
- __HAL_USART_DISABLE_IT: Disable the specified USART interrupt
- __HAL_USART_GET_IT_SOURCE: Check whether the specified USART interrupt has occurred or not

You can refer to the USART HAL driver header file for more useful macros

46.2.2 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
  - 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 (RM0038)).

This section contains the following APIs:

- ***HAL_USART_Init()***
- ***HAL_USART_DeInit()***

- ***HAL_USART_MspInit()***
- ***HAL_USART_MspDeInit()***

46.2.3 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 APIs 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 APIs 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. Non Blocking mode functions 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_TxHalfCpltCallback()
   - HAL_USART_TxCpltCallback()
   - HAL_USART_RxHalfCpltCallback()
   - HAL_USART_RxCpltCallback()
   - HAL_USART_ErrorCallback()
   - HAL_USART_TxRxCpltCallback()

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_IRQHandler()*
- *HAL_USART_TxCpltCallback()*
- *HAL_USART_TxHalfCpltCallback()*
- *HAL_USART_RxCpltCallback()*
- *HAL_USART_RxHalfCpltCallback()*
- *HAL_USART_TxRxCpltCallback()*
- *HAL_USART_ErrorCallback()*

46.2.4 Peripheral State and Errors functions

This subsection provides a set of functions allowing to return the State of USART communication process, return Peripheral Errors occurred during communication process

- HAL_USART_GetState() API can be helpful to check in run-time the state of the USART peripheral.
- HAL_USART_GetError() check in run-time errors that could be occurred during communication.

This section contains the following APIs:

- *HAL_USART_GetState()*
- *HAL_USART_GetError()*

46.2.5 Detailed description of functions

HAL_USART_Init

Function name — **HAL_StatusTypeDef HAL_USART_Init (USART_HandleTypeDef * husart)**

Function description — Initializes the USART mode according to the specified parameters in the USART_InitTypeDef and create the associated handle.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **HAL:** status

HAL_USART_DeInit

Function name — **HAL_StatusTypeDef HAL_USART_DeInit (USART_HandleTypeDef * husart)**

Function description — DeInitializes the USART peripheral.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **HAL:** status

HAL_USART_MspInit

Function name **void HAL_USART_MspInit (USART_HandleTypeDef * husart)**

Function description USART MSP Init.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_MspDeInit

Function name **void HAL_USART_MspDeInit (USART_HandleTypeDef * husart)**

Function description USART MSP DeInit.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

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:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pTxData:** Pointer to data buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_USART_Receive

Function name **HAL_StatusTypeDef HAL_USART_Receive (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size, uint32_t Timeout)**

Function description Full-Duplex Receive an amount of data in blocking mode.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pRxData:** Pointer to data buffer
- **Size:** Amount of data to be received
- **Timeout:** Timeout duration

Return values
- **HAL:** status

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 receive an amount of data in full-duplex mode (blocking mode).

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pTxData:** Pointer to data transmitted buffer
- **pRxData:** Pointer to data received buffer
- **Size:** Amount of data to be sent
- **Timeout:** Timeout duration

Return values
- **HAL:** status

HAL_USART_Transmit_IT

Function name **HAL_StatusTypeDef HAL_USART_Transmit_IT (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size)**

Function description Simplex Send an amount of data in non-blocking mode.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pTxData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values
- **HAL:** status

Notes
- The USART errors are not managed to avoid the overrun error.

HAL_USART_Receive_IT

Function name **HAL_StatusTypeDef HAL_USART_Receive_IT (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size)**

Function description Simplex Receive an amount of data in non-blocking mode.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pRxData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values
- **HAL:** status

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 receive an amount of data in full-duplex mode (non-blocking).

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pTxData:** Pointer to data transmitted buffer
- **pRxData:** Pointer to data received buffer
- **Size:** Amount of data to be received

Return values
- **HAL:** status

HAL_USART_Transmit_DMA

Function name — **HAL_StatusTypeDef HAL_USART_Transmit_DMA (USART_HandleTypeDef * husart, uint8_t * pTxData, uint16_t Size)**

Function description — Simplex Send an amount of data in non-blocking mode.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pTxData:** Pointer to data buffer
- **Size:** Amount of data to be sent

Return values
- **HAL:** status

HAL_USART_Receive_DMA

Function name — **HAL_StatusTypeDef HAL_USART_Receive_DMA (USART_HandleTypeDef * husart, uint8_t * pRxData, uint16_t Size)**

Function description — Full-Duplex Receive an amount of data in non-blocking mode.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.
- **pRxData:** Pointer to data buffer
- **Size:** Amount of data to be received

Return values
- **HAL:** status

Notes
- The USART DMA transmit channel must be configured in order to generate the clock for the slave.
- When the USART parity is enabled (PCE = 1) the data received contain the parity bit.

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:** Pointer to a USART_HandleTypeDef structure that

contains the configuration information for the specified USART module.
- **pTxData:** Pointer to data transmitted buffer
- **pRxData:** Pointer to data received buffer
- **Size:** Amount of data to be received

Return values
- **HAL:** status

Notes
- When the USART parity is enabled (PCE = 1) the data received contain the parity bit.

HAL_USART_DMAPause

Function name **HAL_StatusTypeDef HAL_USART_DMAPause (USART_HandleTypeDef * husart)**

Function description Pauses the DMA Transfer.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **HAL:** status

HAL_USART_DMAResume

Function name **HAL_StatusTypeDef HAL_USART_DMAResume (USART_HandleTypeDef * husart)**

Function description Resumes the DMA Transfer.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **HAL:** status

HAL_USART_DMAStop

Function name **HAL_StatusTypeDef HAL_USART_DMAStop (USART_HandleTypeDef * husart)**

Function description Stops the DMA Transfer.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **HAL:** status

HAL_USART_IRQHandler

Function name **void HAL_USART_IRQHandler (USART_HandleTypeDef * husart)**

Function description This function handles USART interrupt request.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_TxCpltCallback

Function name **void HAL_USART_TxCpltCallback (USART_HandleTypeDef * husart)**

Function description Tx Transfer completed callbacks.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_TxHalfCpltCallback

Function name **void HAL_USART_TxHalfCpltCallback (USART_HandleTypeDef * husart)**

Function description Tx Half Transfer completed callbacks.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_RxCpltCallback

Function name **void HAL_USART_RxCpltCallback (USART_HandleTypeDef * husart)**

Function description Rx Transfer completed callbacks.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_RxHalfCpltCallback

Function name **void HAL_USART_RxHalfCpltCallback (USART_HandleTypeDef * husart)**

Function description Rx Half Transfer completed callbacks.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

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:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_ErrorCallback

Function name **void HAL_USART_ErrorCallback (USART_HandleTypeDef * husart)**

Function description USART error callbacks.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **None:**

HAL_USART_GetState

Function name **HAL_USART_StateTypeDef HAL_USART_GetState (USART_HandleTypeDef * husart)**

Function description Returns the USART state.

Parameters
- **husart:** Pointer to a USART_HandleTypeDef structure that contains the configuration information for the specified USART module.

Return values
- **HAL:** 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:** Error Code

46.3 USART Firmware driver defines

46.3.1 USART

USART Clock

USART_CLOCK_DISABLE

USART_CLOCK_ENABLE

USART Clock Phase

USART_PHASE_1EDGE

USART_PHASE_2EDGE

USART Clock Polarity

USART_POLARITY_LOW

USART_POLARITY_HIGH

USART Error Codes

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

USART Exported Macros

__HAL_USART_RESET_HANDLE_STATE

Description:

- Reset USART handle state.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_GET_FLAG

Description:

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

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __FLAG__: specifies the flag to check. This parameter can be one of the following values:
  - USART_FLAG_TXE: Transmit data register empty flag
  - USART_FLAG_TC: Transmission Complete flag
  - USART_FLAG_RXNE: Receive data register 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 flags.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __FLAG__: specifies the flag to check. This parameter can be any combination of the following values:
  - USART_FLAG_TC: Transmission Complete flag.
  - USART_FLAG_RXNE: Receive data register not empty flag.

Return value:

- None

Notes:

- PE (Parity error), FE (Framing error), NE (Noise error), ORE (OverRun error) and IDLE (Idle line detected) flags are cleared by software sequence: a read operation to USART_SR register followed by a read operation to USART_DR register. RXNE flag can be also cleared by a read to the USART_DR register. TC flag can be also cleared by software sequence: a read operation to USART_SR register followed by a write operation to USART_DR register. TXE flag is cleared only by a write to the USART_DR register.

__HAL_USART_CLEAR_PEFLAG

Description:

- Clear the USART PE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle

selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_CLEAR_FEFLAG

Description:

- Clear the USART FE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_CLEAR_NEFLAG

Description:

- Clear the USART NE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_CLEAR_OREFLAG

Description:

- Clear the USART ORE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_CLEAR_IDLEFLAG

Description:

- Clear the USART IDLE pending flag.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle

selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_ENABLE_IT

Description:

- Enable the specified Usart interrupts.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __INTERRUPT__: specifies the USART interrupt source to enable. This parameter can be one of the following values:
  - USART_IT_TXE: Transmit Data Register empty interrupt
  - USART_IT_TC: Transmission complete interrupt
  - USART_IT_RXNE: Receive Data register 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 interrupts.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __INTERRUPT__: specifies the USART interrupt source to disable. This parameter can be one of the following values:
  - USART_IT_TXE: Transmit

Data Register empty interrupt
- USART_IT_TC: Transmission complete interrupt
- USART_IT_RXNE: Receive Data register 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_SOURCE

Description:

- Check whether the specified Usart interrupt has occurred or not.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).
- __IT__: specifies the USART interrupt source to check. This parameter can be one of the following values:
  - USART_IT_TXE: Transmit Data Register empty interrupt
  - USART_IT_TC: Transmission complete interrupt
  - USART_IT_RXNE: Receive Data register not empty interrupt
  - USART_IT_IDLE: Idle line detection interrupt
  - USART_IT_ERR: Error interrupt
  - USART_IT_PE: Parity Error interrupt

Return value:

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

__HAL_USART_ONE_BIT_SAMPLE_ENABLE

Description:

- Enables the USART one bit sample method.

Parameters:

- __HANDLE__: specifies the USART Handle.

Return value:

- None

__HAL_USART_ONE_BIT_SAMPLE_DISABLE

Description:

- Disables the UART one bit sample method.

Parameters:

- __HANDLE__: specifies the UART Handle.

Return value:

- None

__HAL_USART_ENABLE

Description:

- Enable USART.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

__HAL_USART_DISABLE

Description:

- Disable USART.

Parameters:

- __HANDLE__: specifies the USART Handle. USART Handle selects the USARTx peripheral (USART availability and x value depending on device).

Return value:

- None

USART Flags

USART_FLAG_CTS

USART_FLAG_LBD

USART_FLAG_TXE

USART_FLAG_TC

USART_FLAG_RXNE

USART_FLAG_IDLE

USART_FLAG_ORE

USART_FLAG_NE

USART_FLAG_FE

USART_FLAG_PE

USART Interrupts Definition

USART_IT_PE

USART_IT_TXE

USART_IT_TC

USART_IT_RXNE

USART_IT_IDLE

USART_IT_LBD

USART_IT_CTS

USART_IT_ERR

USART Last Bit

USART_LASTBIT_DISABLE

USART_LASTBIT_ENABLE

USART Mode

USART_MODE_RX

USART_MODE_TX

USART_MODE_TX_RX

USART NACK State

USART_NACK_ENABLE

USART_NACK_DISABLE

USART Parity

USART_PARITY_NONE

USART_PARITY_EVEN

USART_PARITY_ODD

USART Number of Stop Bits

USART_STOPBITS_1

USART_STOPBITS_0_5

USART_STOPBITS_2

USART_STOPBITS_1_5

USART Word Length

USART_WORDLENGTH_8B

USART_WORDLENGTH_9B

47 HAL WWDG Generic Driver

47.1 WWDG Firmware driver registers structures

47.1.1 WWDG_InitTypeDef

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***

47.1.2 WWDG_HandleTypeDef

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

47.2 WWDG Firmware driver API description

47.2.1 WWDG specific features

Once enabled the WWDG generates a system reset on expiry of a programmed time period, unless the program refreshes the counter (T[6;0] downcounter) before reaching 0x3F value (i.e. a reset is generated when the counter value rolls over from 0x40 to 0x3F).

- An MCU reset is also generated if the counter value is refreshed before the counter has reached the refresh window value. This implies that the counter must be refreshed in a limited window.
- Once enabled the WWDG cannot be disabled except by a system reset.
- WWDGRST flag in RCC_CSR register informs when a WWDG reset has occurred (check available with __HAL_RCC_GET_FLAG(RCC_FLAG_WWDGRST)).

- The WWDG downcounter input clock is derived from the APB clock divided by a programmable prescaler.
- WWDG downcounter clock (Hz) = PCLK1 / (4096 * Prescaler)
- WWDG timeout (ms) = (1000 * (T[5;0] + 1)) / (WWDG downcounter clock) where T[5;0] are the lowest 6 bits of downcounter.
- WWDG Counter refresh is allowed between the following limits :
  - min time (ms) = (1000 * (T[5;0] - Window)) / (WWDG downcounter clock)
  - max time (ms) = (1000 * (T[5;0] - 0x40)) / (WWDG downcounter clock)
- Min-max timeout value @80 MHz(PCLK1): ~51.2 us / ~26.22 ms
- The Early Wakeup Interrupt (EWI) can be used if specific safety operations or data logging must be performed before the actual reset is generated. When the downcounter reaches the value 0x40, an 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. In some applications, the EWI interrupt can be used to manage a software system check and/or system recovery/graceful degradation, without generating a WWDG reset. In this case, the corresponding interrupt service routine (ISR) should reload the WWDG counter to avoid the WWDG reset, then trigger the required actions. Note:When the EWI interrupt cannot be served, e.g. due to a system lock in a higher priority task, the WWDG reset will eventually be generated.
- Debug mode : When the microcontroller enters debug mode (core halted), the WWDG counter either continues to work normally or stops, depending on DBG_WWDG_STOP configuration bit in DBG module, accessible through __HAL_DBGMCU_FREEZE_WWDG() and __HAL_DBGMCU_UNFREEZE_WWDG() macros

47.2.2 How to use this driver

- Enable WWDG APB1 clock using __HAL_RCC_WWDG_CLK_ENABLE().
- Set the WWDG prescaler, refresh window, counter value and Early Wakeup Interrupt mode using using HAL_WWDG_Init() function. This enables WWDG peripheral and the downcounter starts downcounting from given counter value. Init function can be called again to modify all watchdog parameters, however if EWI mode has been set once, it can't be clear until next reset.
- The application program must refresh the WWDG counter at regular intervals during normal operation to prevent an MCU reset using HAL_WWDG_Refresh() function. This operation must occur only when the counter is lower than the window value already programmed.
- if Early Wakeup Interrupt mode is enable an interrupt is generated when the counter reaches 0x40. User can add his own code in weak function HAL_WWDG_EarlyWakeupCallback().

WWDG HAL driver macros list

Below the list of most used macros in WWDG HAL driver.

- __HAL_WWDG_GET_IT_SOURCE: Check the selected WWDG's interrupt source.
- __HAL_WWDG_GET_FLAG: Get the selected WWDG's flag status.
- __HAL_WWDG_CLEAR_FLAG: Clear the WWDG's pending flags.

47.2.3 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()***

47.2.4 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()***

47.2.5 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:**

47.3 WWDG Firmware driver defines

47.3.1 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

48 LL ADC Generic Driver

48.1 ADC Firmware driver registers structures

48.1.1 LL_ADC_CommonInitTypeDef

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, HSI RC oscillator is the only clock source for ADC. Therefore, HSI RC oscillator must be preliminarily enabled at RCC top level.On this STM32 serie, some clock ratio constraints between ADC clock and APB clock must be respected:In all cases: if APB clock frequency is too low compared ADC clock frequency, a delay between conversions must be inserted.If ADC group injected is used: ADC clock frequency should be lower than APB clock frequency /4 for resolution 12 or 10 bits, APB clock frequency /3 for resolution 8 bits, APB clock frequency /2 for resolution 6 bits. Refer to reference manual. This feature can be modified afterwards using unitary function **LL_ADC_SetCommonClock()**.

48.1.2 LL_ADC_InitTypeDef

Data Fields

- ***uint32_t Resolution***
- ***uint32_t DataAlignment***
- ***uint32_t LowPowerMode***
- ***uint32_t SequencersScanMode***

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 concatenation of a value of ***ADC_LL_EC_LP_MODE_AUTOWAIT*** and a value of ***ADC_LL_EC_LP_MODE_AUTOPOWEROFF***This feature can be modified afterwards using unitary function **LL_ADC_SetLowPowerModeAutoWait()** and **LL_ADC_SetLowPowerModeAutoPowerOff()**.
- ***uint32_t LL_ADC_InitTypeDef::SequencersScanMode***
  Set ADC scan selection. This parameter can be a value of ***ADC_LL_EC_SCAN_SELECTION***This feature can be modified afterwards using unitary function **LL_ADC_SetSequencersScanMode()**.

48.1.3 LL_ADC_REG_InitTypeDef

Data Fields

- ***uint32_t TriggerSource***
- ***uint32_t SequencerLength***
- ***uint32_t SequencerDiscont***
- ***uint32_t ContinuousMode***
- ***uint32_t DMATransfer***

Field Documentation

- ***uint32_t LL_ADC_REG_InitTypeDef::TriggerSource***
  Set ADC group regular conversion trigger source: internal (SW start) or from external IP (timer event, external interrupt line). This parameter can be a value of ***ADC_LL_EC_REG_TRIGGER_SOURCE***
  Note: On this STM32 serie, setting of external trigger edge is performed using function **LL_ADC_REG_StartConversionExtTrig()**. 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***
  Note: This parameter is discarded if scan mode is disabled (refer to parameter 'ADC_SequencersScanMode'). 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()**.

48.1.4 LL_ADC_INJ_InitTypeDef

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 IP (timer event, external interrupt line). This parameter can be a value of ***ADC_LL_EC_INJ_TRIGGER_SOURCE***
  Note: On this STM32 serie, setting of external trigger edge is performed using function **LL_ADC_INJ_StartConversionExtTrig()**. 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***
  Note: This parameter is discarded if scan mode is disabled (refer to parameter 'ADC_SequencersScanMode'). 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()**.

48.2 ADC Firmware driver API description

48.2.1 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
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 DATA 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_ASYNC_DIV1
  - LL_ADC_CLOCK_ASYNC_DIV2
  - LL_ADC_CLOCK_ASYNC_DIV4

Return values
- **None:**

Notes
- On this STM32 serie, HSI RC oscillator is the only clock source for ADC. Therefore, HSI RC oscillator must be preliminarily enabled at RCC top level.
- On this STM32 serie, some clock ratio constraints between ADC clock and APB clock must be respected: In all cases: if APB clock frequency is too low compared ADC clock frequency, a delay between conversions must be inserted.If ADC group injected is used: ADC clock frequency should be lower than APB clock frequency /4 for resolution 12 or 10 bits, APB clock frequency /3 for resolution 8 bits, APB clock frequency /2 for resolution 6 bits. Refer to reference manual.

Reference Manual to LL API cross reference:
- CCR ADCPRE 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_ASYNC_DIV1
  - LL_ADC_CLOCK_ASYNC_DIV2

- LL_ADC_CLOCK_ASYNC_DIV4

Reference Manual to LL API cross reference:
- CCR ADCPRE 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

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 TSVREFE LL_ADC_SetCommonPathInternalCh

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

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 TSVREFE LL_ADC_GetCommonPathInternalCh

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:**

Reference Manual to LL API cross reference:
- CR1 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:
- CR1 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.

Reference Manual to LL API cross reference:
- CR2 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:
- CR2 ALIGN LL_ADC_SetDataAlignment

LL_ADC_SetLowPowerModeAutoWait

Function name **__STATIC_INLINE void LL_ADC_SetLowPowerModeAutoWait (ADC_TypeDef * ADCx, uint32_t LowPowerModeAutoWait)**

Function description Set ADC low power mode auto wait.

Parameters
- **ADCx:** ADC instance
- **LowPowerModeAutoWait:** This parameter can be one of the following values:
  - LL_ADC_LP_AUTOWAIT_NONE
  - LL_ADC_LP_AUTOWAIT
  - LL_ADC_LP_AUTOWAIT_7_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_15_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_31_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_63_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_127_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_255_APBCLOCKCYCLES

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": refer to function LL_ADC_SetLowPowerModeAutoPowerOff().

- 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:

- CR2 DELS LL_ADC_SetLowPowerModeAutoWait

LL_ADC_GetLowPowerModeAutoWait

Function name **__STATIC_INLINE uint32_t LL_ADC_GetLowPowerModeAutoWait (ADC_TypeDef * ADCx)**

Function description Get ADC low power mode auto wait.

Parameters

- **ADCx:** ADC instance

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_LP_AUTOWAIT_NONE
  - LL_ADC_LP_AUTOWAIT
  - LL_ADC_LP_AUTOWAIT_7_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_15_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_31_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_63_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_127_APBCLOCKCYCLES
  - LL_ADC_LP_AUTOWAIT_255_APBCLOCKCYCLES

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": refer to function LL_ADC_SetLowPowerModeAutoPowerOff().
- 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:
- CR2 DELS LL_ADC_GetLowPowerModeAutoWait

LL_ADC_SetLowPowerModeAutoPowerOff

Function name: **__STATIC_INLINE void LL_ADC_SetLowPowerModeAutoPowerOff (ADC_TypeDef * ADCx, uint32_t LowPowerModeAutoPowerOff)**

Function description: Set ADC low power mode auto power-off.

Parameters:
- **ADCx:** ADC instance
- **LowPowerModeAutoPowerOff:** This parameter can be one of the following values:
  - LL_ADC_LP_AUTOPOWEROFF_NONE
  - LL_ADC_LP_AUTOPOWEROFF_IDLE_PHASE
  - LL_ADC_LP_AUTOPOWEROFF_AUTOWAIT_PHASE
  - LL_ADC_LP_AUTOPOWEROFF_IDLE_AUTOWAIT_PHASES

Return values:
- **None:**

Notes:
- Description of ADC low power modes: ADC low power mode "auto wait": refer to function LL_ADC_SetLowPowerModeAutoWait().ADC low power mode "auto power-off": 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".

Reference Manual to LL API cross reference:
- CR1 PDI LL_ADC_GetLowPowerModeAutoPowerOff
- CR1 PDD LL_ADC_GetLowPowerModeAutoPowerOff

LL_ADC_GetLowPowerModeAutoPowerOff

Function name: **__STATIC_INLINE uint32_t LL_ADC_GetLowPowerModeAutoPowerOff (ADC_TypeDef * ADCx)**

Function: Get ADC low power mode auto power-off.

description

Parameters
- **ADCx:** ADC instance

Return values
- **Returned:** value can be one of the following values:
  - LL_ADC_LP_AUTOPOWEROFF_NONE
  - LL_ADC_LP_AUTOPOWEROFF_IDLE_PHASE
  - LL_ADC_LP_AUTOPOWEROFF_AUTOWAIT_PHASE
  - LL_ADC_LP_AUTOPOWEROFF_IDLE_AUTOWAIT_PHASES

Notes
- Description of ADC low power modes: ADC low power mode "auto wait": refer to function LL_ADC_SetLowPowerModeAutoWait().ADC low power mode "auto power-off": 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".

Reference Manual to LL API cross reference:
- CR1 PDI LL_ADC_GetLowPowerModeAutoPowerOff
- CR1 PDD LL_ADC_GetLowPowerModeAutoPowerOff

LL_ADC_SetSequencersScanMode

Function name
__STATIC_INLINE void LL_ADC_SetSequencersScanMode (ADC_TypeDef * ADCx, uint32_t ScanMode)

Function description
Set ADC sequencers scan mode, for all ADC groups (group regular, group injected).

Parameters
- **ADCx:** ADC instance
- **ScanMode:** This parameter can be one of the following values:
  - LL_ADC_SEQ_SCAN_DISABLE
  - LL_ADC_SEQ_SCAN_ENABLE

Return values
- **None:**

Notes
- According to sequencers scan mode : If disabled: ADC conversion is performed in unitary conversion mode (one channel converted, that defined in rank 1). Configuration of sequencers of all ADC groups (sequencer scan length, ...) is discarded: equivalent to scan length of 1 rank.If enabled: ADC conversions are performed in sequence conversions mode, according to configuration of sequencers of each ADC group (sequencer scan length, ...). Refer to function LL_ADC_REG_SetSequencerLength() and to function LL_ADC_INJ_SetSequencerLength().
- 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:
- CR1 SCAN LL_ADC_SetSequencersScanMode

LL_ADC_GetSequencersScanMode

Function name	**__STATIC_INLINE uint32_t LL_ADC_GetSequencersScanMode (ADC_TypeDef * ADCx)**
Function description	Get ADC sequencers scan mode, for all ADC groups (group regular, group injected).
Parameters	• **ADCx:** ADC instance
Return values	• **Returned:** value can be one of the following values: – LL_ADC_SEQ_SCAN_DISABLE – LL_ADC_SEQ_SCAN_ENABLE
Notes	• According to sequencers scan mode : If disabled: ADC conversion is performed in unitary conversion mode (one channel converted, that defined in rank 1). Configuration of sequencers of all ADC groups (sequencer scan length, ...) is discarded: equivalent to scan length of 1 rank.If enabled: ADC conversions are performed in sequence conversions mode, according to configuration of sequencers of each ADC group (sequencer scan length, ...). Refer to function LL_ADC_REG_SetSequencerLength() and to function LL_ADC_INJ_SetSequencerLength().
Reference Manual to LL API cross reference:	• CR1 SCAN LL_ADC_GetSequencersScanMode

LL_ADC_SetChannelsBank

Function name	**__STATIC_INLINE void LL_ADC_SetChannelsBank (ADC_TypeDef * ADCx, uint32_t ChannelsBank)**
Function description	Set ADC channels bank.
Parameters	• **ADCx:** ADC instance • **ChannelsBank:** This parameter can be one of the following values: – LL_ADC_CHANNELS_BANK_A – LL_ADC_CHANNELS_BANK_B
Return values	• **None:**
Notes	• Bank selected applies to ADC scope, on all channels (independently of channel mapped on ADC group regular or group injected). • Banks availability depends on devices categories. • 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:	• CR2 ADC_CFG LL_ADC_SetChannelsBank

LL_ADC_GetChannelsBank

Function name	**__STATIC_INLINE uint32_t LL_ADC_GetChannelsBank**

(ADC_TypeDef * ADCx)

Function description: Get ADC channels bank.

Parameters:
- **ADCx:** ADC instance

Return values:
- **Returned:** value can be one of the following values:
  - LL_ADC_CHANNELS_BANK_A
  - LL_ADC_CHANNELS_BANK_B

Notes:
- Bank selected applies to ADC scope, on all channels (independently of channel mapped on ADC group regular or group injected).
- Banks availability depends on devices categories.

Reference Manual to LL API cross reference:
- CR2 ADC_CFG LL_ADC_GetChannelsBank

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 IP (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_TIM2_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM2_CH3
  - LL_ADC_REG_TRIG_EXT_TIM3_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM2_CH2
  - LL_ADC_REG_TRIG_EXT_TIM3_CH1
  - LL_ADC_REG_TRIG_EXT_TIM3_CH3
  - 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_TIM9_CH2
  - LL_ADC_REG_TRIG_EXT_TIM9_TRGO
  - LL_ADC_REG_TRIG_EXT_EXTI_LINE11

Return values:
- **None:**

Notes:
- On this STM32 serie, setting of external trigger edge is performed using function LL_ADC_REG_StartConversionExtTrig().
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:
- CR2 EXTSEL LL_ADC_REG_SetTriggerSource
- CR2 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 IP (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_TIM2_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM2_CH3
  - LL_ADC_REG_TRIG_EXT_TIM3_TRGO
  - LL_ADC_REG_TRIG_EXT_TIM2_CH2
  - LL_ADC_REG_TRIG_EXT_TIM3_CH1
  - LL_ADC_REG_TRIG_EXT_TIM3_CH3
  - 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_TIM9_CH2
  - LL_ADC_REG_TRIG_EXT_TIM9_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:
- CR2 EXTSEL LL_ADC_REG_GetTriggerSource
- CR2 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:
- CR2 EXTEN LL_ADC_REG_IsTriggerSourceSWStart

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. • On this STM32 serie, setting of external trigger edge is performed using function LL_ADC_REG_StartConversionExtTrig().
Reference Manual to LL API cross reference:	• CR2 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()".

- On this STM32 serie, group regular sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode().
- 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_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()".
- On this STM32 serie, group regular sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode().
- 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_SetSequencerLength

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.

Reference Manual to LL API cross reference:
- CR1 DISCEN LL_ADC_REG_SetSequencerDiscont
- CR1 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:
- CR1 DISCEN LL_ADC_REG_GetSequencerDiscont
- CR1 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: (1) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.3, Cat.4 and Cat.5.
  - 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
  - LL_ADC_REG_RANK_17
  - LL_ADC_REG_RANK_18
  - LL_ADC_REG_RANK_19
  - LL_ADC_REG_RANK_20
  - LL_ADC_REG_RANK_21
  - LL_ADC_REG_RANK_22
  - LL_ADC_REG_RANK_23
  - LL_ADC_REG_RANK_24
  - LL_ADC_REG_RANK_25
  - LL_ADC_REG_RANK_26
  - LL_ADC_REG_RANK_27
  - LL_ADC_REG_RANK_28 (1)
- **Channel:** This parameter can be one of the following values:
  (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_CHANNEL_0 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)

- LL_ADC_CHANNEL_30 (3)(4)
- LL_ADC_CHANNEL_31 (3)(4)
- LL_ADC_CHANNEL_VREFINT (3)
- LL_ADC_CHANNEL_TEMPSENSOR (3)
- LL_ADC_CHANNEL_VCOMP (3)
- LL_ADC_CHANNEL_VOPAMP1 (3)(5)
- LL_ADC_CHANNEL_VOPAMP2 (3)(5)
- LL_ADC_CHANNEL_VOPAMP3 (3)(5)

- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4 and Cat.5

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().

Reference Manual to LL API cross reference:

- SQR5 SQ1 LL_ADC_REG_SetSequencerRanks
- SQR5 SQ2 LL_ADC_REG_SetSequencerRanks
- SQR5 SQ3 LL_ADC_REG_SetSequencerRanks
- SQR5 SQ4 LL_ADC_REG_SetSequencerRanks
- SQR5 SQ5 LL_ADC_REG_SetSequencerRanks
- SQR5 SQ6 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ7 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ8 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ9 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ10 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ11 LL_ADC_REG_SetSequencerRanks
- SQR4 SQ12 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ13 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ14 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ15 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ16 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ17 LL_ADC_REG_SetSequencerRanks
- SQR3 SQ18 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ19 LL_ADC_REG_SetSequencerRanks

- SQR2 SQ20 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ21 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ22 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ23 LL_ADC_REG_SetSequencerRanks
- SQR2 SQ24 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ25 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ26 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ27 LL_ADC_REG_SetSequencerRanks
- SQR1 SQ28 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: (1) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.3, Cat.4 and Cat.5.
  - 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
  - LL_ADC_REG_RANK_17
  - LL_ADC_REG_RANK_18
  - LL_ADC_REG_RANK_19
  - LL_ADC_REG_RANK_20
  - LL_ADC_REG_RANK_21
  - LL_ADC_REG_RANK_22
  - LL_ADC_REG_RANK_23
  - LL_ADC_REG_RANK_24
  - LL_ADC_REG_RANK_25
  - LL_ADC_REG_RANK_26
  - LL_ADC_REG_RANK_27
  - LL_ADC_REG_RANK_28 (1)

Return values

- **Returned:** value can be one of the following values: (1) On STM32L1, connection via routing interface (RI) specificity: fast

channel (channel routed directly to ADC switch matrix).
  - LL_ADC_CHANNEL_0 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)(6)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)(6)
  - LL_ADC_CHANNEL_VCOMP (3)(6)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)
- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4 and Cat.5.
- (6) 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:

- SQR5 SQ1 LL_ADC_REG_GetSequencerRanks
- SQR5 SQ2 LL_ADC_REG_GetSequencerRanks
- SQR5 SQ3 LL_ADC_REG_GetSequencerRanks
- SQR5 SQ4 LL_ADC_REG_GetSequencerRanks
- SQR5 SQ5 LL_ADC_REG_GetSequencerRanks
- SQR5 SQ6 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ7 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ8 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ9 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ10 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ11 LL_ADC_REG_GetSequencerRanks
- SQR4 SQ12 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ13 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ14 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ15 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ16 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ17 LL_ADC_REG_GetSequencerRanks
- SQR3 SQ18 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ19 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ20 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ21 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ22 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ23 LL_ADC_REG_GetSequencerRanks
- SQR2 SQ24 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ25 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ26 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ27 LL_ADC_REG_GetSequencerRanks
- SQR1 SQ28 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.
Reference Manual to LL API cross reference:	• CR2 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:	• CR2 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).
- To configure DMA source address (peripheral address), use function LL_ADC_DMA_GetRegAddr().

Reference Manual to LL API cross reference:
- CR2 DMA LL_ADC_REG_SetDMATransfer
- CR2 DDS 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).
- To configure DMA source address (peripheral address), use function LL_ADC_DMA_GetRegAddr().

Reference Manual to LL API cross reference:
- CR2 DMA LL_ADC_REG_GetDMATransfer
- CR2 DDS LL_ADC_REG_GetDMATransfer

LL_ADC_REG_SetFlagEndOfConversion

Function name **__STATIC_INLINE void LL_ADC_REG_SetFlagEndOfConversion (ADC_TypeDef ***

ADCx, uint32_t EocSelection)

Function description: Specify which ADC flag between EOC (end of unitary conversion) or EOS (end of sequence conversions) is used to indicate the end of conversion.

Parameters:
- **ADCx:** ADC instance
- **EocSelection:** This parameter can be one of the following values:
  - LL_ADC_REG_FLAG_EOC_SEQUENCE_CONV
  - LL_ADC_REG_FLAG_EOC_UNITARY_CONV

Return values:
- **None:**

Notes:
- This feature is aimed to be set when using ADC with programming model by polling or interruption (programming model by DMA usually uses DMA interruptions to indicate end of conversion and data transfer).
- For ADC group injected, end of conversion (flag&IT) is raised only at the end of the sequence.

Reference Manual to LL API cross reference:
- CR2 EOCS LL_ADC_REG_SetFlagEndOfConversion

LL_ADC_REG_GetFlagEndOfConversion

Function name: **__STATIC_INLINE uint32_t LL_ADC_REG_GetFlagEndOfConversion (ADC_TypeDef * ADCx)**

Function description: Get which ADC flag between EOC (end of unitary conversion) or EOS (end of sequence conversions) is used to indicate the end of conversion.

Parameters:
- **ADCx:** ADC instance

Return values:
- **Returned:** value can be one of the following values:
  - LL_ADC_REG_FLAG_EOC_SEQUENCE_CONV
  - LL_ADC_REG_FLAG_EOC_UNITARY_CONV

Reference Manual to LL API cross reference:
- CR2 EOCS LL_ADC_REG_GetFlagEndOfConversion

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 IP (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_TIM9_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM9_TRGO

- LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
- LL_ADC_INJ_TRIG_EXT_TIM2_CH1
- LL_ADC_INJ_TRIG_EXT_TIM3_CH4
- LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
- LL_ADC_INJ_TRIG_EXT_TIM4_CH1
- LL_ADC_INJ_TRIG_EXT_TIM4_CH2
- LL_ADC_INJ_TRIG_EXT_TIM4_CH3
- LL_ADC_INJ_TRIG_EXT_TIM10_CH1
- LL_ADC_INJ_TRIG_EXT_TIM7_TRGO
- LL_ADC_INJ_TRIG_EXT_EXTI_LINE15

Return values
- **None:**

Notes
- On this STM32 serie, setting of external trigger edge is performed using function LL_ADC_INJ_StartConversionExtTrig().
- Availability of parameters of trigger sources from timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:
- CR2 JEXTSEL LL_ADC_INJ_SetTriggerSource
- CR2 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 IP (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_TIM9_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM9_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM2_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM2_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM3_CH4
  - LL_ADC_INJ_TRIG_EXT_TIM4_TRGO
  - LL_ADC_INJ_TRIG_EXT_TIM4_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM4_CH2
  - LL_ADC_INJ_TRIG_EXT_TIM4_CH3
  - LL_ADC_INJ_TRIG_EXT_TIM10_CH1
  - LL_ADC_INJ_TRIG_EXT_TIM7_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:
- CR2 JEXTSEL LL_ADC_INJ_GetTriggerSource
- CR2 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:
- CR2 JEXTEN LL_ADC_INJ_IsTriggerSourceSWStart

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:
- CR2 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).
- On this STM32 serie, group injected sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode().
- 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_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).
- On this STM32 serie, group injected sequencer configuration is conditioned to ADC instance sequencer mode. If ADC instance sequencer mode is disabled, sequencers of all groups (group regular, group injected) can be configured but their execution is disabled (limited to rank 1). Refer to function LL_ADC_SetSequencersScanMode().
- 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:
- CR1 DISCEN 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:
- CR1 DISCEN LL_ADC_REG_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: (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_CHANNEL_0 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)

  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)
  - LL_ADC_CHANNEL_VCOMP (3)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)

- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4 and Cat.5

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().

Reference Manual to LL API cross

- JSQR JSQ1 LL_ADC_INJ_SetSequencerRanks
- JSQR JSQ2 LL_ADC_INJ_SetSequencerRanks

reference:
- 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: (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_CHANNEL_0 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)(6)

  - LL_ADC_CHANNEL_TEMPSENSOR (3)(6)
  - LL_ADC_CHANNEL_VCOMP (3)(6)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)
- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4 and Cat.5.
- (6) 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_SetSequencerRanks
- JSQR JSQ2 LL_ADC_INJ_SetSequencerRanks
- JSQR JSQ3 LL_ADC_INJ_SetSequencerRanks
- JSQR JSQ4 LL_ADC_INJ_SetSequencerRanks

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.

Reference Manual to LL API cross reference:
- CR1 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:
- CR1 JAUTO LL_ADC_INJ_GetTrigAuto

LL_ADC_INJ_SetOffset

Function name: **__STATIC_INLINE void LL_ADC_INJ_SetOffset (ADC_TypeDef * ADCx, uint32_t Rank, uint32_t OffsetLevel)**

Function description: Set ADC group injected offset.

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
- **OffsetLevel:** Value between Min_Data=0x000 and Max_Data=0xFFF

Return values:
- **None:**

Notes:
- It sets: ADC group injected rank to which the offset programmed will be appliedOffset 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.
- Offset cannot be enabled or disabled. To emulate offset

disabled, set an offset value equal to 0.

Reference Manual to LL API cross reference:
- JOFR1 JOFFSET1 LL_ADC_INJ_SetOffset
- JOFR2 JOFFSET2 LL_ADC_INJ_SetOffset
- JOFR3 JOFFSET3 LL_ADC_INJ_SetOffset
- JOFR4 JOFFSET4 LL_ADC_INJ_SetOffset

LL_ADC_INJ_GetOffset

Function name: **__STATIC_INLINE uint32_t LL_ADC_INJ_GetOffset (ADC_TypeDef * ADCx, uint32_t Rank)**

Function description: Get ADC group injected offset.

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:
- It gives 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.

Reference Manual to LL API cross reference:
- JOFR1 JOFFSET1 LL_ADC_INJ_GetOffset
- JOFR2 JOFFSET2 LL_ADC_INJ_GetOffset
- JOFR3 JOFFSET3 LL_ADC_INJ_GetOffset
- JOFR4 JOFFSET4 LL_ADC_INJ_GetOffset

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: (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_CHANNEL_0 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)

  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)
  - LL_ADC_CHANNEL_VCOMP (3)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)

- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4 and Cat.5
- **SamplingTime:** This parameter can be one of the following values:
  - LL_ADC_SAMPLINGTIME_4CYCLES
  - LL_ADC_SAMPLINGTIME_9CYCLES
  - LL_ADC_SAMPLINGTIME_16CYCLES
  - LL_ADC_SAMPLINGTIME_24CYCLES
  - LL_ADC_SAMPLINGTIME_48CYCLES
  - LL_ADC_SAMPLINGTIME_96CYCLES
  - LL_ADC_SAMPLINGTIME_192CYCLES
  - LL_ADC_SAMPLINGTIME_384CYCLES

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. Refer to reference manual for ADC processing time of this STM32 serie.
- In case of ADC conversion of internal channel (VrefInt, temperature sensor, ...), a sampling time minimum value is required. Refer to device datasheet.

Reference Manual to LL API cross reference:

- SMPR0 SMP31 LL_ADC_SetChannelSamplingTime
- SMPR0 SMP30 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP29 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP28 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP27 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP26 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP25 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP24 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP23 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP22 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP21 LL_ADC_SetChannelSamplingTime
- SMPR1 SMP20 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP19 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP18 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP17 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP16 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP15 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP14 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP13 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP12 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP11 LL_ADC_SetChannelSamplingTime
- SMPR2 SMP10 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP9 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP8 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP7 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP6 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP5 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP4 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP3 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP2 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP1 LL_ADC_SetChannelSamplingTime
- SMPR3 SMP0 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:
  (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_CHANNEL_0 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)
  - LL_ADC_CHANNEL_VCOMP (3)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)
- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4

and Cat.5

Return values

- **Returned:** value can be one of the following values:
  - LL_ADC_SAMPLINGTIME_4CYCLES
  - LL_ADC_SAMPLINGTIME_9CYCLES
  - LL_ADC_SAMPLINGTIME_16CYCLES
  - LL_ADC_SAMPLINGTIME_24CYCLES
  - LL_ADC_SAMPLINGTIME_48CYCLES
  - LL_ADC_SAMPLINGTIME_96CYCLES
  - LL_ADC_SAMPLINGTIME_192CYCLES
  - LL_ADC_SAMPLINGTIME_384CYCLES

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. Refer to reference manual for ADC processing time of this STM32 serie.

Reference Manual to LL API cross reference:

- SMPR0 SMP31 LL_ADC_GetChannelSamplingTime
- SMPR0 SMP30 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP29 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP28 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP27 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP26 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP25 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP24 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP23 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP22 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP21 LL_ADC_GetChannelSamplingTime
- SMPR1 SMP20 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP19 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP18 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP17 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP16 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP15 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP14 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP13 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP12 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP11 LL_ADC_GetChannelSamplingTime
- SMPR2 SMP10 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP9 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP8 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP7 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP6 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP5 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP4 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP3 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP2 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP1 LL_ADC_GetChannelSamplingTime
- SMPR3 SMP0 LL_ADC_GetChannelSamplingTime

LL_ADC_SetChannelRouting

Function name
__STATIC_INLINE void LL_ADC_SetChannelRouting (ADC_TypeDef * ADCx, uint32_t Channel, uint32_t Routing)

Function description
Set ADC channels routing.

Parameters
- **ADCx:** ADC instance
- **Channel:** This parameter can be one of the following values: (1) Used as ADC direct channel (fast channel) if OPAMP1 is in power down mode.
  - LL_ADC_CHANNEL_3_ROUTING (1)
  - LL_ADC_CHANNEL_8_ROUTING (2)
  - LL_ADC_CHANNEL_13_ROUTING (3)
- (2) Used as ADC direct channel (fast channel) if OPAMP2 is in power down mode.
- (3) Used as ADC re-routed channel if OPAMP3 is in power down mode. Otherwise, channel 13 is connected to OPAMP3 output and routed through switches COMP1_SW1 and VCOMP to ADC switch matrix. (Note: OPAMP3 is available on STM32L1 Cat.4 only).
- **Routing:** This parameter can be one of the following values:
  - LL_ADC_CHANNEL_ROUTING_DEFAULT
  - LL_ADC_CHANNEL_ROUTING_DIRECT

Notes
- Channel routing set configuration between ADC IP and GPIO pads, it is used to increase ADC channels speed (setting of direct channel).
- This feature is specific to STM32L1, on devices category Cat.3, Cat.4, Cat.5. To use this function, COMP RCC clock domain must be enabled. Refer to LL_APB1_GRP1_PERIPH_COMP.

Reference Manual to LL API cross reference:
- CSR FCH3 LL_ADC_SetChannelRouting
- CSR FCH8 LL_ADC_SetChannelRouting
- CSR RCH13 LL_ADC_SetChannelRouting

LL_ADC_GetChannelRouting

Function name
__STATIC_INLINE uint32_t LL_ADC_GetChannelRouting (ADC_TypeDef * ADCx, uint32_t Channel)

Function description
Get ADC channels speed.

Parameters
- **ADCx:** ADC instance
- **Channel:** This parameter can be one of the following values: (1) Used as ADC direct channel (fast channel) if OPAMP1 is in power down mode.
  - LL_ADC_CHANNEL_3_ROUTING (1)
  - LL_ADC_CHANNEL_8_ROUTING (2)
  - LL_ADC_CHANNEL_13_ROUTING (3)
- (2) Used as ADC direct channel (fast channel) if OPAMP2 is in power down mode.
- (3) Used as ADC re-routed channel if OPAMP3 is in power down mode. Otherwise, channel 13 is connected to OPAMP3 output and routed through switches COMP1_SW1 and VCOMP to ADC switch matrix. (Note: OPAMP3 is available

on STM32L1 Cat.4 only).

Return values
- **Returned:** value can be one of the following values:
  - LL_ADC_CHANNEL_ROUTING_DEFAULT
  - LL_ADC_CHANNEL_ROUTING_DIRECT

Notes
- Channel routing set configuration between ADC IP and GPIO pads, it is used to increase ADC channels speed (setting of direct channel).
- This feature is specific to STM32L1, on devices category Cat.3, Cat.4, Cat.5. To use this function, COMP RCC clock domain must be enabled. Refer to LL_APB1_GRP1_PERIPH_COMP.

Reference Manual to LL API cross reference:
- CSR FCH3 LL_ADC_GetChannelRouting
- CSR FCH8 LL_ADC_GetChannelRouting
- CSR RCH13 LL_ADC_GetChannelRouting

LL_ADC_SetAnalogWDMonitChannels

Function name **__STATIC_INLINE void LL_ADC_SetAnalogWDMonitChannels (ADC_TypeDef * ADCx, uint32_t AWDChannelGroup)**

Function description Set ADC analog watchdog monitored channels: a single channel or all channels, on ADC groups regular and-or injected.

Parameters
- **ADCx:** ADC instance
- **AWDChannelGroup:** This parameter can be one of the following values: (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_AWD_DISABLE
  - LL_ADC_AWD_ALL_CHANNELS_REG
  - LL_ADC_AWD_ALL_CHANNELS_INJ
  - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
  - LL_ADC_AWD_CHANNEL_0_REG (2)
  - LL_ADC_AWD_CHANNEL_0_INJ (2)
  - LL_ADC_AWD_CHANNEL_0_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_1_REG (2)
  - LL_ADC_AWD_CHANNEL_1_INJ (2)
  - LL_ADC_AWD_CHANNEL_1_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_2_REG (2)
  - LL_ADC_AWD_CHANNEL_2_INJ (2)
  - LL_ADC_AWD_CHANNEL_2_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_3_REG (2)
  - LL_ADC_AWD_CHANNEL_3_INJ (2)
  - LL_ADC_AWD_CHANNEL_3_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_4_REG (1)
  - LL_ADC_AWD_CHANNEL_4_INJ (1)
  - LL_ADC_AWD_CHANNEL_4_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_5_REG (1)
  - LL_ADC_AWD_CHANNEL_5_INJ (1)
  - LL_ADC_AWD_CHANNEL_5_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_6_REG (2)
  - LL_ADC_AWD_CHANNEL_6_INJ (2)
  - LL_ADC_AWD_CHANNEL_6_REG_INJ (2)

- LL_ADC_AWD_CHANNEL_7_REG (2)
- LL_ADC_AWD_CHANNEL_7_INJ (2)
- LL_ADC_AWD_CHANNEL_7_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_8_REG (2)
- LL_ADC_AWD_CHANNEL_8_INJ (2)
- LL_ADC_AWD_CHANNEL_8_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_9_REG (2)
- LL_ADC_AWD_CHANNEL_9_INJ (2)
- LL_ADC_AWD_CHANNEL_9_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_10_REG (2)
- LL_ADC_AWD_CHANNEL_10_INJ (2)
- LL_ADC_AWD_CHANNEL_10_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_11_REG (2)
- LL_ADC_AWD_CHANNEL_11_INJ (2)
- LL_ADC_AWD_CHANNEL_11_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_12_REG (2)
- LL_ADC_AWD_CHANNEL_12_INJ (2)
- LL_ADC_AWD_CHANNEL_12_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_13_REG (3)
- LL_ADC_AWD_CHANNEL_13_INJ (3)
- LL_ADC_AWD_CHANNEL_13_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_14_REG (3)
- LL_ADC_AWD_CHANNEL_14_INJ (3)
- LL_ADC_AWD_CHANNEL_14_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_15_REG (3)
- LL_ADC_AWD_CHANNEL_15_INJ (3)
- LL_ADC_AWD_CHANNEL_15_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_16_REG (3)
- LL_ADC_AWD_CHANNEL_16_INJ (3)
- LL_ADC_AWD_CHANNEL_16_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_17_REG (3)
- LL_ADC_AWD_CHANNEL_17_INJ (3)
- LL_ADC_AWD_CHANNEL_17_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_18_REG (3)
- LL_ADC_AWD_CHANNEL_18_INJ (3)
- LL_ADC_AWD_CHANNEL_18_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_19_REG (3)
- LL_ADC_AWD_CHANNEL_19_INJ (3)
- LL_ADC_AWD_CHANNEL_19_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_20_REG (3)
- LL_ADC_AWD_CHANNEL_20_INJ (3)
- LL_ADC_AWD_CHANNEL_20_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_21_REG (3)
- LL_ADC_AWD_CHANNEL_21_INJ (3)
- LL_ADC_AWD_CHANNEL_21_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_22_REG (1)
- LL_ADC_AWD_CHANNEL_22_INJ (1)
- LL_ADC_AWD_CHANNEL_22_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_23_REG (1)
- LL_ADC_AWD_CHANNEL_23_INJ (1)
- LL_ADC_AWD_CHANNEL_23_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_24_REG (1)

  - LL_ADC_AWD_CHANNEL_24_INJ (1)
  - LL_ADC_AWD_CHANNEL_24_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_25_REG (1)
  - LL_ADC_AWD_CHANNEL_25_INJ (1)
  - LL_ADC_AWD_CHANNEL_25_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_26_REG (3)
  - LL_ADC_AWD_CHANNEL_26_INJ (3)
  - LL_ADC_AWD_CHANNEL_26_REG_INJ (3)
  - LL_ADC_AWD_CHANNEL_27_REG (3)(4)
  - LL_ADC_AWD_CHANNEL_27_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_27_REG_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_28_REG (3)(4)
  - LL_ADC_AWD_CHANNEL_28_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_28_REG_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_29_REG (3)(4)
  - LL_ADC_AWD_CHANNEL_29_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_29_REG_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_30_REG (3)(4)
  - LL_ADC_AWD_CHANNEL_30_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_30_REG_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_31_REG (3)(4)
  - LL_ADC_AWD_CHANNEL_31_INJ (3)(4)
  - LL_ADC_AWD_CHANNEL_31_REG_INJ (3)(4)
  - LL_ADC_AWD_CH_VREFINT_REG (3)
  - LL_ADC_AWD_CH_VREFINT_INJ (3)
  - LL_ADC_AWD_CH_VREFINT_REG_INJ (3)
  - LL_ADC_AWD_CH_TEMPSENSOR_REG (3)
  - LL_ADC_AWD_CH_TEMPSENSOR_INJ (3)
  - LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ (3)
  - LL_ADC_AWD_CH_VCOMP_REG (3)
  - LL_ADC_AWD_CH_VCOMP_INJ (3)
  - LL_ADC_AWD_CH_VCOMP_REG_INJ (3)
  - LL_ADC_AWD_CH_VOPAMP1_REG (3)(5)
  - LL_ADC_AWD_CH_VOPAMP1_INJ (3)(5)
  - LL_ADC_AWD_CH_VOPAMP1_REG_INJ (3)(5)
  - LL_ADC_AWD_CH_VOPAMP2_REG (3)(5)
  - LL_ADC_AWD_CH_VOPAMP2_INJ (3)(5)
  - LL_ADC_AWD_CH_VOPAMP2_REG_INJ (3)(5)
  - LL_ADC_AWD_CH_VOPAMP3_REG (3)(5)
  - LL_ADC_AWD_CH_VOPAMP3_INJ (3)(5)
  - LL_ADC_AWD_CH_VOPAMP3_REG_INJ (3)(5)

- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
- (5) On STM32L1, parameter not available on all devices: OPAMP1 and OPAMP2 available only on STM32L1 Cat.3, Cat.4 and Cat.5, OPAMP3 available only on STM32L1 Cat.4 and Cat.5

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 is only 1 kind 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).

Reference Manual to LL API cross reference:
- CR1 AWD1CH LL_ADC_SetAnalogWDMonitChannels
- CR1 AWD1SGL LL_ADC_SetAnalogWDMonitChannels
- CR1 AWD1EN LL_ADC_SetAnalogWDMonitChannels

LL_ADC_GetAnalogWDMonitChannels

Function name **__STATIC_INLINE uint32_t LL_ADC_GetAnalogWDMonitChannels (ADC_TypeDef * ADCx)**

Function description Get ADC analog watchdog monitored channel.

Parameters
- **ADCx:** ADC instance

Return values
- **Returned:** value can be one of the following values: (1) On STM32L1, connection via routing interface (RI) specificity: fast channel (channel routed directly to ADC switch matrix).
  - LL_ADC_AWD_DISABLE
  - LL_ADC_AWD_ALL_CHANNELS_REG
  - LL_ADC_AWD_ALL_CHANNELS_INJ
  - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
  - LL_ADC_AWD_CHANNEL_0_REG (2)
  - LL_ADC_AWD_CHANNEL_0_INJ (2)
  - LL_ADC_AWD_CHANNEL_0_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_1_REG (2)
  - LL_ADC_AWD_CHANNEL_1_INJ (2)
  - LL_ADC_AWD_CHANNEL_1_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_2_REG (2)
  - LL_ADC_AWD_CHANNEL_2_INJ (2)
  - LL_ADC_AWD_CHANNEL_2_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_3_REG (2)
  - LL_ADC_AWD_CHANNEL_3_INJ (2)
  - LL_ADC_AWD_CHANNEL_3_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_4_REG (1)
  - LL_ADC_AWD_CHANNEL_4_INJ (1)
  - LL_ADC_AWD_CHANNEL_4_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_5_REG (1)
  - LL_ADC_AWD_CHANNEL_5_INJ (1)
  - LL_ADC_AWD_CHANNEL_5_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_6_REG (2)
  - LL_ADC_AWD_CHANNEL_6_INJ (2)
  - LL_ADC_AWD_CHANNEL_6_REG_INJ (2)

- LL_ADC_AWD_CHANNEL_7_REG (2)
- LL_ADC_AWD_CHANNEL_7_INJ (2)
- LL_ADC_AWD_CHANNEL_7_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_8_REG (2)
- LL_ADC_AWD_CHANNEL_8_INJ (2)
- LL_ADC_AWD_CHANNEL_8_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_9_REG (2)
- LL_ADC_AWD_CHANNEL_9_INJ (2)
- LL_ADC_AWD_CHANNEL_9_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_10_REG (2)
- LL_ADC_AWD_CHANNEL_10_INJ (2)
- LL_ADC_AWD_CHANNEL_10_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_11_REG (2)
- LL_ADC_AWD_CHANNEL_11_INJ (2)
- LL_ADC_AWD_CHANNEL_11_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_12_REG (2)
- LL_ADC_AWD_CHANNEL_12_INJ (2)
- LL_ADC_AWD_CHANNEL_12_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_13_REG (3)
- LL_ADC_AWD_CHANNEL_13_INJ (3)
- LL_ADC_AWD_CHANNEL_13_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_14_REG (3)
- LL_ADC_AWD_CHANNEL_14_INJ (3)
- LL_ADC_AWD_CHANNEL_14_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_15_REG (3)
- LL_ADC_AWD_CHANNEL_15_INJ (3)
- LL_ADC_AWD_CHANNEL_15_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_16_REG (3)
- LL_ADC_AWD_CHANNEL_16_INJ (3)
- LL_ADC_AWD_CHANNEL_16_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_17_REG (3)
- LL_ADC_AWD_CHANNEL_17_INJ (3)
- LL_ADC_AWD_CHANNEL_17_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_18_REG (3)
- LL_ADC_AWD_CHANNEL_18_INJ (3)
- LL_ADC_AWD_CHANNEL_18_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_19_REG (3)
- LL_ADC_AWD_CHANNEL_19_INJ (3)
- LL_ADC_AWD_CHANNEL_19_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_20_REG (3)
- LL_ADC_AWD_CHANNEL_20_INJ (3)
- LL_ADC_AWD_CHANNEL_20_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_21_REG (3)
- LL_ADC_AWD_CHANNEL_21_INJ (3)
- LL_ADC_AWD_CHANNEL_21_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_22_REG (1)
- LL_ADC_AWD_CHANNEL_22_INJ (1)
- LL_ADC_AWD_CHANNEL_22_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_23_REG (1)
- LL_ADC_AWD_CHANNEL_23_INJ (1)
- LL_ADC_AWD_CHANNEL_23_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_24_REG (1)

- LL_ADC_AWD_CHANNEL_24_INJ (1)
- LL_ADC_AWD_CHANNEL_24_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_25_REG (1)
- LL_ADC_AWD_CHANNEL_25_INJ (1)
- LL_ADC_AWD_CHANNEL_25_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_26_REG (3)
- LL_ADC_AWD_CHANNEL_26_INJ (3)
- LL_ADC_AWD_CHANNEL_26_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_27_REG (3)(4)
- LL_ADC_AWD_CHANNEL_27_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_27_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_28_REG (3)(4)
- LL_ADC_AWD_CHANNEL_28_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_28_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_29_REG (3)(4)
- LL_ADC_AWD_CHANNEL_29_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_29_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_30_REG (3)(4)
- LL_ADC_AWD_CHANNEL_30_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_30_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_31_REG (3)(4)
- LL_ADC_AWD_CHANNEL_31_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_31_REG_INJ (3)(4)

- (2) On STM32L1, for devices with feature 'channels banks' available: Channel different in bank A and bank B.
- (3) On STM32L1, for devices with feature 'channels banks' available: Channel common to both bank A and bank B.
- (4) On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.

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 is only 1 kind 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).

Reference Manual to LL API cross reference:

- CR1 AWD1CH LL_ADC_GetAnalogWDMonitChannels
- CR1 AWD1SGL LL_ADC_GetAnalogWDMonitChannels
- CR1 AWD1EN LL_ADC_GetAnalogWDMonitChannels

LL_ADC_SetAnalogWDThresholds

Function name	**__STATIC_INLINE void LL_ADC_SetAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDThresholdsHighLow, uint32_t AWDThresholdValue)**
Function description	Set ADC analog watchdog threshold value of threshold high or low.
Parameters	• **ADCx:** ADC instance • **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	• 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 is only 1 kind 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).
Reference Manual to LL API cross reference:	• HTR HT LL_ADC_SetAnalogWDThresholds • LTR LT LL_ADC_SetAnalogWDThresholds

LL_ADC_GetAnalogWDThresholds

Function name	**__STATIC_INLINE uint32_t LL_ADC_GetAnalogWDThresholds (ADC_TypeDef * ADCx, uint32_t AWDThresholdsHighLow)**
Function description	Get ADC analog watchdog threshold value of threshold high or threshold low.
Parameters	• **ADCx:** ADC instance • **AWDThresholdsHighLow:** This parameter can be one of the following values: – LL_ADC_AWD_THRESHOLD_HIGH – LL_ADC_AWD_THRESHOLD_LOW
Return values	• **Value:** between Min_Data=0x000 and Max_Data=0xFFF
Notes	• 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	• HTR HT LL_ADC_GetAnalogWDThresholds • LTR LT LL_ADC_GetAnalogWDThresholds

reference:

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. • Due to the latency introduced by the synchronization between two clock domains (ADC clock source asynchronous), some hardware constraints must be respected: ADC must be enabled (LL_ADC_Enable()) only when ADC is not ready to convert.ADC must be disabled (LL_ADC_Disable()) only when ADC is ready to convert. Status of ADC ready to convert can be checked using function LL_ADC_IsActiveFlag_ADRDY().
Reference Manual to LL API cross reference:	• CR2 ADON 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	• Due to the latency introduced by the synchronization between two clock domains (ADC clock source asynchronous), some hardware constraints must be respected: ADC must be enabled (LL_ADC_Enable()) only when ADC is not ready to convert.ADC must be disabled (LL_ADC_Disable()) only when ADC is ready to convert. Status of ADC ready to convert can be checked using function LL_ADC_IsActiveFlag_ADRDY().
Reference Manual to LL API cross reference:	• CR2 ADON 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.
Reference Manual to LL API cross reference:	• CR2 ADON LL_ADC_IsEnabled

LL_ADC_REG_StartConversionSWStart

Function name	**__STATIC_INLINE void LL_ADC_REG_StartConversionSWStart (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 only for internal trigger (SW start), not for 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 start must be performed using function LL_ADC_REG_StartConversionExtTrig(). (if external trigger edge would have been set during ADC other settings, ADC conversion would start at trigger event as soon as ADC is enabled).
Reference Manual to LL API cross reference:	• CR2 SWSTART LL_ADC_REG_StartConversionSWStart

LL_ADC_REG_StartConversionExtTrig

Function name	**__STATIC_INLINE void LL_ADC_REG_StartConversionExtTrig (ADC_TypeDef * ADCx, uint32_t ExternalTriggerEdge)**
Function description	Start ADC group regular conversion from external trigger.
Parameters	• **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 • **ADCx:** ADC instance
Return values	• **None:**
Notes	• ADC conversion will start at next trigger event (on the selected trigger edge) following the ADC start conversion command. • On this STM32 serie, this function is relevant for ADC conversion start from external trigger. If internal trigger (SW start) is needed, perform ADC conversion start using function LL_ADC_REG_StartConversionSWStart().

Reference Manual to LL API cross reference:	• CR2 EXTEN LL_ADC_REG_StartConversionExtTrig

LL_ADC_REG_StopConversionExtTrig

Function name	**__STATIC_INLINE void LL_ADC_REG_StopConversionExtTrig (ADC_TypeDef * ADCx)**
Function description	Stop ADC group regular conversion from external trigger.
Parameters	• **ADCx:** ADC instance
Return values	• **None:**
Notes	• No more ADC conversion will start at next trigger event following the ADC stop conversion command. If a conversion is on-going, it will be completed. • On this STM32 serie, there is no specific command to stop a conversion on-going or to stop ADC converting in continuous mode. These actions can be performed using function LL_ADC_Disable().
Reference Manual to LL API cross reference:	• CR2 EXTEN LL_ADC_REG_StopConversionExtTrig

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_StartConversionSWStart

Function name: **__STATIC_INLINE void LL_ADC_INJ_StartConversionSWStart (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 only for internal trigger (SW start), not for 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 start must be performed using function LL_ADC_INJ_StartConversionExtTrig(). (if external trigger edge would have been set during ADC other settings, ADC conversion would start at trigger event as soon as ADC is enabled).

Reference Manual to LL API cross reference:
- CR2 JSWSTART LL_ADC_INJ_StartConversionSWStart

LL_ADC_INJ_StartConversionExtTrig

Function name: **__STATIC_INLINE void LL_ADC_INJ_StartConversionExtTrig (ADC_TypeDef * ADCx, uint32_t ExternalTriggerEdge)**

Function description: Start ADC group injected conversion from external trigger.

Parameters:
- **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
- **ADCx:** ADC instance

Return values:
- **None:**

Notes:
- ADC conversion will start at next trigger event (on the selected trigger edge) following the ADC start conversion command.
- On this STM32 serie, this function is relevant for ADC conversion start from external trigger. If internal trigger (SW start) is needed, perform ADC conversion start using function LL_ADC_INJ_StartConversionSWStart().

Reference Manual to LL API cross reference:
- CR2 JEXTEN LL_ADC_INJ_StartConversionExtTrig

LL_ADC_INJ_StopConversionExtTrig

Function name	**__STATIC_INLINE void LL_ADC_INJ_StopConversionExtTrig (ADC_TypeDef * ADCx)**
Function description	Stop ADC group injected conversion from external trigger.
Parameters	• **ADCx:** ADC instance
Return values	• **None:**
Notes	• No more ADC conversion will start at next trigger event following the ADC stop conversion command. If a conversion is on-going, it will be completed. • On this STM32 serie, there is no specific command to stop a conversion on-going or to stop ADC converting in continuous mode. These actions can be performed using function LL_ADC_Disable().
Reference Manual to LL API cross reference:	• CR2 JEXTEN LL_ADC_INJ_StopConversionExtTrig

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 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 • **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).

Reference Manual to LL API cross reference:
- SR ADONS LL_ADC_IsActiveFlag_ADRDY

LL_ADC_IsActiveFlag_EOCS

Function name
__STATIC_INLINE uint32_t LL_ADC_IsActiveFlag_EOCS (ADC_TypeDef * ADCx)

Function description
Get flag ADC group regular end of unitary conversion or end of

sequence conversions, depending on ADC configuration.

Parameters	• **ADCx:** ADC instance
Return values	• **State:** of bit (1 or 0).
Notes	• To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross reference:	• SR EOC LL_ADC_IsActiveFlag_EOCS

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:	• SR OVR LL_ADC_IsActiveFlag_OVR

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:	• SR JEOC LL_ADC_IsActiveFlag_JEOS

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:	• SR AWD LL_ADC_IsActiveFlag_AWD1

LL_ADC_ClearFlag_EOCS

Function name	**__STATIC_INLINE void LL_ADC_ClearFlag_EOCS**

(ADC_TypeDef * ADCx)

Function description	Clear flag ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	• **ADCx:** ADC instance
Return values	• **None:**
Notes	• To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross reference:	• SR EOC LL_ADC_ClearFlag_EOCS

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:	• SR OVR LL_ADC_ClearFlag_OVR

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:	• SR JEOC LL_ADC_ClearFlag_JEOS

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:	• SR AWD LL_ADC_ClearFlag_AWD1

LL_ADC_EnableIT_EOCS

Function name	**__STATIC_INLINE void LL_ADC_EnableIT_EOCS (ADC_TypeDef * ADCx)**
Function description	Enable interruption ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	• **ADCx:** ADC instance
Return values	• **None:**
Notes	• To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross reference:	• CR1 EOCIE LL_ADC_EnableIT_EOCS

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:	• CR1 OVRIE LL_ADC_EnableIT_OVR

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:	• CR1 JEOCIE LL_ADC_EnableIT_JEOS

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	• CR1 AWDIE LL_ADC_EnableIT_AWD1

reference:

LL_ADC_DisableIT_EOCS

Function name	**__STATIC_INLINE void LL_ADC_DisableIT_EOCS (ADC_TypeDef * ADCx)**
Function description	Disable interruption ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	• **ADCx:** ADC instance
Return values	• **None:**
Notes	• To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion().
Reference Manual to LL API cross reference:	• CR1 EOCIE LL_ADC_DisableIT_EOCS

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:	• CR1 OVRIE LL_ADC_DisableIT_OVR

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:	• CR1 JEOCIE LL_ADC_EnableIT_JEOS

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:	• CR1 AWDIE LL_ADC_EnableIT_AWD1

LL_ADC_IsEnabledIT_EOCS

Function name	**__STATIC_INLINE uint32_t LL_ADC_IsEnabledIT_EOCS (ADC_TypeDef * ADCx)**
Function description	Get state of interruption ADC group regular end of unitary conversion or end of sequence conversions, depending on ADC configuration.
Parameters	• **ADCx:** ADC instance
Return values	• **State:** of bit (1 or 0).
Notes	• To configure flag of end of conversion, use function LL_ADC_REG_SetFlagEndOfConversion(). (0: interrupt disabled, 1: interrupt enabled)
Reference Manual to LL API cross reference:	• CR1 EOCIE LL_ADC_IsEnabledIT_EOCS

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:	• CR1 OVRIE LL_ADC_IsEnabledIT_OVR

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:	• CR1 JEOCIE LL_ADC_EnableIT_JEOS

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:	• CR1 AWDIE LL_ADC_EnableIT_AWD1

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

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().

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:**

48.3 ADC Firmware driver defines

48.3.1 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_CHANNEL_19_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN19, converted by group regular only
LL_ADC_AWD_CHANNEL_19_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN19, converted by group injected only
LL_ADC_AWD_CHANNEL_19_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN19, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_20_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN20, converted by group regular only
LL_ADC_AWD_CHANNEL_20_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN20, converted by group injected only
LL_ADC_AWD_CHANNEL_20_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN20, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_21_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN21,

	converted by group regular only
LL_ADC_AWD_CHANNEL_21_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN21, converted by group injected only
LL_ADC_AWD_CHANNEL_21_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN21, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_22_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN22, converted by group regular only
LL_ADC_AWD_CHANNEL_22_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN22, converted by group injected only
LL_ADC_AWD_CHANNEL_22_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN22, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_23_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN23, converted by group regular only
LL_ADC_AWD_CHANNEL_23_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN23, converted by group injected only
LL_ADC_AWD_CHANNEL_23_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN23, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_24_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN24, converted by group regular only
LL_ADC_AWD_CHANNEL_24_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN24, converted by group injected only
LL_ADC_AWD_CHANNEL_24_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN24, converted by either group regular or injected

LL_ADC_AWD_CHANNEL_25_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN25, converted by group regular only
LL_ADC_AWD_CHANNEL_25_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN25, converted by group injected only
LL_ADC_AWD_CHANNEL_25_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN25, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_26_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN26, converted by group regular only
LL_ADC_AWD_CHANNEL_26_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN26, converted by group injected only
LL_ADC_AWD_CHANNEL_26_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN26, converted by either group regular or injected
LL_ADC_AWD_CHANNEL_27_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN27, converted by group regular only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_27_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN27, converted by group injected only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_27_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN27, converted by either group regular or injected. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_28_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN28, converted by group regular only. On

	STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_28_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN28, converted by group injected only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_28_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN28, converted by either group regular or injected. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_29_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN29, converted by group regular only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_29_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN29, converted by group injected only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_29_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN29, converted by either group regular or injected. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_30_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN30, converted by group regular only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_30_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN30, converted by group injected only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and

	Cat.5.
LL_ADC_AWD_CHANNEL_30_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN30, converted by either group regular or injected. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_31_REG	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN31, converted by group regular only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_31_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN31, converted by group injected only. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_AWD_CHANNEL_31_REG_INJ	ADC analog watchdog monitoring of ADC external channel (channel connected to GPIO pin) ADCx_IN31, converted by either group regular or injected. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
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. Channel common to both bank A and bank B.
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. Channel common to both bank A and bank B.
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. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_TEMPSENSOR_REG	ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by group regular only. Channel common to both

	bank A and bank B.
LL_ADC_AWD_CH_TEMPSENSOR_INJ	ADC analog watchdog monitoring of ADC internal channel connected to Temperature sensor, converted by group injected only. Channel common to both bank A and bank B.
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. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VCOMP_REG	ADC analog watchdog monitoring of ADC internal channel connected to comparator COMP1 positive input via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VCOMP_INJ	ADC analog watchdog monitoring of ADC internal channel connected to comparator COMP1 positive input via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VCOMP_REG_INJ	ADC analog watchdog monitoring of ADC internal channel connected to comparator COMP1 positive input via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP1_REG	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP1 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP1_INJ	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP1 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP1_REG_INJ	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP1 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP2_REG	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP2 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP2_INJ	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP2 output via ADC switch matrix. Channel common to both bank A and

	bank B.
LL_ADC_AWD_CH_VOPAMP2_REG_INJ	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP2 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP3_REG	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP3 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP3_INJ	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP3 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_AWD_CH_VOPAMP3_REG_INJ	ADC analog watchdog monitoring of ADC internal channel connected to OPAMP3 output via ADC switch matrix. Channel common to both bank A and bank B.

Analog watchdog - Analog watchdog number

LL_ADC_AWD1	ADC analog watchdog number 1

Analog watchdog - Thresholds

LL_ADC_AWD_THRESHOLD_HIGH	ADC analog watchdog threshold high
LL_ADC_AWD_THRESHOLD_LOW	ADC analog watchdog threshold low

ADC instance - Channel number

LL_ADC_CHANNEL_0	ADC external channel (channel connected to GPIO pin) ADCx_IN0 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_1	ADC external channel (channel connected to GPIO pin) ADCx_IN1 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_2	ADC external channel (channel connected to GPIO pin) ADCx_IN2 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_3	ADC external channel (channel connected to GPIO pin) ADCx_IN3 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_4	ADC external channel (channel connected to GPIO pin) ADCx_IN4 . Direct (fast) channel.
LL_ADC_CHANNEL_5	ADC external channel (channel connected to GPIO pin) ADCx_IN5 . Direct (fast) channel.
LL_ADC_CHANNEL_6	ADC external channel (channel connected to GPIO pin) ADCx_IN6 . Channel different in bank A and bank B.

LL_ADC_CHANNEL_7	ADC external channel (channel connected to GPIO pin) ADCx_IN7 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_8	ADC external channel (channel connected to GPIO pin) ADCx_IN8 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_9	ADC external channel (channel connected to GPIO pin) ADCx_IN9 . Channel different in bank A and bank B.
LL_ADC_CHANNEL_10	ADC external channel (channel connected to GPIO pin) ADCx_IN10. Channel different in bank A and bank B.
LL_ADC_CHANNEL_11	ADC external channel (channel connected to GPIO pin) ADCx_IN11. Channel different in bank A and bank B.
LL_ADC_CHANNEL_12	ADC external channel (channel connected to GPIO pin) ADCx_IN12. Channel different in bank A and bank B.
LL_ADC_CHANNEL_13	ADC external channel (channel connected to GPIO pin) ADCx_IN13. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_14	ADC external channel (channel connected to GPIO pin) ADCx_IN14. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_15	ADC external channel (channel connected to GPIO pin) ADCx_IN15. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_16	ADC external channel (channel connected to GPIO pin) ADCx_IN16. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_17	ADC external channel (channel connected to GPIO pin) ADCx_IN17. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_18	ADC external channel (channel connected to GPIO pin) ADCx_IN18. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_19	ADC external channel (channel connected to GPIO pin) ADCx_IN19. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_20	ADC external channel (channel connected to GPIO pin) ADCx_IN20. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_21	ADC external channel (channel connected to GPIO pin) ADCx_IN21. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_22	ADC external channel (channel connected to GPIO pin) ADCx_IN22. Direct (fast) channel.

LL_ADC_CHANNEL_23	ADC external channel (channel connected to GPIO pin) ADCx_IN23. Direct (fast) channel.
LL_ADC_CHANNEL_24	ADC external channel (channel connected to GPIO pin) ADCx_IN24. Direct (fast) channel.
LL_ADC_CHANNEL_25	ADC external channel (channel connected to GPIO pin) ADCx_IN25. Direct (fast) channel.
LL_ADC_CHANNEL_26	ADC external channel (channel connected to GPIO pin) ADCx_IN26. Direct (fast) channel.
LL_ADC_CHANNEL_27	ADC external channel (channel connected to GPIO pin) ADCx_IN27. Channel common to both bank A and bank B. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_CHANNEL_28	ADC external channel (channel connected to GPIO pin) ADCx_IN28. Channel common to both bank A and bank B. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_CHANNEL_29	ADC external channel (channel connected to GPIO pin) ADCx_IN29. Channel common to both bank A and bank B. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_CHANNEL_30	ADC external channel (channel connected to GPIO pin) ADCx_IN30. Channel common to both bank A and bank B. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_CHANNEL_31	ADC external channel (channel connected to GPIO pin) ADCx_IN31. Channel common to both bank A and bank B. On STM32L1, parameter not available on all devices: only on STM32L1 Cat.4 and Cat.5.
LL_ADC_CHANNEL_VREFINT	ADC internal channel connected to VrefInt: Internal voltage reference. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_TEMPSENSOR	ADC internal channel connected to Temperature sensor. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_VCOMP	ADC internal channel connected to comparator COMP1 positive input via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_VOPAMP1	ADC internal channel connected to OPAMP1 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_VOPAMP2	ADC internal channel connected to OPAMP2 output via ADC switch matrix. Channel common to both bank A and bank B.
LL_ADC_CHANNEL_VOPAMP3	ADC internal channel connected to OPAMP3 output via ADC switch matrix. Channel common to both bank A and bank B.

ADC instance - Channels bank

LL_ADC_CHANNELS_BANK_A	ADC channels bank A
LL_ADC_CHANNELS_BANK_B	ADC channels bank B, available in devices categories 3, 4, 5.

Channel - Routing channels list

LL_ADC_CHANNEL_3_ROUTING	ADC channel 3 routing. Used as ADC direct channel (fast channel) if OPAMP1 is in power down mode.
LL_ADC_CHANNEL_8_ROUTING	ADC channel 8 routing. Used as ADC direct channel (fast channel) if OPAMP2 is in power down mode.
LL_ADC_CHANNEL_13_ROUTING	ADC channel 13 routing. Used as ADC re-routed channel if OPAMP3 is in power down mode. Otherwise, channel 13 is connected to OPAMP3 output and routed through switches COMP1_SW1 and VCOMP to ADC switch matrix. (Note: OPAMP3 is available on STM32L1 Cat.4 only).

Channel - Routing selection

LL_ADC_CHANNEL_ROUTING_DEFAULT	ADC channel routing default: slow channel
LL_ADC_CHANNEL_ROUTING_DIRECT	ADC channel routing direct: fast channel.

Channel - Sampling time

LL_ADC_SAMPLINGTIME_4CYCLES	Sampling time 4 ADC clock cycles
LL_ADC_SAMPLINGTIME_9CYCLES	Sampling time 9 ADC clock cycles
LL_ADC_SAMPLINGTIME_16CYCLES	Sampling time 16 ADC clock cycles
LL_ADC_SAMPLINGTIME_24CYCLES	Sampling time 24 ADC clock cycles
LL_ADC_SAMPLINGTIME_48CYCLES	Sampling time 48 ADC clock cycles
LL_ADC_SAMPLINGTIME_96CYCLES	Sampling time 96 ADC clock cycles
LL_ADC_SAMPLINGTIME_192CYCLES	Sampling time 192 ADC clock cycles
LL_ADC_SAMPLINGTIME_384CYCLES	Sampling time 384 ADC clock cycles

ADC common - Clock source

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

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

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_STRT	ADC flag ADC group regular conversion start
LL_ADC_FLAG_EOCS	ADC flag ADC group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function
LL_ADC_FLAG_OVR	ADC flag ADC group regular overrun
LL_ADC_FLAG_JSTRT	ADC flag ADC group injected conversion start
LL_ADC_FLAG_JEOS	ADC flag ADC group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_FLAG_AWD1	ADC flag ADC analog watchdog 1

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_VREFINT_STAB_US	Delay for internal voltage reference stabilization time
LL_ADC_DELAY_TEMPSENSOR_STAB_US	Delay for internal voltage reference stabilization time

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.
LL_ADC_INJ_TRIG_EXT_TIM9_CH1	ADC group injected conversion trigger from external IP: TIM9 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM9_TRGO	ADC group injected conversion trigger from external IP: TIM9 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM2_TRGO	ADC group injected conversion trigger from external IP: TIM2 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM2_CH1	ADC group injected conversion trigger from external IP: 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_CH4	ADC group injected conversion trigger from external IP: 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 IP: TIM4 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM4_CH1	ADC group injected conversion trigger from external IP: TIM4 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM4_CH2	ADC group injected conversion trigger from external IP: TIM4 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM4_CH3	ADC group injected conversion trigger from external IP: TIM4 channel 3 event (capture compare: input capture or output capture).

	Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM10_CH1	ADC group injected conversion trigger from external IP: TIM10 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_TIM7_TRGO	ADC group injected conversion trigger from external IP: TIM7 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_INJ_TRIG_EXT_EXTI_LINE15	ADC group injected conversion trigger from external IP: 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_EOCS	ADC interruption ADC group regular end of unitary conversion or sequence conversions (to configure flag of end of conversion, use function
LL_ADC_IT_OVR	ADC interruption ADC group regular overrun
LL_ADC_IT_JEOS	ADC interruption ADC group injected end of sequence conversions (Note: on this STM32 serie, there is no flag ADC group injected end of unitary conversion. Flag noted as "JEOC" is corresponding to flag "JEOS" in other STM32 families)
LL_ADC_IT_AWD1	ADC interruption ADC analog watchdog 1

ADC instance - Low power mode auto power-off

LL_ADC_LP_AUTOPOWEROFF_NONE	ADC low power mode auto power-off not activated
LL_ADC_LP_AUTOPOWEROFF_IDLE_PHASE	ADC low power mode auto power-off: ADC power off when ADC is not converting (idle phase)
LL_ADC_LP_AUTOPOWEROFF_AUTOWAIT_PHASE	ADC low power mode auto power-off: ADC power off when a delay is inserted between conversions (refer to

function

LL_ADC_LP_AUTOPOWEROFF_IDLE_AUTOWAIT_PHASES	ADC low power mode auto power-off: ADC power off when ADC is not converting (idle phase) and when a delay is inserted between conversions (refer to function

ADC instance - Low power mode auto wait (auto delay)

LL_ADC_LP_AUTOWAIT_NONE	ADC low power mode auto wait not activated
LL_ADC_LP_AUTOWAIT	ADC low power mode auto wait: Dynamic low power mode, ADC conversions are performed only when necessary (when previous ADC conversion data is read). See description with function
LL_ADC_LP_AUTOWAIT_7_APBCLOCKCYCLES	ADC low power mode auto wait: Insert a delay between ADC conversions: 7 APB clock cycles
LL_ADC_LP_AUTOWAIT_15_APBCLOCKCYCLES	ADC low power mode auto wait: Insert a delay between ADC conversions: 15 APB clock cycles
LL_ADC_LP_AUTOWAIT_31_APBCLOCKCYCLES	ADC low power mode auto wait: Insert a delay between ADC conversions: 31 APB clock cycles
LL_ADC_LP_AUTOWAIT_63_APBCLOCKCYCLES	ADC low power mode auto wait: Insert a delay between ADC conversions: 63 APB clock cycles
LL_ADC_LP_AUTOWAIT_127_APBCLOCKCYCLES	ADC low power mode auto wait: Insert a delay between ADC conversions: 127 APB clock cycles
LL_ADC_LP_AUTOWAIT_255_APBCLOCKCYCLES	ADC low power mode auto wait: Insert a delay between ADC conversions: 255 APB clock cycles

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 - 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 - Flag EOC selection (unitary or sequence conversions)

LL_ADC_REG_FLAG_EOC_SEQUENCE_CONV	ADC flag EOC (end of unitary conversion) selected
LL_ADC_REG_FLAG_EOC_UNITARY_CONV	ADC flag EOS (end of sequence conversions) selected

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
LL_ADC_REG_RANK_17	ADC group regular sequencer rank 17
LL_ADC_REG_RANK_18	ADC group regular sequencer rank 18
LL_ADC_REG_RANK_19	ADC group regular sequencer rank 19
LL_ADC_REG_RANK_20	ADC group regular sequencer rank 20
LL_ADC_REG_RANK_21	ADC group regular sequencer rank 21
LL_ADC_REG_RANK_22	ADC group regular sequencer rank 22
LL_ADC_REG_RANK_23	ADC group regular sequencer rank 23
LL_ADC_REG_RANK_24	ADC group regular sequencer rank 24
LL_ADC_REG_RANK_25	ADC group regular sequencer rank 25
LL_ADC_REG_RANK_26	ADC group regular sequencer rank 26
LL_ADC_REG_RANK_27	ADC group regular sequencer rank 27
LL_ADC_REG_RANK_28	ADC group regular sequencer rank 28

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_TIM2_TRGO	ADC group regular conversion trigger from external IP: TIM2 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM2_CH3	ADC group regular conversion trigger from external IP: TIM2 channel 3 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 IP: TIM3 TRGO. Trigger edge set to

	rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM2_CH2	ADC group regular conversion trigger from external IP: 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_CH1	ADC group regular conversion trigger from external IP: TIM3 channel 1 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM3_CH3	ADC group regular conversion trigger from external IP: TIM3 channel 3 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 IP: TIM4 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM4_CH4	ADC group regular conversion trigger from external IP: 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 IP: TIM6 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM9_CH2	ADC group regular conversion trigger from external IP: TIM9 channel 2 event (capture compare: input capture or output capture). Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_TIM9_TRGO	ADC group regular conversion trigger from external IP: TIM9 TRGO. Trigger edge set to rising edge (default setting).
LL_ADC_REG_TRIG_EXT_EXTI_LINE11	ADC group regular conversion trigger from external IP: 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 - Scan selection

LL_ADC_SEQ_SCAN_DISABLE	ADC conversion is performed in unitary conversion mode (one channel converted, that defined in rank 1). Configuration of both groups regular and injected

	sequencers (sequence length, ...) is discarded: equivalent to length of 1 rank.
LL_ADC_SEQ_SCAN_ENABLE	ADC conversions are performed in sequence conversions mode, according to configuration of both groups regular and injected sequencers (sequence length, ...).

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 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)
  - LL_ADC_CHANNEL_VCOMP (3)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)

- LL_ADC_CHANNEL_VOPAMP2 (3)(5)
- LL_ADC_CHANNEL_VOPAMP3 (3)(5)

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 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)

  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)(6)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)(6)
  - LL_ADC_CHANNEL_VCOMP (3)(6)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)

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 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)

- LL_ADC_CHANNEL_25 (1)
- LL_ADC_CHANNEL_26 (3)
- LL_ADC_CHANNEL_27 (3)(4)
- LL_ADC_CHANNEL_28 (3)(4)
- LL_ADC_CHANNEL_29 (3)(4)
- LL_ADC_CHANNEL_30 (3)(4)
- LL_ADC_CHANNEL_31 (3)(4)
- LL_ADC_CHANNEL_VREFINT (3)
- LL_ADC_CHANNEL_TEMPSENSOR (3)
- LL_ADC_CHANNEL_VCOMP (3)
- LL_ADC_CHANNEL_VOPAMP1 (3)(5)
- LL_ADC_CHANNEL_VOPAMP2 (3)(5)
- LL_ADC_CHANNEL_VOPAMP3 (3)(5)

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 (2)

  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)
  - LL_ADC_CHANNEL_VCOMP (3)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)

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 (3)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)
  - LL_ADC_CHANNEL_VCOMP (3)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)

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 (2)
  - LL_ADC_CHANNEL_1 (2)
  - LL_ADC_CHANNEL_2 (2)
  - LL_ADC_CHANNEL_3 (2)
  - LL_ADC_CHANNEL_4 (1)
  - LL_ADC_CHANNEL_5 (1)
  - LL_ADC_CHANNEL_6 (2)
  - LL_ADC_CHANNEL_7 (2)
  - LL_ADC_CHANNEL_8 (2)
  - LL_ADC_CHANNEL_9 (2)
  - LL_ADC_CHANNEL_10 (2)
  - LL_ADC_CHANNEL_11 (2)
  - LL_ADC_CHANNEL_12 (2)
  - LL_ADC_CHANNEL_13 (3)
  - LL_ADC_CHANNEL_14 (3)
  - LL_ADC_CHANNEL_15 (3)
  - LL_ADC_CHANNEL_16 (3)
  - LL_ADC_CHANNEL_17 (3)
  - LL_ADC_CHANNEL_18 (3)
  - LL_ADC_CHANNEL_19 (3)
  - LL_ADC_CHANNEL_20 (3)
  - LL_ADC_CHANNEL_21 (3)
  - LL_ADC_CHANNEL_22 (1)
  - LL_ADC_CHANNEL_23 (1)
  - LL_ADC_CHANNEL_24 (1)
  - LL_ADC_CHANNEL_25 (1)
  - LL_ADC_CHANNEL_26 (3)
  - LL_ADC_CHANNEL_27 (3)(4)
  - LL_ADC_CHANNEL_28 (3)(4)
  - LL_ADC_CHANNEL_29 (3)(4)
  - LL_ADC_CHANNEL_30 (3)(4)
  - LL_ADC_CHANNEL_31 (3)(4)
  - LL_ADC_CHANNEL_VREFINT (3)(6)
  - LL_ADC_CHANNEL_TEMPSENSOR (3)(6)
  - LL_ADC_CHANNEL_VCOMP (3)(6)
  - LL_ADC_CHANNEL_VOPAMP1 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP2 (3)(5)
  - LL_ADC_CHANNEL_VOPAMP3 (3)(5)
- __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
  - LL_ADC_AWD_ALL_CHANNELS_INJ
  - LL_ADC_AWD_ALL_CHANNELS_REG_INJ
  - LL_ADC_AWD_CHANNEL_0_REG (2)
  - LL_ADC_AWD_CHANNEL_0_INJ (2)
  - LL_ADC_AWD_CHANNEL_0_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_1_REG (2)
  - LL_ADC_AWD_CHANNEL_1_INJ (2)
  - LL_ADC_AWD_CHANNEL_1_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_2_REG (2)
  - LL_ADC_AWD_CHANNEL_2_INJ (2)
  - LL_ADC_AWD_CHANNEL_2_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_3_REG (2)
  - LL_ADC_AWD_CHANNEL_3_INJ (2)
  - LL_ADC_AWD_CHANNEL_3_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_4_REG (1)
  - LL_ADC_AWD_CHANNEL_4_INJ (1)
  - LL_ADC_AWD_CHANNEL_4_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_5_REG (1)
  - LL_ADC_AWD_CHANNEL_5_INJ (1)
  - LL_ADC_AWD_CHANNEL_5_REG_INJ (1)
  - LL_ADC_AWD_CHANNEL_6_REG (2)
  - LL_ADC_AWD_CHANNEL_6_INJ (2)
  - LL_ADC_AWD_CHANNEL_6_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_7_REG (2)
  - LL_ADC_AWD_CHANNEL_7_INJ (2)
  - LL_ADC_AWD_CHANNEL_7_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_8_REG (2)
  - LL_ADC_AWD_CHANNEL_8_INJ (2)
  - LL_ADC_AWD_CHANNEL_8_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_9_REG (2)
  - LL_ADC_AWD_CHANNEL_9_INJ (2)
  - LL_ADC_AWD_CHANNEL_9_REG_INJ (2)
  - LL_ADC_AWD_CHANNEL_10_REG (2)

- LL_ADC_AWD_CHANNEL_10_INJ (2)
- LL_ADC_AWD_CHANNEL_10_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_11_REG (2)
- LL_ADC_AWD_CHANNEL_11_INJ (2)
- LL_ADC_AWD_CHANNEL_11_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_12_REG (2)
- LL_ADC_AWD_CHANNEL_12_INJ (2)
- LL_ADC_AWD_CHANNEL_12_REG_INJ (2)
- LL_ADC_AWD_CHANNEL_13_REG (3)
- LL_ADC_AWD_CHANNEL_13_INJ (3)
- LL_ADC_AWD_CHANNEL_13_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_14_REG (3)
- LL_ADC_AWD_CHANNEL_14_INJ (3)
- LL_ADC_AWD_CHANNEL_14_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_15_REG (3)
- LL_ADC_AWD_CHANNEL_15_INJ (3)
- LL_ADC_AWD_CHANNEL_15_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_16_REG (3)
- LL_ADC_AWD_CHANNEL_16_INJ (3)
- LL_ADC_AWD_CHANNEL_16_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_17_REG (3)
- LL_ADC_AWD_CHANNEL_17_INJ (3)
- LL_ADC_AWD_CHANNEL_17_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_18_REG (3)
- LL_ADC_AWD_CHANNEL_18_INJ (3)
- LL_ADC_AWD_CHANNEL_18_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_19_REG (3)
- LL_ADC_AWD_CHANNEL_19_INJ (3)
- LL_ADC_AWD_CHANNEL_19_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_20_REG (3)
- LL_ADC_AWD_CHANNEL_20_INJ (3)
- LL_ADC_AWD_CHANNEL_20_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_21_REG (3)
- LL_ADC_AWD_CHANNEL_21_INJ (3)
- LL_ADC_AWD_CHANNEL_21_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_22_REG (1)
- LL_ADC_AWD_CHANNEL_22_INJ (1)
- LL_ADC_AWD_CHANNEL_22_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_23_REG (1)
- LL_ADC_AWD_CHANNEL_23_INJ (1)

- LL_ADC_AWD_CHANNEL_23_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_24_REG (1)
- LL_ADC_AWD_CHANNEL_24_INJ (1)
- LL_ADC_AWD_CHANNEL_24_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_25_REG (1)
- LL_ADC_AWD_CHANNEL_25_INJ (1)
- LL_ADC_AWD_CHANNEL_25_REG_INJ (1)
- LL_ADC_AWD_CHANNEL_26_REG (3)
- LL_ADC_AWD_CHANNEL_26_INJ (3)
- LL_ADC_AWD_CHANNEL_26_REG_INJ (3)
- LL_ADC_AWD_CHANNEL_27_REG (3)(4)
- LL_ADC_AWD_CHANNEL_27_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_27_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_28_REG (3)(4)
- LL_ADC_AWD_CHANNEL_28_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_28_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_29_REG (3)(4)
- LL_ADC_AWD_CHANNEL_29_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_29_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_30_REG (3)(4)
- LL_ADC_AWD_CHANNEL_30_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_30_REG_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_31_REG (3)(4)
- LL_ADC_AWD_CHANNEL_31_INJ (3)(4)
- LL_ADC_AWD_CHANNEL_31_REG_INJ (3)(4)
- LL_ADC_AWD_CH_VREFINT_REG (3)
- LL_ADC_AWD_CH_VREFINT_INJ (3)
- LL_ADC_AWD_CH_VREFINT_REG_INJ (3)
- LL_ADC_AWD_CH_TEMPSENSOR_REG (3)
- LL_ADC_AWD_CH_TEMPSENSOR_INJ (3)
- LL_ADC_AWD_CH_TEMPSENSOR_REG_INJ (3)
- LL_ADC_AWD_CH_VCOMP_REG (3)
- LL_ADC_AWD_CH_VCOMP_INJ (3)
- LL_ADC_AWD_CH_VCOMP_REG_INJ (3)
- LL_ADC_AWD_CH_VOPAMP1_REG (3)(5)
- LL_ADC_AWD_CH_VOPAMP1_INJ (3)(5)
- LL_ADC_AWD_CH_VOPAMP1_REG_INJ (3)(5)

- LL_ADC_AWD_CH_VOPAMP2_REG (3)(5)
- LL_ADC_AWD_CH_VOPAMP2_INJ (3)(5)
- LL_ADC_AWD_CH_VOPAMP2_REG_INJ (3)(5)
- LL_ADC_AWD_CH_VOPAMP3_REG (3)(5)
- LL_ADC_AWD_CH_VOPAMP3_INJ (3)(5)
- LL_ADC_AWD_CH_VOPAMP3_REG_INJ (3)(5)

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_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_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 equivalent voltage value (unit: mVolt)

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 to 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_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 STM32L1, 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 STM32L1, refer to device datasheet parameter "V110" (corresponding to TS_CAL2).
- __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 12bits (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

49 LL BUS Generic Driver

49.1 BUS Firmware driver API description

49.1.1 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: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)
  - LL_AHB1_GRP1_PERIPH_CRYP (*)
  - LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- AHBENR GPIOAEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIOBEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIOCEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIODEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIOEEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIOHEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIOFEN LL_AHB1_GRP1_EnableClock
- AHBENR GPIOGEN LL_AHB1_GRP1_EnableClock
- AHBENR CRCEN LL_AHB1_GRP1_EnableClock
- AHBENR FLITFEN LL_AHB1_GRP1_EnableClock
- AHBENR DMA1EN LL_AHB1_GRP1_EnableClock
- AHBENR DMA2EN LL_AHB1_GRP1_EnableClock
- AHBENR AESEN LL_AHB1_GRP1_EnableClock
- AHBENR FSMCEN 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: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)
  - LL_AHB1_GRP1_PERIPH_CRYP (*)
  - LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values

- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:

- AHBENR GPIOAEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIOBEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIOCEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIODEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIOEEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIOHEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIOFEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR GPIOGEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR CRCEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR FLITFEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR DMA1EN LL_AHB1_GRP1_IsEnabledClock
- AHBENR DMA2EN LL_AHB1_GRP1_IsEnabledClock
- AHBENR AESEN LL_AHB1_GRP1_IsEnabledClock
- AHBENR FSMCEN 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: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)

- LL_AHB1_GRP1_PERIPH_CRYP (*)
- LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- AHBENR GPIOAEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIOBEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIOCEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIODEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIOEEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIOHEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIOFEN LL_AHB1_GRP1_DisableClock
- AHBENR GPIOGEN LL_AHB1_GRP1_DisableClock
- AHBENR CRCEN LL_AHB1_GRP1_DisableClock
- AHBENR FLITFEN LL_AHB1_GRP1_DisableClock
- AHBENR DMA1EN LL_AHB1_GRP1_DisableClock
- AHBENR DMA2EN LL_AHB1_GRP1_DisableClock
- AHBENR AESEN LL_AHB1_GRP1_DisableClock
- AHBENR FSMCEN 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: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_ALL
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)
  - LL_AHB1_GRP1_PERIPH_CRYP (*)
  - LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- AHBRSTR GPIOARST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIOBRST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIOCRST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIODRST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIOERST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIOHRST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIOFRST LL_AHB1_GRP1_ForceReset
- AHBRSTR GPIOGRST LL_AHB1_GRP1_ForceReset
- AHBRSTR CRCRST LL_AHB1_GRP1_ForceReset

- AHBRSTR FLITFRST LL_AHB1_GRP1_ForceReset
- AHBRSTR DMA1RST LL_AHB1_GRP1_ForceReset
- AHBRSTR DMA2RST LL_AHB1_GRP1_ForceReset
- AHBRSTR AESRST LL_AHB1_GRP1_ForceReset
- AHBRSTR FSMCRST 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: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_ALL
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)
  - LL_AHB1_GRP1_PERIPH_CRYP (*)
  - LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- AHBRSTR GPIOARST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIOBRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIOCRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIODRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIOERST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIOHRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIOFRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR GPIOGRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR CRCRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR FLITFRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR DMA1RST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR DMA2RST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR AESRST LL_AHB1_GRP1_ReleaseReset
- AHBRSTR FSMCRST LL_AHB1_GRP1_ReleaseReset

LL_AHB1_GRP1_EnableClockSleep

Function name **__STATIC_INLINE void LL_AHB1_GRP1_EnableClockSleep (uint32_t Periphs)**

Function description Enable AHB1 peripherals clock during Low Power (Sleep) mode.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_SRAM
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)
  - LL_AHB1_GRP1_PERIPH_CRYP (*)
  - LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHBLPENR GPIOALPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIOBLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIOCLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIODLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIOELPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIOHLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIOFLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR GPIOGLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR CRCLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR FLITFLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR SRAMLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR DMA1LPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR DMA2LPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR AESLPEN LL_AHB1_GRP1_EnableClockSleep
- AHBLPENR FSMCLPEN LL_AHB1_GRP1_EnableClockSleep

LL_AHB1_GRP1_DisableClockSleep

Function name

__STATIC_INLINE void LL_AHB1_GRP1_DisableClockSleep (uint32_t Periphs)

Function description

Disable AHB1 peripherals clock during Low Power (Sleep) mode.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_AHB1_GRP1_PERIPH_GPIOA
  - LL_AHB1_GRP1_PERIPH_GPIOB
  - LL_AHB1_GRP1_PERIPH_GPIOC
  - LL_AHB1_GRP1_PERIPH_GPIOD
  - LL_AHB1_GRP1_PERIPH_GPIOE (*)
  - LL_AHB1_GRP1_PERIPH_GPIOH
  - LL_AHB1_GRP1_PERIPH_GPIOF (*)
  - LL_AHB1_GRP1_PERIPH_GPIOG (*)
  - LL_AHB1_GRP1_PERIPH_CRC
  - LL_AHB1_GRP1_PERIPH_FLASH
  - LL_AHB1_GRP1_PERIPH_SRAM
  - LL_AHB1_GRP1_PERIPH_DMA1
  - LL_AHB1_GRP1_PERIPH_DMA2 (*)
  - LL_AHB1_GRP1_PERIPH_CRYP (*)
  - LL_AHB1_GRP1_PERIPH_FSMC (*)

Return values

- **None:**

Reference Manual to LL API cross reference:

- AHBLPENR GPIOALPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIOBLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIOCLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIODLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIOELPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIOHLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIOFLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR GPIOGLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR CRCLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR FLITFLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR SRAMLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR DMA1LPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR DMA2LPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR AESLPEN LL_AHB1_GRP1_DisableClockSleep
- AHBLPENR FSMCLPEN LL_AHB1_GRP1_DisableClockSleep

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: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB1ENR TIM2EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM3EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM4EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM5EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM6EN LL_APB1_GRP1_EnableClock
- APB1ENR TIM7EN LL_APB1_GRP1_EnableClock
- APB1ENR LCDEN LL_APB1_GRP1_EnableClock
- APB1ENR WWDGEN LL_APB1_GRP1_EnableClock
- APB1ENR SPI2EN LL_APB1_GRP1_EnableClock
- APB1ENR SPI3EN LL_APB1_GRP1_EnableClock
- APB1ENR USART2EN LL_APB1_GRP1_EnableClock
- APB1ENR USART3EN LL_APB1_GRP1_EnableClock
- APB1ENR UART4EN LL_APB1_GRP1_EnableClock
- APB1ENR UART5EN LL_APB1_GRP1_EnableClock
- APB1ENR I2C1EN LL_APB1_GRP1_EnableClock
- APB1ENR I2C2EN LL_APB1_GRP1_EnableClock
- APB1ENR USBEN LL_APB1_GRP1_EnableClock
- APB1ENR PWREN LL_APB1_GRP1_EnableClock
- APB1ENR DACEN LL_APB1_GRP1_EnableClock
- APB1ENR COMPEN LL_APB1_GRP1_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: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values
- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:
- APB1ENR TIM2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR TIM3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR TIM4EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR TIM5EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR TIM6EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR TIM7EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR LCDEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR WWDGEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR SPI2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR SPI3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR USART2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR USART3EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR UART4EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR UART5EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR I2C1EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR I2C2EN LL_APB1_GRP1_IsEnabledClock
- APB1ENR USBEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR PWREN LL_APB1_GRP1_IsEnabledClock
- APB1ENR DACEN LL_APB1_GRP1_IsEnabledClock
- APB1ENR COMPEN LL_APB1_GRP1_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: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB1ENR TIM2EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM3EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM4EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM5EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM6EN LL_APB1_GRP1_DisableClock
- APB1ENR TIM7EN LL_APB1_GRP1_DisableClock
- APB1ENR LCDEN LL_APB1_GRP1_DisableClock
- APB1ENR WWDGEN LL_APB1_GRP1_DisableClock
- APB1ENR SPI2EN LL_APB1_GRP1_DisableClock
- APB1ENR SPI3EN LL_APB1_GRP1_DisableClock
- APB1ENR USART2EN LL_APB1_GRP1_DisableClock
- APB1ENR USART3EN LL_APB1_GRP1_DisableClock
- APB1ENR UART4EN LL_APB1_GRP1_DisableClock
- APB1ENR UART5EN LL_APB1_GRP1_DisableClock
- APB1ENR I2C1EN LL_APB1_GRP1_DisableClock
- APB1ENR I2C2EN LL_APB1_GRP1_DisableClock
- APB1ENR USBEN LL_APB1_GRP1_DisableClock
- APB1ENR PWREN LL_APB1_GRP1_DisableClock
- APB1ENR DACEN LL_APB1_GRP1_DisableClock
- APB1ENR COMPEN LL_APB1_GRP1_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: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB1RSTR TIM2RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM3RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM4RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM5RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM6RST LL_APB1_GRP1_ForceReset
- APB1RSTR TIM7RST LL_APB1_GRP1_ForceReset
- APB1RSTR LCDRST LL_APB1_GRP1_ForceReset
- APB1RSTR WWDGRST LL_APB1_GRP1_ForceReset
- APB1RSTR SPI2RST LL_APB1_GRP1_ForceReset
- APB1RSTR SPI3RST LL_APB1_GRP1_ForceReset
- APB1RSTR USART2RST LL_APB1_GRP1_ForceReset
- APB1RSTR USART3RST LL_APB1_GRP1_ForceReset
- APB1RSTR UART4RST LL_APB1_GRP1_ForceReset
- APB1RSTR UART5RST LL_APB1_GRP1_ForceReset
- APB1RSTR I2C1RST LL_APB1_GRP1_ForceReset
- APB1RSTR I2C2RST LL_APB1_GRP1_ForceReset
- APB1RSTR USBRST LL_APB1_GRP1_ForceReset
- APB1RSTR PWRRST LL_APB1_GRP1_ForceReset
- APB1RSTR DACRST LL_APB1_GRP1_ForceReset
- APB1RSTR COMPRST LL_APB1_GRP1_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: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1RSTR TIM2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM5RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM6RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR TIM7RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR LCDRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR WWDGRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR SPI2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR SPI3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR USART2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR USART3RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR UART4RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR UART5RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR I2C1RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR I2C2RST LL_APB1_GRP1_ReleaseReset
- APB1RSTR USBRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR PWRRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR DACRST LL_APB1_GRP1_ReleaseReset
- APB1RSTR COMPRST LL_APB1_GRP1_ReleaseReset

LL_APB1_GRP1_EnableClockSleep

Function name

__STATIC_INLINE void LL_APB1_GRP1_EnableClockSleep (uint32_t Periphs)

Function description

Enable APB1 peripherals clock during Low Power (Sleep) mode.

Parameters

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values

- **None:**

Reference Manual to LL API cross reference:

- APB1LPENR TIM2LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR TIM3LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR TIM4LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR TIM5LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR TIM6LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR TIM7LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR LCDLPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR WWDGLPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR SPI2LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR SPI3LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR USART2LPEN LL_APB1_GRP1_EnableClockSleep
- APB1LPENR USART3LPEN

LL_APB1_GRP1_EnableClockSleep
- APB1LPENR UART4LPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR UART5LPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR I2C1LPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR I2C2LPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR USBLPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR PWRLPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR DACLPEN
LL_APB1_GRP1_EnableClockSleep
- APB1LPENR COMPLPEN
LL_APB1_GRP1_EnableClockSleep

LL_APB1_GRP1_DisableClockSleep

Function name
__STATIC_INLINE void LL_APB1_GRP1_DisableClockSleep (uint32_t Periphs)

Function description
Disable APB1 peripherals clock during Low Power (Sleep) mode.

Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - 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_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_USB
  - LL_APB1_GRP1_PERIPH_PWR
  - LL_APB1_GRP1_PERIPH_DAC1
  - LL_APB1_GRP1_PERIPH_COMP
  - LL_APB1_GRP1_PERIPH_OPAMP (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB1LPENR TIM2LPEN
LL_APB1_GRP1_DisableClockSleep
- APB1LPENR TIM3LPEN
LL_APB1_GRP1_DisableClockSleep

- APB1LPENR TIM4LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR TIM5LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR TIM6LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR TIM7LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR LCDLPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR WWDGLPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR SPI2LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR SPI3LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR USART2LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR USART3LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR UART4LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR UART5LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR I2C1LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR I2C2LPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR USBLPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR PWRLPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR DACLPEN
  LL_APB1_GRP1_DisableClockSleep
- APB1LPENR COMPLPEN
  LL_APB1_GRP1_DisableClockSleep

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: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11
  - LL_APB2_GRP1_PERIPH_ADC1
  - LL_APB2_GRP1_PERIPH_SDIO (*)
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_USART1

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2ENR SYSCFGEN LL_APB2_GRP1_EnableClock
- APB2ENR TIM9EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM10EN LL_APB2_GRP1_EnableClock
- APB2ENR TIM11EN LL_APB2_GRP1_EnableClock
- APB2ENR ADC1EN LL_APB2_GRP1_EnableClock
- APB2ENR SDIOEN LL_APB2_GRP1_EnableClock
- APB2ENR SPI1EN LL_APB2_GRP1_EnableClock
- APB2ENR USART1EN 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: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11
  - LL_APB2_GRP1_PERIPH_ADC1
  - LL_APB2_GRP1_PERIPH_SDIO (*)
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_USART1

Return values
- **State:** of Periphs (1 or 0).

Reference Manual to LL API cross reference:
- APB2ENR SYSCFGEN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM9EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM10EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR TIM11EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR ADC1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR SDIOEN LL_APB2_GRP1_IsEnabledClock
- APB2ENR SPI1EN LL_APB2_GRP1_IsEnabledClock
- APB2ENR USART1EN 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: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11
  - LL_APB2_GRP1_PERIPH_ADC1
  - LL_APB2_GRP1_PERIPH_SDIO (*)
  - LL_APB2_GRP1_PERIPH_SPI1

- LL_APB2_GRP1_PERIPH_USART1

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2ENR SYSCFGEN LL_APB2_GRP1_DisableClock
- APB2ENR TIM9EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM10EN LL_APB2_GRP1_DisableClock
- APB2ENR TIM11EN LL_APB2_GRP1_DisableClock
- APB2ENR ADC1EN LL_APB2_GRP1_DisableClock
- APB2ENR SDIOEN LL_APB2_GRP1_DisableClock
- APB2ENR SPI1EN LL_APB2_GRP1_DisableClock
- APB2ENR USART1EN 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: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_ALL
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11
  - LL_APB2_GRP1_PERIPH_ADC1
  - LL_APB2_GRP1_PERIPH_SDIO (*)
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_USART1

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2RSTR SYSCFGRST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM9RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM10RST LL_APB2_GRP1_ForceReset
- APB2RSTR TIM11RST LL_APB2_GRP1_ForceReset
- APB2RSTR ADC1RST LL_APB2_GRP1_ForceReset
- APB2RSTR SDIORST LL_APB2_GRP1_ForceReset
- APB2RSTR SPI1RST LL_APB2_GRP1_ForceReset
- APB2RSTR USART1RST 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: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_ALL
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11

- LL_APB2_GRP1_PERIPH_ADC1
- LL_APB2_GRP1_PERIPH_SDIO (*)
- LL_APB2_GRP1_PERIPH_SPI1
- LL_APB2_GRP1_PERIPH_USART1

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2RSTR SYSCFGRST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM9RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM10RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR TIM11RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR ADC1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SDIORST LL_APB2_GRP1_ReleaseReset
- APB2RSTR SPI1RST LL_APB2_GRP1_ReleaseReset
- APB2RSTR USART1RST LL_APB2_GRP1_ReleaseReset

LL_APB2_GRP1_EnableClockSleep

Function name **__STATIC_INLINE void LL_APB2_GRP1_EnableClockSleep (uint32_t Periphs)**

Function description Enable APB2 peripherals clock during Low Power (Sleep) mode.

Parameters
- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11
  - LL_APB2_GRP1_PERIPH_ADC1
  - LL_APB2_GRP1_PERIPH_SDIO (*)
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_USART1

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2LPENR SYSCFGLPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR TIM9LPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR TIM10LPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR TIM11LPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR ADC1LPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR SDIOLPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR SPI1LPEN LL_APB2_GRP1_EnableClockSleep
- APB2LPENR USART1LPEN LL_APB2_GRP1_EnableClockSleep

LL_APB2_GRP1_DisableClockSleep

Function name **__STATIC_INLINE void LL_APB2_GRP1_DisableClockSleep**

(uint32_t Periphs)

Function description: Disable APB2 peripherals clock during Low Power (Sleep) mode.

Parameters:

- **Periphs:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_APB2_GRP1_PERIPH_SYSCFG
  - LL_APB2_GRP1_PERIPH_TIM9
  - LL_APB2_GRP1_PERIPH_TIM10
  - LL_APB2_GRP1_PERIPH_TIM11
  - LL_APB2_GRP1_PERIPH_ADC1
  - LL_APB2_GRP1_PERIPH_SDIO (*)
  - LL_APB2_GRP1_PERIPH_SPI1
  - LL_APB2_GRP1_PERIPH_USART1

Return values:

- **None:**

Reference Manual to LL API cross reference:

- APB2LPENR SYSCFGLPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR TIM9LPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR TIM10LPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR TIM11LPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR ADC1LPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR SDIOLPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR SPI1LPEN LL_APB2_GRP1_DisableClockSleep
- APB2LPENR USART1LPEN LL_APB2_GRP1_DisableClockSleep

49.2 BUS Firmware driver defines

49.2.1 BUS

AHB1 GRP1 PERIPH

LL_AHB1_GRP1_PERIPH_ALL

LL_AHB1_GRP1_PERIPH_GPIOA

LL_AHB1_GRP1_PERIPH_GPIOB

LL_AHB1_GRP1_PERIPH_GPIOC

LL_AHB1_GRP1_PERIPH_GPIOD

LL_AHB1_GRP1_PERIPH_GPIOE

LL_AHB1_GRP1_PERIPH_GPIOH

LL_AHB1_GRP1_PERIPH_GPIOF

LL_AHB1_GRP1_PERIPH_GPIOG

LL_AHB1_GRP1_PERIPH_SRAM

LL_AHB1_GRP1_PERIPH_CRC

LL_AHB1_GRP1_PERIPH_FLASH

LL_AHB1_GRP1_PERIPH_DMA1

LL_AHB1_GRP1_PERIPH_DMA2

LL_AHB1_GRP1_PERIPH_CRYP

LL_AHB1_GRP1_PERIPH_FSMC

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_LCD

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_USB

LL_APB1_GRP1_PERIPH_PWR

LL_APB1_GRP1_PERIPH_DAC1

LL_APB1_GRP1_PERIPH_COMP

LL_APB1_GRP1_PERIPH_OPAMP

APB2 GRP1 PERIPH

LL_APB2_GRP1_PERIPH_ALL

LL_APB2_GRP1_PERIPH_SYSCFG

LL_APB2_GRP1_PERIPH_TIM9

LL_APB2_GRP1_PERIPH_TIM10

LL_APB2_GRP1_PERIPH_TIM11

LL_APB2_GRP1_PERIPH_ADC1

LL_APB2_GRP1_PERIPH_SDIO

LL_APB2_GRP1_PERIPH_SPI1

LL_APB2_GRP1_PERIPH_USART1

50 LL COMP Generic Driver

50.1 COMP Firmware driver registers structures

50.1.1 LL_COMP_InitTypeDef

Data Fields

- ***uint32_t PowerMode***
- ***uint32_t InputPlus***
- ***uint32_t InputMinus***
- ***uint32_t OutputSelection***

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::OutputSelection***
  Set comparator output selection. This parameter can be a value of ***COMP_LL_EC_OUTPUT_SELECTION***This feature can be modified afterwards using unitary function **LL_COMP_SetOutputSelection()**.

50.2 COMP Firmware driver API description

50.2.1 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_COMP2_INPUT_PLUS_COMMON
Return values	• **None:**

Reference Manual to LL API cross reference:
- CSR WNDWE 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_COMP2_INPUT_PLUS_COMMON

Reference Manual to LL API cross reference:
- CSR WNDWE 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: (1) Available only on COMP instance: COMP2.
  - LL_COMP_POWERMODE_MEDIUMSPEED (1)
  - LL_COMP_POWERMODE_ULTRALOWPOWER (1)

Return values:
- **None:**

Reference Manual to LL API cross reference:
- COMP2_CSR SPEED 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: (1) Available only on COMP instance: COMP2.

- LL_COMP_POWERMODE_MEDIUMSPEED (1)
- LL_COMP_POWERMODE_ULTRALOWPOWER (1)

Reference Manual to LL API cross reference:

- COMP2_CSR SPEED LL_COMP_GetPowerMode

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: (1) Available only on COMP instance: COMP1.
  - LL_COMP_INPUT_PLUS_NONE
  - LL_COMP_INPUT_PLUS_IO1 (2)
  - LL_COMP_INPUT_PLUS_IO2 (2)
  - LL_COMP_INPUT_PLUS_IO3 (2)(5)
  - LL_COMP_INPUT_PLUS_IO4 (2)(5)
  - LL_COMP_INPUT_PLUS_IO5 (1)
  - LL_COMP_INPUT_PLUS_IO6 (1)
  - LL_COMP_INPUT_PLUS_IO7 (1)
  - LL_COMP_INPUT_PLUS_IO8 (1)
  - LL_COMP_INPUT_PLUS_IO9 (1)
  - LL_COMP_INPUT_PLUS_IO10 (1)
  - LL_COMP_INPUT_PLUS_IO11 (1)
  - LL_COMP_INPUT_PLUS_IO12 (1)
  - LL_COMP_INPUT_PLUS_IO13 (1)
  - LL_COMP_INPUT_PLUS_IO14 (1)
  - LL_COMP_INPUT_PLUS_IO15 (1)
  - LL_COMP_INPUT_PLUS_IO16 (1)
  - LL_COMP_INPUT_PLUS_IO17 (1)
  - LL_COMP_INPUT_PLUS_IO18 (1)
  - LL_COMP_INPUT_PLUS_IO19 (1)
  - LL_COMP_INPUT_PLUS_IO20 (1)
  - LL_COMP_INPUT_PLUS_IO21 (1)
  - LL_COMP_INPUT_PLUS_IO22 (1)
  - LL_COMP_INPUT_PLUS_IO23 (1)
  - LL_COMP_INPUT_PLUS_IO24 (1)
  - LL_COMP_INPUT_PLUS_IO25 (1)
  - LL_COMP_INPUT_PLUS_IO26 (1)
  - LL_COMP_INPUT_PLUS_IO27 (1)
  - LL_COMP_INPUT_PLUS_IO28 (1)
  - LL_COMP_INPUT_PLUS_IO29 (1)(4)
  - LL_COMP_INPUT_PLUS_IO30 (1)(4)
  - LL_COMP_INPUT_PLUS_IO31 (1)(4)
  - LL_COMP_INPUT_PLUS_IO32 (1)(4)
  - LL_COMP_INPUT_PLUS_IO33 (1)(4)
  - LL_COMP_INPUT_PLUS_OPAMP1 (1)(3)
  - LL_COMP_INPUT_PLUS_OPAMP2 (1)(3)
  - LL_COMP_INPUT_PLUS_OPAMP3 (1)(4)

- (2) Available only on COMP instance: COMP2.
- (3) Available on devices: STM32L100xB, STM32L151xB, STM32L152xB, STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD
- (4) Available on devices: STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD
- (5) Available on devices: STM32L100xC, STM32L151xC, STM32L152xC, STM32L162xC, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD) || defined(STM32L151xE) || defined(STM32L151xDX, STM32L152xE, STM32L152xDX, STM32L162xE, STM32L162xDX

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:
- RI RI_ASCR1_CH LL_COMP_SetInputPlus
- RI RI_ASCR2_GR6 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: (1) Available only on COMP instance: COMP1.
  - LL_COMP_INPUT_PLUS_NONE
  - LL_COMP_INPUT_PLUS_IO1 (2)
  - LL_COMP_INPUT_PLUS_IO2 (2)
  - LL_COMP_INPUT_PLUS_IO3 (2)(5)
  - LL_COMP_INPUT_PLUS_IO4 (2)(5)
  - LL_COMP_INPUT_PLUS_IO5 (1)
  - LL_COMP_INPUT_PLUS_IO6 (1)
  - LL_COMP_INPUT_PLUS_IO7 (1)
  - LL_COMP_INPUT_PLUS_IO8 (1)
  - LL_COMP_INPUT_PLUS_IO9 (1)
  - LL_COMP_INPUT_PLUS_IO10 (1)
  - LL_COMP_INPUT_PLUS_IO11 (1)
  - LL_COMP_INPUT_PLUS_IO12 (1)
  - LL_COMP_INPUT_PLUS_IO13 (1)
  - LL_COMP_INPUT_PLUS_IO14 (1)
  - LL_COMP_INPUT_PLUS_IO15 (1)
  - LL_COMP_INPUT_PLUS_IO16 (1)
  - LL_COMP_INPUT_PLUS_IO17 (1)
  - LL_COMP_INPUT_PLUS_IO18 (1)
  - LL_COMP_INPUT_PLUS_IO19 (1)

- LL_COMP_INPUT_PLUS_IO20 (1)
- LL_COMP_INPUT_PLUS_IO21 (1)
- LL_COMP_INPUT_PLUS_IO22 (1)
- LL_COMP_INPUT_PLUS_IO23 (1)
- LL_COMP_INPUT_PLUS_IO24 (1)
- LL_COMP_INPUT_PLUS_IO25 (1)
- LL_COMP_INPUT_PLUS_IO26 (1)
- LL_COMP_INPUT_PLUS_IO27 (1)
- LL_COMP_INPUT_PLUS_IO28 (1)
- LL_COMP_INPUT_PLUS_IO29 (1)(4)
- LL_COMP_INPUT_PLUS_IO30 (1)(4)
- LL_COMP_INPUT_PLUS_IO31 (1)(4)
- LL_COMP_INPUT_PLUS_IO32 (1)(4)
- LL_COMP_INPUT_PLUS_IO33 (1)(4)
- LL_COMP_INPUT_PLUS_OPAMP1 (1)(3)
- LL_COMP_INPUT_PLUS_OPAMP2 (1)(3)
- LL_COMP_INPUT_PLUS_OPAMP3 (1)(4)

- (2) Available only on COMP instance: COMP2.
- (3) Available on devices: STM32L100xB, STM32L151xB, STM32L152xB, STM32L100xBA, STM32L151xBA, STM32L152xBA, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD
- (4) Available on devices: STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD
- (5) Available on devices: STM32L100xC, STM32L151xC, STM32L152xC, STM32L162xC, STM32L151xCA, STM32L151xD, STM32L152xCA, STM32L152xD, STM32L162xCA, STM32L162xD) || defined(STM32L151xE) || defined(STM32L151xDX, STM32L152xE, STM32L152xDX, STM32L162xE, STM32L162xDX

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:

- RI RI_ASCR1_CH LL_COMP_GetInputPlus
- RI RI_ASCR2_GR6 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: (1) Available only on COMP instance: COMP2.
  - LL_COMP_INPUT_MINUS_1_4VREFINT (1)
  - LL_COMP_INPUT_MINUS_1_2VREFINT (1)
  - LL_COMP_INPUT_MINUS_3_4VREFINT (1)
  - LL_COMP_INPUT_MINUS_VREFINT
  - LL_COMP_INPUT_MINUS_DAC1_CH1 (1)

- LL_COMP_INPUT_MINUS_DAC1_CH2 (1)
- LL_COMP_INPUT_MINUS_IO1 (1)

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 COMP_CSR_INSEL 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: (1) Available only on COMP instance: COMP2.
  - LL_COMP_INPUT_MINUS_1_4VREFINT (1)
  - LL_COMP_INPUT_MINUS_1_2VREFINT (1)
  - LL_COMP_INPUT_MINUS_3_4VREFINT (1)
  - LL_COMP_INPUT_MINUS_VREFINT
  - LL_COMP_INPUT_MINUS_DAC1_CH1 (1)
  - LL_COMP_INPUT_MINUS_DAC1_CH2 (1)
  - LL_COMP_INPUT_MINUS_IO1 (1)

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 COMP_CSR_INSEL LL_COMP_SetInputMinus

LL_COMP_SetInputPullingResistor

Function name
__STATIC_INLINE void LL_COMP_SetInputPullingResistor (COMP_TypeDef * COMPx, uint32_t InputPullingResistor)

Function description
Set comparator input pulling resistor.

Parameters
- **COMPx:** Comparator instance
- **InputPullingResistor:** This parameter can be one of the following values: (1) Available only on COMP instance: COMP1.
  - LL_COMP_INPUT_MINUS_PULL_NO
  - LL_COMP_INPUT_MINUS_PULL_UP_10K (1)
  - LL_COMP_INPUT_MINUS_PULL_UP_400K (1)
  - LL_COMP_INPUT_MINUS_PULL_DOWN_10K (1)
  - LL_COMP_INPUT_MINUS_PULL_DOWN_400K (1)

Return values
- **None:**

Reference Manual to
- CSR 10KPU LL_COMP_SetInputPullingResistor

LL API cross reference:
- CSR 400KPU LL_COMP_SetInputPullingResistor
- CSR 10KPD LL_COMP_SetInputPullingResistor
- CSR 400KPD LL_COMP_SetInputPullingResistor

LL_COMP_GetInputPullingResistor

Function name: **__STATIC_INLINE uint32_t LL_COMP_GetInputPullingResistor (COMP_TypeDef * COMPx)**

Function description: Get comparator input pulling resistor.

Parameters:
- **COMPx:** Comparator instance

Return values:
- **Returned:** value can be one of the following values: (1) Available only on COMP instance: COMP1.
  - LL_COMP_INPUT_MINUS_PULL_NO
  - LL_COMP_INPUT_MINUS_PULL_UP_10K (1)
  - LL_COMP_INPUT_MINUS_PULL_UP_400K (1)
  - LL_COMP_INPUT_MINUS_PULL_DOWN_10K (1)
  - LL_COMP_INPUT_MINUS_PULL_DOWN_400K (1)

Reference Manual to LL API cross reference:
- CSR 10KPU LL_COMP_SetInputPullingResistor
- CSR 400KPU LL_COMP_SetInputPullingResistor
- CSR 10KPD LL_COMP_SetInputPullingResistor
- CSR 400KPD LL_COMP_SetInputPullingResistor

LL_COMP_SetOutputSelection

Function name: **__STATIC_INLINE void LL_COMP_SetOutputSelection (COMP_TypeDef * COMPx, uint32_t OutputSelection)**

Function description: Set comparator output selection.

Parameters:
- **COMPx:** Comparator instance
- **OutputSelection:** This parameter can be one of the following values: (1) Parameter availability depending on timer availability on the selected device. (2) Available only on COMP instance: COMP2.
  - LL_COMP_OUTPUT_NONE
  - LL_COMP_OUTPUT_TIM2_IC4 (1)(2)
  - LL_COMP_OUTPUT_TIM2_OCREFCLR (1)(2)
  - LL_COMP_OUTPUT_TIM3_IC4 (1)(2)
  - LL_COMP_OUTPUT_TIM3_OCREFCLR (1)(2)
  - LL_COMP_OUTPUT_TIM4_IC4 (1)(2)
  - LL_COMP_OUTPUT_TIM4_OCREFCLR (1)(2)
  - LL_COMP_OUTPUT_TIM10_IC1 (1)(2)

Return values:
- **None:**

Notes:
- Availability of parameters of output selection to timer depends on timers availability on the selected device.

Reference Manual to LL API cross reference:
- CSR OUTSEL LL_COMP_SetOutputSelection

LL_COMP_GetOutputSelection

Function name	**__STATIC_INLINE uint32_t LL_COMP_GetOutputSelection (COMP_TypeDef * COMPx)**
Function description	Get comparator output selection.
Parameters	• **COMPx:** Comparator instance
Return values	• **Returned:** value can be one of the following values: (1) Parameter availability depending on timer availability on the selected device. (2) Available only on COMP instance: COMP2. – LL_COMP_OUTPUT_NONE – LL_COMP_OUTPUT_TIM2_IC4 (1)(2) – LL_COMP_OUTPUT_TIM2_OCREFCLR (1)(2) – LL_COMP_OUTPUT_TIM3_IC4 (1)(2) – LL_COMP_OUTPUT_TIM3_OCREFCLR (1)(2) – LL_COMP_OUTPUT_TIM4_IC4 (1)(2) – LL_COMP_OUTPUT_TIM4_OCREFCLR (1)(2) – LL_COMP_OUTPUT_TIM10_IC1 (1)(2)
Notes	• Availability of parameters of output selection to timer depends on timers availability on the selected device.
Reference Manual to LL API cross reference:	• CSR OUTSEL LL_COMP_GetOutputSelection

LL_COMP_Enable

Function name	**__STATIC_INLINE void LL_COMP_Enable (COMP_TypeDef * COMPx)**
Function description	Enable comparator instance.
Parameters	• **COMPx:** Comparator instance (1)
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 COMP1EN LL_COMP_Enable • CSR COMP_CSR_INSEL 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:**
Notes	• On this STM32 serie, COMP2 is disabled by clearing input minus selection. If COMP2 must be enabled afterwards, input

minus must be set. Refer to function LL_COMP_SetInputMinus().

Reference Manual to LL API cross reference:
- CSR COMP1EN LL_COMP_Disable
- CSR COMP_CSR_INSEL 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 COMP1EN LL_COMP_IsEnabled
- CSR COMP_CSR_INSEL LL_COMP_IsEnabled

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:
- On this STM32 serie, comparator polarity is not settable and 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

Reference Manual to LL API cross reference:
- CSR CMP1OUT LL_COMP_ReadOutputLevel
- CSR CMP2OUT 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:**

50.3 COMP Firmware driver defines

50.3.1 COMP

Comparator common modes - Window mode

LL_COMP_WINDOWMODE_DISABLE	Window mode disable: Comparators 1 and 2 are independent
LL_COMP_WINDOWMODE_COMP2_INPUT_PLUS_COMMON	Window mode enable: Comparators instances pair COMP1 and COMP2 have their input plus connected together. The common input is COMP2 input plus (COMP1 input plus is no more accessible, either from GPIO and from ADC channel VCOMP).

Definitions of COMP hardware constraints delays

LL_COMP_DELAY_STARTUP_US Delay for COMP startup time

Comparator inputs - Input minus (input inverting) selection

LL_COMP_INPUT_MINUS_1_4VREFINT Comparator input minus connected to 1/4 VrefInt (specific to COMP instance: COMP2)

LL_COMP_INPUT_MINUS_1_2VREFINT Comparator input minus connected to 1/2 VrefInt (specific to COMP instance: COMP2)

LL_COMP_INPUT_MINUS_3_4VREFINT Comparator input minus connected to 3/4 VrefInt (specific to COMP instance: COMP2)

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) (specific to COMP instance: COMP2)

LL_COMP_INPUT_MINUS_DAC1_CH2 Comparator input minus connected to DAC1 channel 2 (DAC_OUT2) (specific to COMP instance: COMP2)

LL_COMP_INPUT_MINUS_IO1 Comparator input minus connected to IO1 (pin PB3 for COMP2) (specific to COMP instance: COMP2)

Comparator inputs - Input plus (input non-inverting) selection

LL_COMP_INPUT_PLUS_NONE Comparator input plus connected not connected

LL_COMP_INPUT_PLUS_IO1 Comparator input plus connected to IO1 (pin PB4 for COMP2) (specific to COMP instance: COMP2)

LL_COMP_INPUT_PLUS_IO2 Comparator input plus connected to IO1 (pin PB5 for COMP2) (specific to COMP instance: COMP2)

LL_COMP_INPUT_PLUS_IO3 Comparator input plus connected to IO1 (pin PB6 for COMP2) (specific to COMP instance: COMP2)

LL_COMP_INPUT_PLUS_IO4 Comparator input plus connected to IO1 (pin PB7 for COMP2) (specific to COMP instance: COMP2)

LL_COMP_INPUT_PLUS_IO5 Comparator input plus connected to IO5 (pin PA0 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO6 Comparator input plus connected to IO6 (pin PA1 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO7 Comparator input plus connected to IO7 (pin PA2 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO8 Comparator input plus connected to IO8 (pin PA3 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO9 Comparator input plus connected to IO9 (pin PA4 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO10 Comparator input plus connected to IO10 (pin PA5 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO11 Comparator input plus connected to IO11 (pin PA5 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO12 Comparator input plus connected to IO12 (pin PA7 for COMP1) (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_IO13	Comparator input plus connected to IO13 (pin PB0 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO14	Comparator input plus connected to IO14 (pin PB1 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO15	Comparator input plus connected to IO15 (pin PC0 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO16	Comparator input plus connected to IO16 (pin PC1 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO17	Comparator input plus connected to IO17 (pin PC2 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO18	Comparator input plus connected to IO18 (pin PC3 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO19	Comparator input plus connected to IO19 (pin PC4 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO20	Comparator input plus connected to IO20 (pin PC5 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO21	Comparator input plus connected to IO21 (pin PB12 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO22	Comparator input plus connected to IO22 (pin PB13 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO23	Comparator input plus connected to IO23 (pin PB14 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO24	Comparator input plus connected to IO24 (pin PB15 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO25	Comparator input plus connected to IO25 (pin PE7 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO26	Comparator input plus connected to IO26 (pin PE8 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO27	Comparator input plus connected to IO27 (pin PE9 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO28	Comparator input plus connected to IO28 (pin PE10 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO29	Comparator input plus connected to IO29 (pin PF6 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO30	Comparator input plus connected to IO30 (pin PF7 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO31	Comparator input plus connected to IO31 (pin PF8 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO32	Comparator input plus connected to IO32 (pin PF9 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_IO33	Comparator input plus connected to IO33 (pin PF10 for COMP1) (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_OPAMP1	Comparator input plus connected to OPAMP1 output (specific to COMP instance: COMP1)

LL_COMP_INPUT_PLUS_OPAMP2	Comparator input plus connected to OPAMP2 output (specific to COMP instance: COMP1)
LL_COMP_INPUT_PLUS_OPAMP3	Comparator input plus connected to OPAMP3 output (specific to COMP instance: COMP1)

Comparator input - Pulling resistor

LL_COMP_INPUT_MINUS_PULL_NO	Comparator input minus not connected to any pulling resistor
LL_COMP_INPUT_MINUS_PULL_UP_10K	Comparator input minus connected to pull-up resistor of 10kOhm (specific to COMP instance: COMP1)
LL_COMP_INPUT_MINUS_PULL_UP_400K	Comparator input minus connected to pull-up resistor of 400kOhm (specific to COMP instance: COMP1)
LL_COMP_INPUT_MINUS_PULL_DOWN_10K	Comparator input minus connected to pull-down resistor of 10kOhm (specific to COMP instance: COMP1)
LL_COMP_INPUT_MINUS_PULL_DOWN_400K	Comparator input minus connected to pull-down resistor of 400kOhm (specific to COMP instance: COMP1)

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 selection

LL_COMP_OUTPUT_NONE	COMP output is not connected to other peripherals (except GPIO and EXTI that are always connected to COMP output) (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM2_IC4	COMP output connected to TIM2 input capture 4 (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM2_OCREFCLR	COMP output connected to TIM2 OCREF clear (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM3_IC4	COMP output connected to TIM3 input capture 4 (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM3_OCREFCLR	COMP output connected to TIM3 OCREF clear (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM4_IC4	COMP output connected to TIM4 input capture 4 (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM4_OCREFCLR	COMP output connected to TIM4 OCREF clear (specific to COMP instance: COMP2)
LL_COMP_OUTPUT_TIM10_IC1	COMP output connected to TIM10 input capture 1 (specific to COMP instance: COMP2)

Comparator modes - Power mode

LL_COMP_POWERMODE_ULTRALOWPOWER	COMP power mode to low speed (specific to COMP instance: COMP2)
LL_COMP_POWERMODE_MEDIUMSPEED	COMP power mode to fast speed (specific to COMP instance: COMP2)

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

51 LL CORTEX Generic Driver

51.1 CORTEX Firmware driver API description

51.1.1 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 (0x1: revision 1, 0x2: revision 2)
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-M3 devices
Reference Manual to LL API cross	• SCB_CPUID ARCHITECTURE LL_CPUID_GetConstant

reference:

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 0xC23 for Cortex-M3
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 (0x0: patch 0, 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

51.2 CORTEX Firmware driver defines

51.2.1 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

52 LL CRC Generic Driver

52.1 CRC Firmware driver API description

52.1.1 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:**
Reference Manual to LL API cross reference:	• CR RESET LL_CRC_ResetCRCCalculationUnit

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_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_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 (General-purpose 8-bit data register).
Notes	• This register can be used as a temporary storage location for one byte.
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 (8-bit) between between Min_Data=0 and Max_Data=0xFF
Return values	• **None:**
Notes	• This register can be used as a temporary storage location for one byte.
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

52.2 CRC Firmware driver defines

52.2.1 CRC

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

53 LL DAC Generic Driver

53.1 DAC Firmware driver registers structures

53.1.1 LL_DAC_InitTypeDef

Data Fields

- ***uint32_t TriggerSource***
- ***uint32_t WaveAutoGeneration***
- ***uint32_t WaveAutoGenerationConfig***
- ***uint32_t OutputBuffer***

Field Documentation

- ***uint32_t LL_DAC_InitTypeDef::TriggerSource***
  Set the conversion trigger source for the selected DAC channel: internal (SW start) or from external IP (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()** or **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()**.

53.2 DAC Firmware driver API description

53.2.1 Detailed description of functions

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_TIM2_TRGO
  - LL_DAC_TRIG_EXT_TIM4_TRGO
  - LL_DAC_TRIG_EXT_TIM6_TRGO
  - LL_DAC_TRIG_EXT_TIM7_TRGO
  - LL_DAC_TRIG_EXT_TIM9_TRGO
  - 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

Return values
- **Returned:** value can be one of the following values:
  - LL_DAC_TRIG_SOFTWARE
  - LL_DAC_TRIG_EXT_TIM2_TRGO
  - LL_DAC_TRIG_EXT_TIM4_TRGO
  - LL_DAC_TRIG_EXT_TIM6_TRGO
  - LL_DAC_TRIG_EXT_TIM7_TRGO
  - LL_DAC_TRIG_EXT_TIM9_TRGO
  - 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
- **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

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
- **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
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

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
- **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

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

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_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
- **OutputBuffer:** This parameter can be one of the following values:
  - LL_DAC_OUTPUT_BUFFER_ENABLE
  - LL_DAC_OUTPUT_BUFFER_DISABLE

Return values
- **None:**

Reference Manual to LL API cross reference:
- CR BOFF1 LL_DAC_SetOutputBuffer
- CR BOFF2 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

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 BOFF1 LL_DAC_GetOutputBuffer
- CR BOFF2 LL_DAC_GetOutputBuffer

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

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

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

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
- **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
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
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
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
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
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
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

Return values:
- **None:**

Notes:
- Preliminarily, DAC trigger must be set to software trigger using function 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
- **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
- **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
- **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
- DHR12RD DACC1DHR

LL API cross reference:
- 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

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_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 instance.

Parameters:
- **DACx:** DAC instance
- **DAC_Channel:** This parameter can be one of the following values:
  - LL_DAC_CHANNEL_1
  - LL_DAC_CHANNEL_2
- **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:
- The setting of these parameters by function LL_DAC_Init() is conditioned to DAC state: DAC instance 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:**

53.3 DAC Firmware driver defines

53.3.1 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_DMAUDR2 DAC channel 2 flag DMA underrun

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 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 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_SOFTWARE	DAC channel conversion trigger internal (SW start)
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_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_TIM9_TRGO	DAC channel conversion trigger from external IP: TIM15 TRGO.
LL_DAC_TRIG_EXT_EXTI_LINE9	DAC channel conversion trigger from external IP: external interrupt line 9.

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

54 LL DMA Generic Driver

54.1 DMA Firmware driver registers structures

54.1.1 LL_DMA_InitTypeDef

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 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::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()**.

54.2 DMA Firmware driver API description

54.2.1 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
- CNDTR NDT LL_DMA_GetDataLength

reference:

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_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	• ISR TCIF7 LL_DMA_IsActiveFlag_TC7

reference:

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
- CCR TCIE LL_DMA_DisableIT_TC

LL API cross reference:

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
- CCR TEIE LL_DMA_IsEnabledIT_TE

reference:

LL_DMA_Init

Function name **uint32_t 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 **uint32_t 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:**

54.3 DMA Firmware driver defines

54.3.1 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

55 LL EXTI Generic Driver

55.1 EXTI Firmware driver registers structures

55.1.1 LL_EXTI_InitTypeDef

Data Fields

- ***uint32_t Line_0_31***
- ***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***
- ***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***.

55.2 EXTI Firmware driver API description

55.2.1 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:
- IMR IMx LL_EXTI_EnableIT_0_31

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:
- IMR IMx LL_EXTI_DisableIT_0_31

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:
- IMR IMx LL_EXTI_IsEnabledIT_0_31

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:
- EMR EMx LL_EXTI_EnableEvent_0_31

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:
- EMR EMx LL_EXTI_DisableEvent_0_31

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:
- EMR EMx LL_EXTI_IsEnabledEvent_0_31

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:
- RTSR RTx LL_EXTI_EnableRisingTrig_0_31

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:

- RTSR RTx LL_EXTI_DisableRisingTrig_0_31

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:

- RTSR RTx LL_EXTI_IsEnabledRisingTrig_0_31

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:
- FTSR FTx LL_EXTI_EnableFallingTrig_0_31

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:
- FTSR FTx LL_EXTI_DisableFallingTrig_0_31

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:
- FTSR FTx LL_EXTI_IsEnabledFallingTrig_0_31

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_IMR, writing a 1 to this bit when it is at '0' sets the corresponding pending bit in EXTI_PR resulting in an interrupt request generation. This bit is cleared by clearing the corresponding bit in the EXTI_PR 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:
- SWIER SWIx LL_EXTI_GenerateSWI_0_31

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:
- PR PIFx LL_EXTI_IsActiveFlag_0_31

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
- PR PIFx LL_EXTI_ReadFlag_0_31

reference:

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:
- PR PIFx LL_EXTI_ClearFlag_0_31

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:
  - SUCCESS: EXTI registers are initialized
  - ERROR: not applicable

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:
  - SUCCESS: EXTI registers are de-initialized
  - ERROR: not applicable

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:**

55.3 EXTI Firmware driver defines

55.3.1 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_ALL_0_31	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

56 LL GPIO Generic Driver

56.1 GPIO Firmware driver registers structures

56.1.1 LL_GPIO_InitTypeDef

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()**.

56.2 GPIO Firmware driver API description

56.2.1 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
- OTYPER OTy LL_GPIO_SetPinOutputType

reference:

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
-
- BSRR 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
- ODR ODy LL_GPIO_TogglePin

reference:

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:**

56.3 GPIO Firmware driver defines

56.3.1 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

57 LL I2C Generic Driver

57.1 I2C Firmware driver registers structures

57.1.1 LL_I2C_InitTypeDef

Data Fields

- ***uint32_t PeripheralMode***
- ***uint32_t ClockSpeed***
- ***uint32_t DutyCycle***
- ***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::ClockSpeed***
  Specifies the clock frequency. This parameter must be set to a value lower than 400kHz (in Hz)This feature can be modified afterwards using unitary function **LL_I2C_SetClockPeriod()** or **LL_I2C_SetDutyCycle()** or **LL_I2C_SetClockSpeedMode()** or **LL_I2C_ConfigSpeed()**.
- ***uint32_t LL_I2C_InitTypeDef::DutyCycle***
  Specifies the I2C fast mode duty cycle. This parameter can be a value of ***I2C_LL_EC_DUTYCYCLE***This feature can be modified afterwards using unitary function **LL_I2C_SetDutyCycle()**.
- ***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()**.

57.2 I2C Firmware driver API description

57.2.1 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:**
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_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:	• CR2 DMAEN 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:	• CR2 DMAEN 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:	• CR2 DMAEN 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:	• CR2 DMAEN 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:	• CR2 DMAEN 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	• CR2 DMAEN LL_I2C_IsEnabledDMAReq_RX

reference:

LL_I2C_DMA_GetRegAddr

Function name	**__STATIC_INLINE uint32_t LL_I2C_DMA_GetRegAddr (I2C_TypeDef * I2Cx)**
Function description	Get the data register address used for DMA transfer.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **Address:** of data register
Reference Manual to LL API cross reference:	• DR DR 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_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 ENGC 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 ENGC 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 ENGC LL_I2C_IsEnabledGeneralCall

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 ADD0 LL_I2C_SetOwnAddress1 • OAR1 ADD1_7 LL_I2C_SetOwnAddress1 • OAR1 ADD8_9 LL_I2C_SetOwnAddress1 • OAR1 ADDMODE LL_I2C_SetOwnAddress1

LL_I2C_SetOwnAddress2

Function name	**__STATIC_INLINE void LL_I2C_SetOwnAddress2 (I2C_TypeDef * I2Cx, uint32_t OwnAddress2)**
Function description	Set the 7bits Own Address2.
Parameters	• **I2Cx:** I2C Instance. • **OwnAddress2:** This parameter must be a value between Min_Data=0 and Max_Data=0x7F.
Return values	• **None:**
Notes	• This action has no effect if own address2 is enabled.
Reference Manual to LL API cross reference:	• OAR2 ADD2 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 ENDUAL 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 ENDUAL 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 ENDUAL LL_I2C_IsEnabledOwnAddress2

LL_I2C_SetPeriphClock

Function name	**__STATIC_INLINE void LL_I2C_SetPeriphClock (I2C_TypeDef * I2Cx, uint32_t PeriphClock)**
Function description	Configure the Peripheral clock frequency.
Parameters	• **I2Cx:** I2C Instance. • **PeriphClock:** Peripheral Clock (in Hz)
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 FREQ LL_I2C_SetPeriphClock

LL_I2C_GetPeriphClock

Function name	**__STATIC_INLINE uint32_t LL_I2C_GetPeriphClock (I2C_TypeDef * I2Cx)**
Function description	Get the Peripheral clock frequency.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **Value:** of Peripheral Clock (in Hz)
Reference Manual to LL API cross reference:	• CR2 FREQ LL_I2C_GetPeriphClock

LL_I2C_SetDutyCycle

Function name	**__STATIC_INLINE void LL_I2C_SetDutyCycle (I2C_TypeDef * I2Cx, uint32_t DutyCycle)**
Function description	Configure the Duty cycle (Fast mode only).
Parameters	• **I2Cx:** I2C Instance. • **DutyCycle:** This parameter can be one of the following values: – LL_I2C_DUTYCYCLE_2

– LL_I2C_DUTYCYCLE_16_9

Return values
- **None:**

Reference Manual to LL API cross reference:
- CCR DUTY LL_I2C_SetDutyCycle

LL_I2C_GetDutyCycle

Function name
__STATIC_INLINE uint32_t LL_I2C_GetDutyCycle (I2C_TypeDef * I2Cx)

Function description
Get the Duty cycle (Fast mode only).

Parameters
- **I2Cx:** I2C Instance.

Return values
- **Returned:** value can be one of the following values:
  – LL_I2C_DUTYCYCLE_2
  – LL_I2C_DUTYCYCLE_16_9

Reference Manual to LL API cross reference:
- CCR DUTY LL_I2C_GetDutyCycle

LL_I2C_SetClockSpeedMode

Function name
__STATIC_INLINE void LL_I2C_SetClockSpeedMode (I2C_TypeDef * I2Cx, uint32_t ClockSpeedMode)

Function description
Configure the I2C master clock speed mode.

Parameters
- **I2Cx:** I2C Instance.
- **ClockSpeedMode:** This parameter can be one of the following values:
  – LL_I2C_CLOCK_SPEED_STANDARD_MODE
  – LL_I2C_CLOCK_SPEED_FAST_MODE

Return values
- **None:**

Reference Manual to LL API cross reference:
- CCR FS LL_I2C_SetClockSpeedMode

LL_I2C_GetClockSpeedMode

Function name
__STATIC_INLINE uint32_t LL_I2C_GetClockSpeedMode (I2C_TypeDef * I2Cx)

Function description
Get the the I2C master speed mode.

Parameters
- **I2Cx:** I2C Instance.

Return values
- **Returned:** value can be one of the following values:
  – LL_I2C_CLOCK_SPEED_STANDARD_MODE
  – LL_I2C_CLOCK_SPEED_FAST_MODE

Reference Manual to LL API cross reference:
- CCR FS LL_I2C_GetClockSpeedMode

LL_I2C_SetRiseTime

Function name	**__STATIC_INLINE void LL_I2C_SetRiseTime (I2C_TypeDef * I2Cx, uint32_t RiseTime)**
Function description	Configure the SCL, SDA rising time.
Parameters	• **I2Cx:** I2C Instance. • **RiseTime:** This parameter must be a value between Min_Data=0x02 and Max_Data=0x3F.
Return values	• **None:**
Notes	• This bit can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	• TRISE TRISE LL_I2C_SetRiseTime

LL_I2C_GetRiseTime

Function name	**__STATIC_INLINE uint32_t LL_I2C_GetRiseTime (I2C_TypeDef * I2Cx)**
Function description	Get the SCL, SDA rising time.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **Value:** between Min_Data=0x02 and Max_Data=0x3F
Reference Manual to LL API cross reference:	• TRISE TRISE LL_I2C_GetRiseTime

LL_I2C_SetClockPeriod

Function name	**__STATIC_INLINE void LL_I2C_SetClockPeriod (I2C_TypeDef * I2Cx, uint32_t ClockPeriod)**
Function description	Configure the SCL high and low period.
Parameters	• **I2Cx:** I2C Instance. • **ClockPeriod:** This parameter must be a value between Min_Data=0x004 and Max_Data=0xFFF, except in FAST DUTY mode where Min_Data=0x001.
Return values	• **None:**
Notes	• This bit can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	• CCR CCR LL_I2C_SetClockPeriod

LL_I2C_GetClockPeriod

Function name	**__STATIC_INLINE uint32_t LL_I2C_GetClockPeriod (I2C_TypeDef * I2Cx)**

Function description	Get the SCL high and low period.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **Value:** between Min_Data=0x004 and Max_Data=0xFFF, except in FAST DUTY mode where Min_Data=0x001.
Reference Manual to LL API cross reference:	• CCR CCR LL_I2C_GetClockPeriod

LL_I2C_ConfigSpeed

Function name	**__STATIC_INLINE void LL_I2C_ConfigSpeed (I2C_TypeDef * I2Cx, uint32_t PeriphClock, uint32_t ClockSpeed, uint32_t DutyCycle)**
Function description	Configure the SCL speed.
Parameters	• **I2Cx:** I2C Instance. • **PeriphClock:** Peripheral Clock (in Hz) • **ClockSpeed:** This parameter must be a value lower than 400kHz (in Hz). • **DutyCycle:** This parameter can be one of the following values: – LL_I2C_DUTYCYCLE_2 – LL_I2C_DUTYCYCLE_16_9
Return values	• **None:**
Notes	• This bit can only be programmed when the I2C is disabled (PE = 0).
Reference Manual to LL API cross reference:	• CR2 FREQ LL_I2C_ConfigSpeed • TRISE TRISE LL_I2C_ConfigSpeed • CCR FS LL_I2C_ConfigSpeed • CCR DUTY LL_I2C_ConfigSpeed • CCR CCR LL_I2C_ConfigSpeed

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 SMBUS LL_I2C_SetMode • CR1 SMBTYPE LL_I2C_SetMode • CR1 ENARP 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 SMBUS LL_I2C_GetMode • CR1 SMBTYPE LL_I2C_GetMode • CR1 ENARP 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 ALERT 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 ALERT 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 ALERT 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 ENPEC 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 ENPEC 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 ENPEC LL_I2C_IsEnabledSMBusPEC

LL_I2C_EnableIT_TX

Function name	**__STATIC_INLINE void LL_I2C_EnableIT_TX (I2C_TypeDef * I2Cx)**
Function description	Enable TXE interrupt.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 ITEVTEN LL_I2C_EnableIT_TX • CR2 ITBUFEN LL_I2C_EnableIT_TX

LL_I2C_DisableIT_TX

Function name	**__STATIC_INLINE void LL_I2C_DisableIT_TX (I2C_TypeDef * I2Cx)**
Function description	Disable TXE interrupt.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 ITEVTEN LL_I2C_DisableIT_TX • CR2 ITBUFEN 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 TXE Interrupt is enabled or disabled.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 ITEVTEN LL_I2C_IsEnabledIT_TX • CR2 ITBUFEN 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:	• CR2 ITEVTEN LL_I2C_EnableIT_RX • CR2 ITBUFEN 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:	• CR2 ITEVTEN LL_I2C_DisableIT_RX • CR2 ITBUFEN 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:	• CR2 ITEVTEN LL_I2C_IsEnabledIT_RX • CR2 ITBUFEN LL_I2C_IsEnabledIT_RX

LL_I2C_EnableIT_EVT

Function name	**__STATIC_INLINE void LL_I2C_EnableIT_EVT (I2C_TypeDef * I2Cx)**

Function description	Enable Events interrupts.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• Any of these events will generate interrupt : Start Bit (SB) Address sent, Address matched (ADDR) 10-bit header sent (ADD10) Stop detection (STOPF) Byte transfer finished (BTF) • Any of these events will generate interrupt if Buffer interrupts are enabled too(using unitary function LL_I2C_EnableIT_BUF()) : Receive buffer not empty (RXNE) Transmit buffer empty (TXE)
Reference Manual to LL API cross reference:	• CR2 ITEVTEN LL_I2C_EnableIT_EVT

LL_I2C_DisableIT_EVT

Function name	**__STATIC_INLINE void LL_I2C_DisableIT_EVT (I2C_TypeDef * I2Cx)**
Function description	Disable Events interrupts.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• Any of these events will generate interrupt : Start Bit (SB) Address sent, Address matched (ADDR) 10-bit header sent (ADD10) Stop detection (STOPF) Byte transfer finished (BTF) Receive buffer not empty (RXNE) Transmit buffer empty (TXE)
Reference Manual to LL API cross reference:	• CR2 ITEVTEN LL_I2C_DisableIT_EVT

LL_I2C_IsEnabledIT_EVT

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_EVT (I2C_TypeDef * I2Cx)**
Function description	Check if Events interrupts are enabled or disabled.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 ITEVTEN LL_I2C_IsEnabledIT_EVT

LL_I2C_EnableIT_BUF

Function name	**__STATIC_INLINE void LL_I2C_EnableIT_BUF (I2C_TypeDef * I2Cx)**
Function description	Enable Buffer interrupts.

Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• Any of these Buffer events will generate interrupt if Events interrupts are enabled too(using unitary function LL_I2C_EnableIT_EVT()) : Receive buffer not empty (RXNE) Transmit buffer empty (TXE)
Reference Manual to LL API cross reference:	• CR2 ITBUFEN LL_I2C_EnableIT_BUF

LL_I2C_DisableIT_BUF

Function name	**__STATIC_INLINE void LL_I2C_DisableIT_BUF (I2C_TypeDef * I2Cx)**
Function description	Disable Buffer interrupts.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• Any of these Buffer events will generate interrupt : Receive buffer not empty (RXNE) Transmit buffer empty (TXE)
Reference Manual to LL API cross reference:	• CR2 ITBUFEN LL_I2C_DisableIT_BUF

LL_I2C_IsEnabledIT_BUF

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsEnabledIT_BUF (I2C_TypeDef * I2Cx)**
Function description	Check if Buffer interrupts are enabled or disabled.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 ITBUFEN LL_I2C_IsEnabledIT_BUF

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 : Bus Error detection (BERR) Arbitration Loss (ARLO) Acknowledge

Failure(AF) Overrun/Underrun (OVR) SMBus Timeout detection (TIMEOUT) SMBus PEC error detection (PECERR) SMBus Alert pin event detection (SMBALERT)

Reference Manual to LL API cross reference:
- CR2 ITERREN 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 : Bus Error detection (BERR) Arbitration Loss (ARLO) Acknowledge Failure(AF) Overrun/Underrun (OVR) SMBus Timeout detection (TIMEOUT) SMBus PEC error detection (PECERR) SMBus Alert pin event detection (SMBALERT)

Reference Manual to LL API cross reference:
- CR2 ITERREN 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:
- CR2 ITERREN 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:	• SR1 TXE LL_I2C_IsActiveFlag_TXE

LL_I2C_IsActiveFlag_BTF

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_BTF (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of Byte Transfer Finished flag.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• SR1 BTF LL_I2C_IsActiveFlag_BTF

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:	• SR1 RXNE LL_I2C_IsActiveFlag_RXNE

LL_I2C_IsActiveFlag_SB

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_SB (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of Start Bit (master mode).
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Notes	• RESET: When No Start condition. SET: When Start condition is generated.
Reference Manual to LL API cross reference:	• SR1 SB LL_I2C_IsActiveFlag_SB

LL_I2C_IsActiveFlag_ADDR

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_ADDR (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of Address sent (master mode) or 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 address is fully sent (master mode) or when the received slave address matched with one of the enabled slave address (slave mode).
Reference Manual to LL API cross reference:	• SR1 ADDR LL_I2C_IsActiveFlag_ADDR

LL_I2C_IsActiveFlag_ADD10

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_ADD10 (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of 10-bit header sent (master mode).
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Notes	• RESET: When no ADD10 event occured. SET: When the master has sent the first address byte (header).
Reference Manual to LL API cross reference:	• SR1 ADD10 LL_I2C_IsActiveFlag_ADD10

LL_I2C_IsActiveFlag_AF

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_AF (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of Acknowledge failure flag.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Notes	• RESET: No acknowledge failure. SET: When an acknowledge failure is received after a byte transmission.
Reference Manual to LL API cross reference:	• SR1 AF LL_I2C_IsActiveFlag_AF

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 (slave mode).
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:
- SR1 STOPF LL_I2C_IsActiveFlag_STOP

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:
- SR1 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:
- SR1 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.

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:
- SR1 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.
Reference Manual to LL API cross reference:	• SR1 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.
Reference Manual to LL API cross reference:	• SR1 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.
Reference Manual to LL API cross reference:	• SR1 SMBALERT 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:	• SR2 BUSY LL_I2C_IsActiveFlag_BUSY

LL_I2C_IsActiveFlag_DUAL

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_DUAL (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of Dual flag.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Notes	• RESET: Received address matched with OAR1. SET: Received address matched with OAR2.
Reference Manual to LL API cross reference:	• SR2 DUALF LL_I2C_IsActiveFlag_DUAL

LL_I2C_IsActiveSMBusFlag_SMBHOST

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_SMBHOST (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of SMBus Host address reception (Slave mode).
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: No SMBus Host address SET: SMBus Host address received. • This status is cleared by hardware after a STOP condition or repeated START condition.
Reference Manual to LL API cross reference:	• SR2 SMBHOST LL_I2C_IsActiveSMBusFlag_SMBHOST

LL_I2C_IsActiveSMBusFlag_SMBDEFAULT

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveSMBusFlag_SMBDEFAULT (I2C_TypeDef * I2Cx)**

Function description	Indicate the status of SMBus Device default address reception (Slave mode).
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: No SMBus Device default address SET: SMBus Device default address received. • This status is cleared by hardware after a STOP condition or repeated START condition.
Reference Manual to LL API cross reference:	• SR2 SMBDEFAULT LL_I2C_IsActiveSMBusFlag_SMBDEFAULT

LL_I2C_IsActiveFlag_GENCALL

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_GENCALL (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of General call address reception (Slave mode).
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Notes	• RESET: No Generall call address SET: General call address received. • This status is cleared by hardware after a STOP condition or repeated START condition.
Reference Manual to LL API cross reference:	• SR2 GENCALL LL_I2C_IsActiveFlag_GENCALL

LL_I2C_IsActiveFlag_MSL

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsActiveFlag_MSL (I2C_TypeDef * I2Cx)**
Function description	Indicate the status of Master/Slave flag.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Notes	• RESET: Slave Mode. SET: Master Mode.
Reference Manual to LL API cross reference:	• SR2 MSL LL_I2C_IsActiveFlag_MSL

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:**
Notes	• Clearing this flag is done by a read access to the I2Cx_SR1 register followed by a read access to the I2Cx_SR2 register.
Reference Manual to LL API cross reference:	• SR1 ADDR LL_I2C_ClearFlag_ADDR

LL_I2C_ClearFlag_AF

Function name	**__STATIC_INLINE void LL_I2C_ClearFlag_AF (I2C_TypeDef * I2Cx)**
Function description	Clear Acknowledge failure flag.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Reference Manual to LL API cross reference:	• SR1 AF LL_I2C_ClearFlag_AF

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:**
Notes	• Clearing this flag is done by a read access to the I2Cx_SR1 register followed by a write access to I2Cx_CR1 register.
Reference Manual to LL API cross reference:	• SR1 STOPF LL_I2C_ClearFlag_STOP • CR1 PE LL_I2C_ClearFlag_STOP

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:	• SR1 BERR 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:	• SR1 ARLO 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:	• SR1 OVR 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:**
Reference Manual to LL API cross reference:	• SR1 PECERR 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	• SR1 TIMEOUT LL_I2C_ClearSMBusFlag_TIMEOUT

reference:

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:	• SR1 SMBALERT LL_I2C_ClearSMBusFlag_ALERT

LL_I2C_EnableReset

Function name	**__STATIC_INLINE void LL_I2C_EnableReset (I2C_TypeDef * I2Cx)**
Function description	Enable Reset of I2C peripheral.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 SWRST LL_I2C_EnableReset

LL_I2C_DisableReset

Function name	**__STATIC_INLINE void LL_I2C_DisableReset (I2C_TypeDef * I2Cx)**
Function description	Disable Reset of I2C peripheral.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 SWRST LL_I2C_DisableReset

LL_I2C_IsResetEnabled

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsResetEnabled (I2C_TypeDef * I2Cx)**
Function description	Check if the I2C peripheral is under reset state or not.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:	• CR1 SWRST LL_I2C_IsResetEnabled

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 or Master mode.
Reference Manual to LL API cross reference:	• CR1 ACK 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:	• CR1 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:	• CR1 STOP LL_I2C_GenerateStopCondition

LL_I2C_EnableBitPOS

Function name	**__STATIC_INLINE void LL_I2C_EnableBitPOS (I2C_TypeDef * I2Cx)**
Function description	Enable bit POS (master/host mode).
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• In that case, the ACK bit controls the (N)ACK of the next byte received or the PEC bit indicates that the next byte in shift register is a PEC.
Reference Manual to LL API cross reference:	• CR1 POS LL_I2C_EnableBitPOS

LL_I2C_DisableBitPOS

Function name	**__STATIC_INLINE void LL_I2C_DisableBitPOS (I2C_TypeDef * I2Cx)**
Function description	Disable bit POS (master/host mode).
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• In that case, the ACK bit controls the (N)ACK of the current byte received or the PEC bit indicates that the current byte in shift register is a PEC.
Reference Manual to LL API cross reference:	• CR1 POS LL_I2C_DisableBitPOS

LL_I2C_IsEnabledBitPOS

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsEnabledBitPOS (I2C_TypeDef * I2Cx)**
Function description	Check if bit POS is enabled or disabled.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR1 POS LL_I2C_IsEnabledBitPOS

LL_I2C_GetTransferDirection

Function name	**__STATIC_INLINE uint32_t LL_I2C_GetTransferDirection (I2C_TypeDef * I2Cx)**
Function description	Indicate the value of transfer direction.
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: Bus is in read transfer (peripheral point of view). SET: Bus is in write transfer (peripheral point of view).
Reference Manual to LL API cross reference:	• SR2 TRA LL_I2C_GetTransferDirection

LL_I2C_EnableLastDMA

Function name	**__STATIC_INLINE void LL_I2C_EnableLastDMA (I2C_TypeDef * I2Cx)**
Function description	Enable DMA last transfer.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• This action mean that next DMA EOT is the last transfer.
Reference Manual to LL API cross reference:	• CR2 LAST LL_I2C_EnableLastDMA

LL_I2C_DisableLastDMA

Function name	**__STATIC_INLINE void LL_I2C_DisableLastDMA (I2C_TypeDef * I2Cx)**
Function description	Disable DMA last transfer.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **None:**
Notes	• This action mean that next DMA EOT is not the last transfer.
Reference Manual to LL API cross reference:	• CR2 LAST LL_I2C_DisableLastDMA

LL_I2C_IsEnabledLastDMA

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsEnabledLastDMA (I2C_TypeDef * I2Cx)**
Function description	Check if DMA last transfer is enabled or disabled.
Parameters	• **I2Cx:** I2C Instance.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 LAST LL_I2C_IsEnabledLastDMA

LL_I2C_EnableSMBusPECCompare

Function name	**__STATIC_INLINE void LL_I2C_EnableSMBusPECCompare (I2C_TypeDef * I2Cx)**
Function description	Enable transfer or 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 compared, or by a START or STOP condition, it is also cleared by software.
Reference Manual to LL API cross reference:	• CR1 PEC LL_I2C_EnableSMBusPECCompare

LL_I2C_DisableSMBusPECCompare

Function name	**__STATIC_INLINE void LL_I2C_DisableSMBusPECCompare (I2C_TypeDef * I2Cx)**
Function description	Disable transfer or 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.
Reference Manual to LL API cross reference:	• CR1 PEC LL_I2C_DisableSMBusPECCompare

LL_I2C_IsEnabledSMBusPECCompare

Function name	**__STATIC_INLINE uint32_t LL_I2C_IsEnabledSMBusPECCompare (I2C_TypeDef * I2Cx)**
Function description	Check if the SMBus Packet Error byte transfer or 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:	• CR1 PEC 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:	• SR2 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=0x0 and Max_Data=0xFF
Reference Manual to LL API cross reference:	• DR DR 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=0x0 and Max_Data=0xFF
Return values	• **None:**
Reference Manual to LL API cross reference:	• DR DR LL_I2C_TransmitData8

LL_I2C_Init

Function name	**uint32_t 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	**uint32_t 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:**

57.3 I2C Firmware driver defines

57.3.1 I2C

Master Clock Speed Mode

LL_I2C_CLOCK_SPEED_STANDARD_MODE	Master clock speed range is standard mode
LL_I2C_CLOCK_SPEED_FAST_MODE	Master clock speed range is fast mode

Read Write Direction

LL_I2C_DIRECTION_WRITE	Bus is in write transfer
LL_I2C_DIRECTION_READ	Bus is in read transfer

Fast Mode Duty Cycle

LL_I2C_DUTYCYCLE_2	I2C fast mode Tlow/Thigh = 2
LL_I2C_DUTYCYCLE_16_9	I2C fast mode Tlow/Thigh = 16/9

Get Flags Defines

LL_I2C_SR1_SB	Start Bit (master mode)
LL_I2C_SR1_ADDR	Address sent (master mode) or Address matched flag (slave mode)
LL_I2C_SR1_BTF	Byte Transfer Finished flag
LL_I2C_SR1_ADD10	10-bit header sent (master mode)
LL_I2C_SR1_STOPF	Stop detection flag (slave mode)
LL_I2C_SR1_RXNE	Data register not empty (receivers)
LL_I2C_SR1_TXE	Data register empty (transmitters)

LL_I2C_SR1_BERR	Bus error
LL_I2C_SR1_ARLO	Arbitration lost
LL_I2C_SR1_AF	Acknowledge failure flag
LL_I2C_SR1_OVR	Overrun/Underrun
LL_I2C_SR1_PECERR	PEC Error in reception (SMBus mode)
LL_I2C_SR1_TIMEOUT	Timeout detection flag (SMBus mode)
LL_I2C_SR1_SMALERT	SMBus alert (SMBus mode)
LL_I2C_SR2_MSL	Master/Slave flag
LL_I2C_SR2_BUSY	Bus busy flag
LL_I2C_SR2_TRA	Transmitter/receiver direction
LL_I2C_SR2_GENCALL	General call address (Slave mode)
LL_I2C_SR2_SMBDEFAULT	SMBus Device default address (Slave mode)
LL_I2C_SR2_SMBHOST	SMBus Host address (Slave mode)
LL_I2C_SR2_DUALF	Dual flag (Slave mode)

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_CR2_ITEVTEN	Events interrupts enable
LL_I2C_CR2_ITBUFEN	Buffer interrupts enable
LL_I2C_CR2_ITERREN	Error interrupts enable

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.

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

Exported_Macros_Helper

__LL_I2C_FREQ_HZ_TO_MHZ

Description:

- Convert Peripheral Clock Frequency in Mhz.

Parameters:

- __PCLK__: This parameter must be a value of peripheral clock (in Hz).

Return value:

- Value: of peripheral clock (in Mhz)

__LL_I2C_FREQ_MHZ_TO_HZ

Description:

- Convert Peripheral Clock Frequency in Hz.

Parameters:

- __PCLK__: This parameter must be a value of peripheral clock (in Mhz).

Return value:

- Value: of peripheral clock (in Hz)

__LL_I2C_RISE_TIME

Description:

- Compute I2C Clock rising time.

Parameters:

- __FREQRANGE__: This parameter must be a value of peripheral clock (in Mhz).
- __SPEED__: This parameter must be a value lower than 400kHz (in Hz).

Return value:

- Value: between Min_Data=0x02 and Max_Data=0x3F

__LL_I2C_SPEED_TO_CCR

Description:

- Compute Speed clock range to a Clock Control Register (I2C_CCR_CCR) value.

Parameters:

- __PCLK__: This parameter must be a value of peripheral clock (in Hz).
- __SPEED__: This parameter must be a value lower than 400kHz (in Hz).
- __DUTYCYCLE__: This parameter can be one of the following values:
  - LL_I2C_DUTYCYCLE_2
  - LL_I2C_DUTYCYCLE_16_9

Return value:

- Value: between Min_Data=0x004 and Max_Data=0xFFF, except in FAST DUTY mode where Min_Data=0x001.

__LL_I2C_SPEED_STANDARD_TO_CCR

Description:

- Compute Speed Standard clock range to a Clock Control Register (I2C_CCR_CCR) value.

Parameters:

- __PCLK__: This parameter must be a

value of peripheral clock (in Hz).
- __SPEED__: This parameter must be a value lower than 100kHz (in Hz).

Return value:

- Value: between Min_Data=0x004 and Max_Data=0xFFF.

__LL_I2C_SPEED_FAST_TO_CCR

Description:

- Compute Speed Fast clock range to a Clock Control Register (I2C_CCR_CCR) value.

Parameters:

- __PCLK__: This parameter must be a value of peripheral clock (in Hz).
- __SPEED__: This parameter must be a value between Min_Data=100Khz and Max_Data=400Khz (in Hz).
- __DUTYCYCLE__: This parameter can be one of the following values:
  - LL_I2C_DUTYCYCLE_2
  - LL_I2C_DUTYCYCLE_16_9

Return value:

- Value: between Min_Data=0x001 and Max_Data=0xFFF

__LL_I2C_10BIT_ADDRESS

Description:

- Get the Least significant bits of a 10-Bits address.

Parameters:

- __ADDRESS__: This parameter must be a value of a 10-Bits slave address.

Return value:

- Value: between Min_Data=0x00 and Max_Data=0xFF

__LL_I2C_10BIT_HEADER_WRITE

Description:

- Convert a 10-Bits address to a 10-Bits header with Write direction.

Parameters:

- __ADDRESS__: This parameter must be a value of a 10-Bits slave address.

Return value:

- Value: between Min_Data=0xF0 and Max_Data=0xF6

__LL_I2C_10BIT_HEADER_READ

Description:

- Convert a 10-Bits address to a 10-Bits

header with Read direction.

Parameters:

- __ADDRESS__: This parameter must be a value of a 10-Bits slave address.

Return value:

- Value: between Min_Data=0xF1 and Max_Data=0xF7

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

58 LL I2S Generic Driver

58.1 I2S Firmware driver registers structures

58.1.1 LL_I2S_InitTypeDef

Data Fields

- ***uint32_t Mode***
- ***uint32_t Standard***
- ***uint32_t DataFormat***
- ***uint32_t MCLKOutput***
- ***uint32_t AudioFreq***
- ***uint32_t ClockPolarity***

Field Documentation

- ***uint32_t LL_I2S_InitTypeDef::Mode***
  Specifies the I2S operating mode. This parameter can be a value of ***I2S_LL_EC_MODE***This feature can be modified afterwards using unitary function **LL_I2S_SetTransferMode()**.
- ***uint32_t LL_I2S_InitTypeDef::Standard***
  Specifies the standard used for the I2S communication. This parameter can be a value of ***I2S_LL_EC_STANDARD***This feature can be modified afterwards using unitary function **LL_I2S_SetStandard()**.
- ***uint32_t LL_I2S_InitTypeDef::DataFormat***
  Specifies the data format for the I2S communication. This parameter can be a value of ***I2S_LL_EC_DATA_FORMAT***This feature can be modified afterwards using unitary function **LL_I2S_SetDataFormat()**.
- ***uint32_t LL_I2S_InitTypeDef::MCLKOutput***
  Specifies whether the I2S MCLK output is enabled or not. This parameter can be a value of ***I2S_LL_EC_MCLK_OUTPUT***This feature can be modified afterwards using unitary functions **LL_I2S_EnableMasterClock()** or **LL_I2S_DisableMasterClock**.
- ***uint32_t LL_I2S_InitTypeDef::AudioFreq***
  Specifies the frequency selected for the I2S communication. This parameter can be a value of ***I2S_LL_EC_AUDIO_FREQ***Audio Frequency can be modified afterwards using Reference manual formulas to calculate Prescaler Linear, Parity and unitary functions **LL_I2S_SetPrescalerLinear()** and **LL_I2S_SetPrescalerParity()** to set it.
- ***uint32_t LL_I2S_InitTypeDef::ClockPolarity***
  Specifies the idle state of the I2S clock. This parameter can be a value of ***I2S_LL_EC_POLARITY***This feature can be modified afterwards using unitary function **LL_I2S_SetClockPolarity()**.

58.2 I2S Firmware driver API description

58.2.1 Detailed description of functions

LL_I2S_Enable

Function name	**__STATIC_INLINE void LL_I2S_Enable (SPI_TypeDef * SPIx)**
Function description	Select I2S mode and Enable I2S peripheral.
Parameters	• **SPIx:** SPI Instance

Return values
- **None:**

Reference Manual to LL API cross reference:
- I2SCFGR I2SMOD LL_I2S_Enable
- I2SCFGR I2SE LL_I2S_Enable

LL_I2S_Disable

Function name **__STATIC_INLINE void LL_I2S_Disable (SPI_TypeDef * SPIx)**

Function description Disable I2S peripheral.

Parameters
- **SPIx:** SPI Instance

Return values
- **None:**

Reference Manual to LL API cross reference:
- I2SCFGR I2SE LL_I2S_Disable

LL_I2S_IsEnabled

Function name **__STATIC_INLINE uint32_t LL_I2S_IsEnabled (SPI_TypeDef * SPIx)**

Function description Check if I2S peripheral is enabled.

Parameters
- **SPIx:** SPI Instance

Return values
- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:
- I2SCFGR I2SE LL_I2S_IsEnabled

LL_I2S_SetDataFormat

Function name **__STATIC_INLINE void LL_I2S_SetDataFormat (SPI_TypeDef * SPIx, uint32_t DataFormat)**

Function description Set I2S data frame length.

Parameters
- **SPIx:** SPI Instance
- **DataFormat:** This parameter can be one of the following values:
  - LL_I2S_DATAFORMAT_16B
  - LL_I2S_DATAFORMAT_16B_EXTENDED
  - LL_I2S_DATAFORMAT_24B
  - LL_I2S_DATAFORMAT_32B

Return values
- **None:**

Reference Manual to LL API cross reference:
- I2SCFGR DATLEN LL_I2S_SetDataFormat
- I2SCFGR CHLEN LL_I2S_SetDataFormat

LL_I2S_GetDataFormat

Function name **__STATIC_INLINE uint32_t LL_I2S_GetDataFormat (SPI_TypeDef * SPIx)**

Function description	Get I2S data frame length.
Parameters	• **SPIx:** SPI Instance
Return values	• **Returned:** value can be one of the following values: – LL_I2S_DATAFORMAT_16B – LL_I2S_DATAFORMAT_16B_EXTENDED – LL_I2S_DATAFORMAT_24B – LL_I2S_DATAFORMAT_32B
Reference Manual to LL API cross reference:	• I2SCFGR DATLEN LL_I2S_GetDataFormat • I2SCFGR CHLEN LL_I2S_GetDataFormat

LL_I2S_SetClockPolarity

Function name	**__STATIC_INLINE void LL_I2S_SetClockPolarity (SPI_TypeDef * SPIx, uint32_t ClockPolarity)**
Function description	Set I2S clock polarity.
Parameters	• **SPIx:** SPI Instance • **ClockPolarity:** This parameter can be one of the following values: – LL_I2S_POLARITY_LOW – LL_I2S_POLARITY_HIGH
Return values	• **None:**
Reference Manual to LL API cross reference:	• I2SCFGR CKPOL LL_I2S_SetClockPolarity

LL_I2S_GetClockPolarity

Function name	**__STATIC_INLINE uint32_t LL_I2S_GetClockPolarity (SPI_TypeDef * SPIx)**
Function description	Get I2S clock polarity.
Parameters	• **SPIx:** SPI Instance
Return values	• **Returned:** value can be one of the following values: – LL_I2S_POLARITY_LOW – LL_I2S_POLARITY_HIGH
Reference Manual to LL API cross reference:	• I2SCFGR CKPOL LL_I2S_GetClockPolarity

LL_I2S_SetStandard

Function name	**__STATIC_INLINE void LL_I2S_SetStandard (SPI_TypeDef * SPIx, uint32_t Standard)**
Function description	Set I2S standard protocol.
Parameters	• **SPIx:** SPI Instance • **Standard:** This parameter can be one of the following values:

- LL_I2S_STANDARD_PHILIPS
- LL_I2S_STANDARD_MSB
- LL_I2S_STANDARD_LSB
- LL_I2S_STANDARD_PCM_SHORT
- LL_I2S_STANDARD_PCM_LONG

Return values
- **None:**

Reference Manual to LL API cross reference:
- I2SCFGR I2SSTD LL_I2S_SetStandard
- I2SCFGR PCMSYNC LL_I2S_SetStandard

LL_I2S_GetStandard

Function name **__STATIC_INLINE uint32_t LL_I2S_GetStandard (SPI_TypeDef * SPIx)**

Function description Get I2S standard protocol.

Parameters
- **SPIx:** SPI Instance

Return values
- **Returned:** value can be one of the following values:
  - LL_I2S_STANDARD_PHILIPS
  - LL_I2S_STANDARD_MSB
  - LL_I2S_STANDARD_LSB
  - LL_I2S_STANDARD_PCM_SHORT
  - LL_I2S_STANDARD_PCM_LONG

Reference Manual to LL API cross reference:
- I2SCFGR I2SSTD LL_I2S_GetStandard
- I2SCFGR PCMSYNC LL_I2S_GetStandard

LL_I2S_SetTransferMode

Function name **__STATIC_INLINE void LL_I2S_SetTransferMode (SPI_TypeDef * SPIx, uint32_t Mode)**

Function description Set I2S transfer mode.

Parameters
- **SPIx:** SPI Instance
- **Mode:** This parameter can be one of the following values:
  - LL_I2S_MODE_SLAVE_TX
  - LL_I2S_MODE_SLAVE_RX
  - LL_I2S_MODE_MASTER_TX
  - LL_I2S_MODE_MASTER_RX

Return values
- **None:**

Reference Manual to LL API cross reference:
- I2SCFGR I2SCFG LL_I2S_SetTransferMode

LL_I2S_GetTransferMode

Function name **__STATIC_INLINE uint32_t LL_I2S_GetTransferMode (SPI_TypeDef * SPIx)**

Function description Get I2S transfer mode.

Parameters
- **SPIx:** SPI Instance

Return values
- **Returned:** value can be one of the following values:
  - LL_I2S_MODE_SLAVE_TX
  - LL_I2S_MODE_SLAVE_RX
  - LL_I2S_MODE_MASTER_TX
  - LL_I2S_MODE_MASTER_RX

Reference Manual to LL API cross reference:
- I2SCFGR I2SCFG LL_I2S_GetTransferMode

LL_I2S_SetPrescalerLinear

Function name
__STATIC_INLINE void LL_I2S_SetPrescalerLinear (SPI_TypeDef * SPIx, uint8_t PrescalerLinear)

Function description
Set I2S linear prescaler.

Parameters
- **SPIx:** SPI Instance
- **PrescalerLinear:** Value between Min_Data=0x02 and Max_Data=0xFF

Return values
- **None:**

Reference Manual to LL API cross reference:
- I2SPR I2SDIV LL_I2S_SetPrescalerLinear

LL_I2S_GetPrescalerLinear

Function name
__STATIC_INLINE uint32_t LL_I2S_GetPrescalerLinear (SPI_TypeDef * SPIx)

Function description
Get I2S linear prescaler.

Parameters
- **SPIx:** SPI Instance

Return values
- **PrescalerLinear:** Value between Min_Data=0x02 and Max_Data=0xFF

Reference Manual to LL API cross reference:
- I2SPR I2SDIV LL_I2S_GetPrescalerLinear

LL_I2S_SetPrescalerParity

Function name
__STATIC_INLINE void LL_I2S_SetPrescalerParity (SPI_TypeDef * SPIx, uint32_t PrescalerParity)

Function description
Set I2S parity prescaler.

Parameters
- **SPIx:** SPI Instance
- **PrescalerParity:** This parameter can be one of the following values:
  - LL_I2S_PRESCALER_PARITY_EVEN
  - LL_I2S_PRESCALER_PARITY_ODD

Return values
- **None:**

Reference Manual to LL API cross reference:	• I2SPR ODD LL_I2S_SetPrescalerParity

LL_I2S_GetPrescalerParity

Function name	**__STATIC_INLINE uint32_t LL_I2S_GetPrescalerParity (SPI_TypeDef * SPIx)**
Function description	Get I2S parity prescaler.
Parameters	• **SPIx:** SPI Instance
Return values	• **Returned:** value can be one of the following values: – LL_I2S_PRESCALER_PARITY_EVEN – LL_I2S_PRESCALER_PARITY_ODD
Reference Manual to LL API cross reference:	• I2SPR ODD LL_I2S_GetPrescalerParity

LL_I2S_EnableMasterClock

Function name	**__STATIC_INLINE void LL_I2S_EnableMasterClock (SPI_TypeDef * SPIx)**
Function description	Enable the master clock ouput (Pin MCK)
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• I2SPR MCKOE LL_I2S_EnableMasterClock

LL_I2S_DisableMasterClock

Function name	**__STATIC_INLINE void LL_I2S_DisableMasterClock (SPI_TypeDef * SPIx)**
Function description	Disable the master clock ouput (Pin MCK)
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• I2SPR MCKOE LL_I2S_DisableMasterClock

LL_I2S_IsEnabledMasterClock

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsEnabledMasterClock (SPI_TypeDef * SPIx)**
Function description	Check if the master clock ouput (Pin MCK) is enabled.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:	• I2SPR MCKOE LL_I2S_IsEnabledMasterClock

LL_I2S_IsActiveFlag_RXNE

Function name	**__STATIC_INLINE uint32_t LL_I2S_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_I2S_IsActiveFlag_RXNE

LL_I2S_IsActiveFlag_TXE

Function name	**__STATIC_INLINE uint32_t LL_I2S_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_I2S_IsActiveFlag_TXE

LL_I2S_IsActiveFlag_BSY

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_BSY (SPI_TypeDef * SPIx)**
Function description	Get busy flag.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• SR BSY LL_I2S_IsActiveFlag_BSY

LL_I2S_IsActiveFlag_OVR

Function name	**__STATIC_INLINE uint32_t LL_I2S_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	• SR OVR LL_I2S_IsActiveFlag_OVR

reference:

LL_I2S_IsActiveFlag_UDR

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_UDR (SPI_TypeDef * SPIx)**
Function description	Get underrun error flag.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• SR UDR LL_I2S_IsActiveFlag_UDR

LL_I2S_IsActiveFlag_FRE

Function name	**__STATIC_INLINE uint32_t LL_I2S_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_I2S_IsActiveFlag_FRE

LL_I2S_IsActiveFlag_CHSIDE

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsActiveFlag_CHSIDE (SPI_TypeDef * SPIx)**
Function description	Get channel side flag.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).
Notes	• 0: Channel Left has to be transmitted or has been received 1: Channel Right has to be transmitted or has been received It has no significance in PCM mode.
Reference Manual to LL API cross reference:	• SR CHSIDE LL_I2S_IsActiveFlag_CHSIDE

LL_I2S_ClearFlag_OVR

Function name	**__STATIC_INLINE void LL_I2S_ClearFlag_OVR (SPI_TypeDef * SPIx)**
Function description	Clear overrun error flag.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**

Reference Manual to LL API cross reference:	• SR OVR LL_I2S_ClearFlag_OVR

LL_I2S_ClearFlag_UDR

Function name	**__STATIC_INLINE void LL_I2S_ClearFlag_UDR (SPI_TypeDef * SPIx)**
Function description	Clear underrun error flag.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• SR UDR LL_I2S_ClearFlag_UDR

LL_I2S_ClearFlag_FRE

Function name	**__STATIC_INLINE void LL_I2S_ClearFlag_FRE (SPI_TypeDef * SPIx)**
Function description	Clear frame format error flag.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• SR FRE LL_I2S_ClearFlag_FRE

LL_I2S_EnableIT_ERR

Function name	**__STATIC_INLINE void LL_I2S_EnableIT_ERR (SPI_TypeDef * SPIx)**
Function description	Enable error IT.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Notes	• This bit controls the generation of an interrupt when an error condition occurs (OVR, UDR and FRE in I2S mode).
Reference Manual to LL API cross reference:	• CR2 ERRIE LL_I2S_EnableIT_ERR

LL_I2S_EnableIT_RXNE

Function name	**__STATIC_INLINE void LL_I2S_EnableIT_RXNE (SPI_TypeDef * SPIx)**
Function description	Enable Rx buffer not empty IT.
Parameters	• **SPIx:** SPI Instance

Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 RXNEIE LL_I2S_EnableIT_RXNE

LL_I2S_EnableIT_TXE

Function name	**__STATIC_INLINE void LL_I2S_EnableIT_TXE (SPI_TypeDef * SPIx)**
Function description	Enable Tx buffer empty IT.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 TXEIE LL_I2S_EnableIT_TXE

LL_I2S_DisableIT_ERR

Function name	**__STATIC_INLINE void LL_I2S_DisableIT_ERR (SPI_TypeDef * SPIx)**
Function description	Disable error IT.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Notes	• This bit controls the generation of an interrupt when an error condition occurs (OVR, UDR and FRE in I2S mode).
Reference Manual to LL API cross reference:	• CR2 ERRIE LL_I2S_DisableIT_ERR

LL_I2S_DisableIT_RXNE

Function name	**__STATIC_INLINE void LL_I2S_DisableIT_RXNE (SPI_TypeDef * SPIx)**
Function description	Disable Rx buffer not empty IT.
Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 RXNEIE LL_I2S_DisableIT_RXNE

LL_I2S_DisableIT_TXE

Function name	**__STATIC_INLINE void LL_I2S_DisableIT_TXE (SPI_TypeDef * SPIx)**
Function description	Disable Tx buffer empty IT.

Parameters	• **SPIx:** SPI Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR2 TXEIE LL_I2S_DisableIT_TXE

LL_I2S_IsEnabledIT_ERR

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsEnabledIT_ERR (SPI_TypeDef * SPIx)**
Function description	Check if ERR IT is enabled.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 ERRIE LL_I2S_IsEnabledIT_ERR

LL_I2S_IsEnabledIT_RXNE

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsEnabledIT_RXNE (SPI_TypeDef * SPIx)**
Function description	Check if RXNE IT is enabled.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 RXNEIE LL_I2S_IsEnabledIT_RXNE

LL_I2S_IsEnabledIT_TXE

Function name	**__STATIC_INLINE uint32_t LL_I2S_IsEnabledIT_TXE (SPI_TypeDef * SPIx)**
Function description	Check if TXE IT is enabled.
Parameters	• **SPIx:** SPI Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CR2 TXEIE LL_I2S_IsEnabledIT_TXE

LL_I2S_EnableDMAReq_RX

Function name	**__STATIC_INLINE void LL_I2S_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_I2S_EnableDMAReq_RX

LL_I2S_DisableDMAReq_RX

Function name	**__STATIC_INLINE void LL_I2S_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_I2S_DisableDMAReq_RX

LL_I2S_IsEnabledDMAReq_RX

Function name	**__STATIC_INLINE uint32_t LL_I2S_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_I2S_IsEnabledDMAReq_RX

LL_I2S_EnableDMAReq_TX

Function name	**__STATIC_INLINE void LL_I2S_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_I2S_EnableDMAReq_TX

LL_I2S_DisableDMAReq_TX

Function name	**__STATIC_INLINE void LL_I2S_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_I2S_DisableDMAReq_TX

LL_I2S_IsEnabledDMAReq_TX

Function name	**__STATIC_INLINE uint32_t LL_I2S_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_I2S_IsEnabledDMAReq_TX

LL_I2S_ReceiveData16

Function name	**__STATIC_INLINE uint16_t LL_I2S_ReceiveData16 (SPI_TypeDef * SPIx)**
Function description	Read 16-Bits in data register.
Parameters	• **SPIx:** SPI Instance
Return values	• **RxData:** Value between Min_Data=0x0000 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	• DR DR LL_I2S_ReceiveData16

LL_I2S_TransmitData16

Function name	**__STATIC_INLINE void LL_I2S_TransmitData16 (SPI_TypeDef * SPIx, uint16_t TxData)**
Function description	Write 16-Bits in data register.
Parameters	• **SPIx:** SPI Instance • **TxData:** Value between Min_Data=0x0000 and Max_Data=0xFFFF
Return values	• **None:**
Reference Manual to LL API cross reference:	• DR DR LL_I2S_TransmitData16

LL_I2S_DeInit

Function name	**ErrorStatus LL_I2S_DeInit (SPI_TypeDef * SPIx)**
Function description	De-initialize the SPI/I2S 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_I2S_Init

Function name **ErrorStatus LL_I2S_Init (SPI_TypeDef * SPIx, LL_I2S_InitTypeDef * I2S_InitStruct)**

Function description Initializes the SPI/I2S registers according to the specified parameters in I2S_InitStruct.

Parameters
- **SPIx:** SPI Instance
- **I2S_InitStruct:** pointer to a LL_I2S_InitTypeDef structure

Return values
- **An:** ErrorStatus enumeration value:
  - SUCCESS: SPI registers are Initialized
  - ERROR: SPI registers are not Initialized

Notes
- As some bits in SPI configuration registers can only be written when the SPI is disabled (SPI_CR1_SPE bit =0), SPI IP should be in disabled state prior calling this function. Otherwise, ERROR result will be returned.

LL_I2S_StructInit

Function name **void LL_I2S_StructInit (LL_I2S_InitTypeDef * I2S_InitStruct)**

Function description Set each LL_I2S_InitTypeDef field to default value.

Parameters
- **I2S_InitStruct:** pointer to a LL_I2S_InitTypeDef structure whose fields will be set to default values.

Return values
- **None:**

LL_I2S_ConfigPrescaler

Function name **void LL_I2S_ConfigPrescaler (SPI_TypeDef * SPIx, uint32_t PrescalerLinear, uint32_t PrescalerParity)**

Function description Set linear and parity prescaler.

Parameters
- **SPIx:** SPI Instance
- **PrescalerLinear:** value: Min_Data=0x02 and Max_Data=0xFF.
- **PrescalerParity:** This parameter can be one of the following values:
  - LL_I2S_PRESCALER_PARITY_EVEN
  - LL_I2S_PRESCALER_PARITY_ODD

Return values
- **None:**

Notes
- To calculate value of PrescalerLinear(I2SDIV[7:0] bits) and PrescalerParity(ODD bit) Check Audio frequency table and formulas inside Reference Manual (SPI/I2S).

58.3 I2S Firmware driver defines

58.3.1 I2S

Audio Frequency

LL_I2S_AUDIOFREQ_192K	Audio Frequency configuration 192000 Hz
LL_I2S_AUDIOFREQ_96K	Audio Frequency configuration 96000 Hz
LL_I2S_AUDIOFREQ_48K	Audio Frequency configuration 48000 Hz
LL_I2S_AUDIOFREQ_44K	Audio Frequency configuration 44100 Hz
LL_I2S_AUDIOFREQ_32K	Audio Frequency configuration 32000 Hz
LL_I2S_AUDIOFREQ_22K	Audio Frequency configuration 22050 Hz
LL_I2S_AUDIOFREQ_16K	Audio Frequency configuration 16000 Hz
LL_I2S_AUDIOFREQ_11K	Audio Frequency configuration 11025 Hz
LL_I2S_AUDIOFREQ_8K	Audio Frequency configuration 8000 Hz
LL_I2S_AUDIOFREQ_DEFAULT	Audio Freq not specified. Register I2SDIV = 2

Data format

LL_I2S_DATAFORMAT_16B	Data length 16 bits, Channel lenght 16bit
LL_I2S_DATAFORMAT_16B_EXTENDED	Data length 16 bits, Channel lenght 32bit
LL_I2S_DATAFORMAT_24B	Data length 24 bits, Channel lenght 32bit
LL_I2S_DATAFORMAT_32B	Data length 16 bits, Channel lenght 32bit

Get Flags Defines

LL_I2S_SR_RXNE	Rx buffer not empty flag
LL_I2S_SR_TXE	Tx buffer empty flag
LL_I2S_SR_BSY	Busy flag
LL_I2S_SR_UDR	Underrun flag
LL_I2S_SR_OVR	Overrun flag
LL_I2S_SR_FRE	TI mode frame format error flag

MCLK Output

LL_I2S_MCLK_OUTPUT_DISABLE	Master clock output is disabled
LL_I2S_MCLK_OUTPUT_ENABLE	Master clock output is enabled

Operation Mode

LL_I2S_MODE_SLAVE_TX	Slave Tx configuration
LL_I2S_MODE_SLAVE_RX	Slave Rx configuration
LL_I2S_MODE_MASTER_TX	Master Tx configuration
LL_I2S_MODE_MASTER_RX	Master Rx configuration

Clock Polarity

LL_I2S_POLARITY_LOW	Clock steady state is low level
LL_I2S_POLARITY_HIGH	Clock steady state is high level

Prescaler Factor

LL_I2S_PRESCALER_PARITY_EVEN	Odd factor: Real divider value is = I2SDIV * 2
LL_I2S_PRESCALER_PARITY_ODD	Odd factor: Real divider value is = (I2SDIV * 2)+1

I2s Standard

LL_I2S_STANDARD_PHILIPS	I2S standard philips
LL_I2S_STANDARD_MSB	MSB justified standard (left justified)
LL_I2S_STANDARD_LSB	LSB justified standard (right justified)
LL_I2S_STANDARD_PCM_SHORT	PCM standard, short frame synchronization
LL_I2S_STANDARD_PCM_LONG	PCM standard, long frame synchronization

Common Write and read registers Macros

LL_I2S_WriteReg

Description:

- Write a value in I2S register.

Parameters:

- __INSTANCE__: I2S Instance
- __REG__: Register to be written
- __VALUE__: Value to be written in the register

Return value:

- None

LL_I2S_ReadReg

Description:

- Read a value in I2S register.

Parameters:

- __INSTANCE__: I2S Instance
- __REG__: Register to be read

Return value:

- Register: value

59 LL IWDG Generic Driver

59.1 IWDG Firmware driver API description

59.1.1 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_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_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 RVU LL_IWDG_IsReady

59.2 IWDG Firmware driver defines

59.2.1 IWDG

Get Flags Defines

LL_IWDG_SR_PVU	Watchdog prescaler value update
LL_IWDG_SR_RVU	Watchdog counter reload 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

60 LL OPAMP Generic Driver

60.1 OPAMP Firmware driver registers structures

60.1.1 LL_OPAMP_InitTypeDef

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***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. 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()**.

60.2 OPAMP Firmware driver API description

60.2.1 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 AOP_RANGE 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 AOP_RANGE 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
- CSR OPA1LPM LL_OPAMP_SetPowerMode

reference:
- CSR OPA2LPM LL_OPAMP_SetPowerMode
- CSR OPA3LPM 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 OPA1LPM LL_OPAMP_GetPowerMode
- CSR OPA2LPM LL_OPAMP_GetPowerMode
- CSR OPA3LPM 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, entering in calibration mode makes loosing OPAMP internal switches configuration. Therefore, when going back to functional mode, functional mode must be set again using LL_OPAMP_SetFunctionalMode().

Reference Manual to LL API cross reference:
- CSR S3SELx LL_OPAMP_SetMode
- CSR S4SELx LL_OPAMP_SetMode
- CSR S5SELx LL_OPAMP_SetMode
- CSR S6SELx LL_OPAMP_SetMode
- CSR S7SEL2 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 S3SELx LL_OPAMP_SetMode • CSR S4SELx LL_OPAMP_SetMode • CSR S5SELx LL_OPAMP_SetMode • CSR S6SELx LL_OPAMP_SetMode • CSR S7SEL2 LL_OPAMP_SetMode

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
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 S3SELx 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
Reference Manual to LL API cross reference:	• CSR S3SELx LL_OPAMP_GetFunctionalMode

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: (1) Parameter specific to OPAMP instances: OPAMP1, OPAMP2. – LL_OPAMP_INPUT_NONINVERT_IO0 – LL_OPAMP_INPUT_NONINV_DAC1_CH1 (1) – LL_OPAMP_INPUT_NONINV_DAC1_CH2 (2) • (2) Parameter specific to OPAMP instances: OPAMP2, OPAMP3.
Return values	• **None:**
Reference Manual to LL API cross reference:	• CSR S5SELx LL_OPAMP_SetInputNonInverting • • CSR S6SELx LL_OPAMP_SetInputNonInverting • • CSR S7SEL2 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: (1) Parameter specific to OPAMP instances: OPAMP1, OPAMP2. – LL_OPAMP_INPUT_NONINVERT_IO0 – LL_OPAMP_INPUT_NONINV_DAC1_CH1 (1) – LL_OPAMP_INPUT_NONINV_DAC1_CH2 (2) • (2) Parameter specific to OPAMP instances: OPAMP2, OPAMP3.
Reference Manual to LL API cross reference:	• CSR S5SELx LL_OPAMP_GetInputNonInverting • • CSR S6SELx LL_OPAMP_GetInputNonInverting •

- CSR S7SEL2 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: (1) Alternative IO pin, not low leakage, availability depends on STM32L1 serie devices packages. – LL_OPAMP_INPUT_INVERT_IO0 – LL_OPAMP_INPUT_INVERT_IO1 (1) – LL_OPAMP_INPUT_INVERT_CONNECT_NO
Return values	• **None:**
Notes	• OPAMP inverting input is used with OPAMP in mode standalone. Otherwise (OPAMP in mode follower), OPAMP inverting input is not used (not connected to GPIO pin).
Reference Manual to LL API cross reference:	• CSR S4SELx LL_OPAMP_SetInputInverting • • CSR ANAWSELx 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: (1) Alternative IO pin, not low leakage, availability depends on STM32L1 serie devices packages. – LL_OPAMP_INPUT_INVERT_IO0 – LL_OPAMP_INPUT_INVERT_IO1 (1) – LL_OPAMP_INPUT_INVERT_CONNECT_NO
Reference Manual to LL API cross reference:	• CSR S4SELx LL_OPAMP_SetInputInverting • • CSR ANAWSELx LL_OPAMP_SetInputInverting

LL_OPAMP_SetCommonTrimmingMode

Function name	**__STATIC_INLINE void LL_OPAMP_SetCommonTrimmingMode (OPAMP_Common_TypeDef * OPAMPxy_COMMON, uint32_t TrimmingMode)**
Function description	Set OPAMP trimming mode.
Parameters	• **OPAMPxy_COMMON:** OPAMP common instance (can be set directly from CMSIS definition or by using helper macro __LL_OPAMP_COMMON_INSTANCE())

- **TrimmingMode:** This parameter can be one of the following values:
  - LL_OPAMP_TRIMMING_FACTORY
  - LL_OPAMP_TRIMMING_USER

Return values
- **None:**

Notes
- The OPAMP trimming mode applies to several OPAMP instances (if several OPAMP instances available on the selected device).

Reference Manual to LL API cross reference:
- OTR OT_USER LL_OPAMP_SetCommonTrimmingMode

LL_OPAMP_GetCommonTrimmingMode

Function name
__STATIC_INLINE uint32_t LL_OPAMP_GetCommonTrimmingMode (OPAMP_Common_TypeDef * OPAMPxy_COMMON)

Function description
Get OPAMP trimming mode.

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_TRIMMING_FACTORY
  - LL_OPAMP_TRIMMING_USER

Notes
- The OPAMP trimming mode applies to several OPAMP instances (if several OPAMP instances available on the selected device).

Reference Manual to LL API cross reference:
- OTR OT_USER LL_OPAMP_GetCommonTrimmingMode

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
  - LL_OPAMP_TRIMMING_NONE

Return values
- **None:**

Notes
- Preliminarily, OPAMP must be set in mode calibration using function LL_OPAMP_SetMode().

Reference Manual to
- CSR OPA1CAL_H LL_OPAMP_SetCalibrationSelection

LL API cross reference:
- CSR OPA1CAL_L 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
  - LL_OPAMP_TRIMMING_NONE

Notes:
- Preliminarily, OPAMP must be set in mode calibration using function LL_OPAMP_SetMode().

Reference Manual to LL API cross reference:
- CSR OPA1CAL_H LL_OPAMP_SetCalibrationSelection
- CSR OPA1CAL_L LL_OPAMP_SetCalibrationSelection

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 OPAxCALOUT 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:**

Notes
- On STM32L1 serie, OPAMP trimming mode must be re-configured at each update of trimming values in power mode normal. Refer to function LL_OPAMP_SetCommonTrimmingMode().

Reference Manual to LL API cross reference:
- OTR AOx_OPT_OFFSET_TRIM_HIGH LL_OPAMP_SetTrimmingValue
- OTR AOx_OPT_OFFSET_TRIM_LOW LL_OPAMP_SetTrimmingValue
- LPOTR AOx_OPT_OFFSET_TRIM_LP_HIGH LL_OPAMP_SetTrimmingValue
- LPOTR AOx_OPT_OFFSET_TRIM_LP_LOW 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 AOx_OPT_OFFSET_TRIM_HIGH LL_OPAMP_GetTrimmingValue
- OTR AOx_OPT_OFFSET_TRIM_LOW LL_OPAMP_GetTrimmingValue
- LPOTR AOx_OPT_OFFSET_TRIM_LP_HIGH LL_OPAMP_GetTrimmingValue
- LPOTR AOx_OPT_OFFSET_TRIM_LP_LOW 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 OPAxPD 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 OPAxPD 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 OPAxPD 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:**

60.3 OPAMP Firmware driver defines

60.3.1 OPAMP

OPAMP functional mode

LL_OPAMP_MODE_STANDALONE	OPAMP functional mode, OPAMP operation in standalone (on STM32L1 serie, it corresponds to OPAMP internal switches S3 opened (switch SanB state depends on switch S4 state))
LL_OPAMP_MODE_FOLLOWER	OPAMP functional mode, OPAMP operation in follower (on STM32L1 serie, it corresponds to OPAMP internal switches S3 and SanB closed)

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 (low leakage input). Note: OPAMP inverting input is used with OPAMP in mode standalone. Otherwise (OPAMP in mode follower), OPAMP inverting input is not used (not connected

	to GPIO pin).
LL_OPAMP_INPUT_INVERT_IO1	OPAMP inverting input connected to GPIO pin (alternative IO pin, not low leakage, availability depends on STM32L1 serie devices packages). Note: OPAMP inverting input is used with OPAMP in mode standalone. 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)

OPAMP input non-inverting

LL_OPAMP_INPUT_NONINVERT_IO0	OPAMP non inverting input connected to GPIO pin (low leakage input)
LL_OPAMP_INPUT_NONINV_DAC1_CH1	OPAMP non inverting input connected to DAC1 channel1 output (specific to OPAMP instances: OPAMP1, OPAMP2)
LL_OPAMP_INPUT_NONINV_DAC1_CH2	OPAMP non inverting input connected to DAC1 channel2 output (specific to OPAMP instances: OPAMP2, OPAMP3)
LL_OPAMP_INPUT_NONINV_DAC1_CH2_OPAMP3	OPAMP non inverting input connected to DAC1 channel2 output (specific to OPAMP instances: OPAMP3)

OPAMP mode calibration or functional.

LL_OPAMP_MODE_FUNCTIONAL	OPAMP functional mode
LL_OPAMP_MODE_CALIBRATION	OPAMP calibration mode (on STM32L1 serie, it corresponds to all OPAMP input internal switches opened)

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 STM32L1 serie: Vdda lower than 2.4V.
LL_OPAMP_POWERSUPPLY_RANGE_HIGH	Power supply range high. On STM32L1 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
LL_OPAMP_TRIMMING_NONE	OPAMP trimming unselect transistors differential pair NMOS and 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

61 LL PWR Generic Driver

61.1 PWR Firmware driver API description

61.1.1 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:**
Notes	• Remind to set the Regulator to low power before enabling LowPower run mode (bit LL_PWR_REGU_LPMODES_LOW_POWER).
Reference Manual to LL API cross reference:	• CR LPRUN 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:	• CR LPRUN LL_PWR_DisableLowPowerRunMode

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:	• CR LPRUN LL_PWR_IsEnabledLowPowerRunMode

LL_PWR_EnterLowPowerRunMode

Function name	**__STATIC_INLINE void LL_PWR_EnterLowPowerRunMode (void)**
Function descrip	Set voltage Regulator to low-power and switch from run main mode to run low-power mode.

tion	
Return values	• **None:**
Notes	• This "high level" function is introduced to provide functional compatibility with other families. Notice that the two registers have to be written sequentially, so this function is not atomic. To assure atomicity you can call separately the following functions: LL_PWR_SetRegulModeLP(LL_PWR_REGU_LPMODES_LOW_POWER); LL_PWR_EnableLowPowerRunMode();
Reference Manual to LL API cross reference:	• CR LPSDSR LL_PWR_EnterLowPowerRunMode • CR LPRUN LL_PWR_EnterLowPowerRunMode

LL_PWR_ExitLowPowerRunMode

Function name	**__STATIC_INLINE void LL_PWR_ExitLowPowerRunMode (void)**
Function description	Set voltage Regulator to main and switch from run main mode to low-power mode.
Return values	• **None:**
Notes	• This "high level" function is introduced to provide functional compatibility with other families. Notice that the two registers have to be written sequentially, so this function is not atomic. To assure atomicity you can call separately the following functions: LL_PWR_DisableLowPowerRunMode();LL_PWR_SetRegulModeLP(LL_PWR_REGU_LPMODES_MAIN);
Reference Manual to LL API cross reference:	• CR LPSDSR LL_PWR_ExitLowPowerRunMode • CR LPRUN LL_PWR_ExitLowPowerRunMode

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
- LL_PWR_REGU_VOLTAGE_SCALE3

Return values
- **None:**

Reference Manual to LL API cross reference:
- CR 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
  - LL_PWR_REGU_VOLTAGE_SCALE3

Reference Manual to LL API cross reference:
- CR VOS LL_PWR_GetRegulVoltageScaling

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:
- CR 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:
- CR 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
- CR DBP LL_PWR_IsEnabledBkUpAccess

reference:

LL_PWR_SetRegulModeLP

Function name	**__STATIC_INLINE void LL_PWR_SetRegulModeLP (uint32_t RegulMode)**
Function description	Set voltage Regulator mode during low power modes.
Parameters	• **RegulMode:** This parameter can be one of the following values: – LL_PWR_REGU_LPMODES_MAIN – LL_PWR_REGU_LPMODES_LOW_POWER
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR LPSDSR LL_PWR_SetRegulModeLP

LL_PWR_GetRegulModeLP

Function name	**__STATIC_INLINE uint32_t LL_PWR_GetRegulModeLP (void)**
Function description	Get voltage Regulator mode during low power modes.
Return values	• **Returned:** value can be one of the following values: – LL_PWR_REGU_LPMODES_MAIN – LL_PWR_REGU_LPMODES_LOW_POWER
Reference Manual to LL API cross reference:	• CR LPSDSR LL_PWR_GetRegulModeLP

LL_PWR_SetPowerMode

Function name	**__STATIC_INLINE void LL_PWR_SetPowerMode (uint32_t PDMode)**
Function description	Set Power Down mode when CPU enters deepsleep.
Parameters	• **PDMode:** This parameter can be one of the following values: – LL_PWR_MODE_STOP – LL_PWR_MODE_STANDBY
Return values	• **None:**
Notes	• Set the Regulator to low power (bit LL_PWR_REGU_LPMODES_LOW_POWER) before setting MODE_STOP. If the Regulator remains in "main mode", it consumes more power without providing any additional feature. In MODE_STANDBY the Regulator is automatically off.
Reference Manual to LL API cross reference:	• CR PDDS LL_PWR_SetPowerMode

LL_PWR_GetPowerMode

Function name	**__STATIC_INLINE uint32_t LL_PWR_GetPowerMode (void)**
Function description	Get Power Down mode when CPU enters deepsleep.
Return values	• **Returned:** value can be one of the following values: – LL_PWR_MODE_STOP – LL_PWR_MODE_STANDBY
Reference Manual to LL API cross reference:	• CR PDDS LL_PWR_GetPowerMode

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:	• CR 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:	• CR 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:
- CR 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:
- CR 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:
- CR PVDE LL_PWR_IsEnabledPVD

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: (*) not available on all devices
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3 (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- CSR EWUP1 LL_PWR_EnableWakeUpPin
-
- CSR EWUP2 LL_PWR_EnableWakeUpPin
-
- CSR EWUP3 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: (*) not available on all devices
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3 (*)

Return values:
- **None:**

Reference Manual to LL API cross reference:
- CSR EWUP1 LL_PWR_DisableWakeUpPin
-
- CSR EWUP2 LL_PWR_DisableWakeUpPin
-
- CSR EWUP3 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: (*) not available on all devices
  - LL_PWR_WAKEUP_PIN1
  - LL_PWR_WAKEUP_PIN2
  - LL_PWR_WAKEUP_PIN3 (*)

Return values:
- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:
- CSR EWUP1 LL_PWR_IsEnabledWakeUpPin
-
- CSR EWUP2 LL_PWR_IsEnabledWakeUpPin
-
- CSR EWUP3 LL_PWR_IsEnabledWakeUpPin

LL_PWR_EnableUltraLowPower

Function name: **__STATIC_INLINE void LL_PWR_EnableUltraLowPower (void)**

Function description: Enable ultra low-power mode by enabling VREFINT switch off in low-power modes.

Return values:
- **None:**

Reference Manual to LL API cross reference:
- CR ULP LL_PWR_EnableUltraLowPower

LL_PWR_DisableUltraLowPower

Function name: **__STATIC_INLINE void LL_PWR_DisableUltraLowPower (void)**

Function description: Disable ultra low-power mode by disabling VREFINT switch off in

low-power modes.

Return values
- **None:**

Reference Manual to LL API cross reference:
- CR ULP LL_PWR_DisableUltraLowPower

LL_PWR_IsEnabledUltraLowPower

Function name **__STATIC_INLINE uint32_t LL_PWR_IsEnabledUltraLowPower (void)**

Function description Check if ultra low-power mode is enabled by checking if VREFINT switch off in low-power modes is enabled.

Return values
- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:
- CR ULP LL_PWR_IsEnabledUltraLowPower

LL_PWR_EnableFastWakeUp

Function name **__STATIC_INLINE void LL_PWR_EnableFastWakeUp (void)**

Function description Enable fast wakeup by ignoring VREFINT startup time when exiting from low-power mode.

Return values
- **None:**

Notes
- Works in conjunction with ultra low power mode.

Reference Manual to LL API cross reference:
- CR FWU LL_PWR_EnableFastWakeUp

LL_PWR_DisableFastWakeUp

Function name **__STATIC_INLINE void LL_PWR_DisableFastWakeUp (void)**

Function description Disable fast wakeup by waiting VREFINT startup time when exiting from low-power mode.

Return values
- **None:**

Notes
- Works in conjunction with ultra low power mode.

Reference Manual to LL API cross reference:
- CR FWU LL_PWR_DisableFastWakeUp

LL_PWR_IsEnabledFastWakeUp

Function name **__STATIC_INLINE uint32_t LL_PWR_IsEnabledFastWakeUp (void)**

Function description Check if fast wakeup is enabled by checking if VREFINT startup time when exiting from low-power mode is ignored.

Return values
- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:	• CR FWU LL_PWR_IsEnabledFastWakeUp

LL_PWR_IsActiveFlag_WU

Function name	**__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_WU (void)**
Function description	Get Wake-up Flag.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CSR WUF LL_PWR_IsActiveFlag_WU

LL_PWR_IsActiveFlag_SB

Function name	**__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_SB (void)**
Function description	Get Standby Flag.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CSR SBF LL_PWR_IsActiveFlag_SB

LL_PWR_IsActiveFlag_PVDO

Function name	**__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_PVDO (void)**
Function description	Indicate whether VDD voltage is below the selected PVD threshold.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CSR PVDO LL_PWR_IsActiveFlag_PVDO

LL_PWR_IsActiveFlag_VREFINTRDY

Function name	**__STATIC_INLINE uint32_t LL_PWR_IsActiveFlag_VREFINTRDY (void)**
Function description	Get Internal Reference VrefInt Flag.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CSR VREFINTRDYF LL_PWR_IsActiveFlag_VREFINTRDY

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:
- CSR 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:
- CSR REGLPF LL_PWR_IsActiveFlag_REGLPF

LL_PWR_ClearFlag_SB

Function name: **__STATIC_INLINE void LL_PWR_ClearFlag_SB (void)**

Function description: Clear Standby Flag.

Return values
- **None:**

Reference Manual to LL API cross reference:
- CR 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:
- CR CWUF LL_PWR_ClearFlag_WU

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

61.2 PWR Firmware driver defines

61.2.1 PWR

Clear Flags Defines

LL_PWR_CR_CSBF Clear standby flag

LL_PWR_CR_CWUF Clear wakeup flag

Get Flags Defines

LL_PWR_CSR_WUF Wakeup flag

LL_PWR_CSR_SBF Standby flag

LL_PWR_CSR_PVDO Power voltage detector output flag

LL_PWR_CSR_VREFINTRDYF VREFINT ready flag

LL_PWR_CSR_VOS Voltage scaling select flag

LL_PWR_CSR_REGLPF Regulator low power flag

LL_PWR_CSR_EWUP1 Enable WKUP pin 1

LL_PWR_CSR_EWUP2 Enable WKUP pin 2

LL_PWR_CSR_EWUP3 Enable WKUP pin 3

Mode Power

LL_PWR_MODE_STOP Enter Stop mode when the CPU enters deepsleep

LL_PWR_MODE_STANDBY Enter Standby mode when the CPU enters deepsleep

Power Voltage Detector Level

LL_PWR_PVDLEVEL_0 Voltage threshold detected by PVD 1.9 V

LL_PWR_PVDLEVEL_1 Voltage threshold detected by PVD 2.1 V

LL_PWR_PVDLEVEL_2 Voltage threshold detected by PVD 2.3 V

LL_PWR_PVDLEVEL_3 Voltage threshold detected by PVD 2.5 V

LL_PWR_PVDLEVEL_4 Voltage threshold detected by PVD 2.7 V

LL_PWR_PVDLEVEL_5 Voltage threshold detected by PVD 2.9 V

LL_PWR_PVDLEVEL_6 Voltage threshold detected by PVD 3.1 V

LL_PWR_PVDLEVEL_7 External input analog voltage (Compare internally to VREFINT)

Regulator Mode In Low Power Modes

LL_PWR_REGU_LPMODES_MAIN Voltage Regulator in main mode during deepsleep/sleep/low-power run mode

LL_PWR_REGU_LPMODES_LOW_POWER Voltage Regulator in low-power mode during deepsleep/sleep/low-power run mode

Regulator Voltage

LL_PWR_REGU_VOLTAGE_SCALE1 1.8V (range 1)

LL_PWR_REGU_VOLTAGE_SCALE2 1.5V (range 2)

LL_PWR_REGU_VOLTAGE_SCALE3 1.2V (range 3)

Wakeup Pins

LL_PWR_WAKEUP_PIN1 WKUP pin 1 : PA0

LL_PWR_WAKEUP_PIN2 WKUP pin 2 : PC13

LL_PWR_WAKEUP_PIN3 WKUP pin 3 : PE6 or PA2 according to device

PWR 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

62 LL RCC Generic Driver

62.1 RCC Firmware driver registers structures

62.1.1 LL_RCC_ClocksTypeDef

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

62.2 RCC Firmware driver API description

62.2.1 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_DisableCSS

Function name	**__STATIC_INLINE void LL_RCC_HSE_DisableCSS (void)**
Function description	Disable the Clock Security System.
Return values	• **None:**
Notes	• Cannot be disabled in HSE is ready (only by hardware)
Reference Manual to LL API cross reference:	• CR CSSON LL_RCC_HSE_DisableCSS

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_SetRTC_HSEPrescaler

Function name	**__STATIC_INLINE void LL_RCC_SetRTC_HSEPrescaler (uint32_t Div)**
Function description	Configure the RTC prescaler (divider)
Parameters	• **Div:** This parameter can be one of the following values: – LL_RCC_RTC_HSE_DIV_2 – LL_RCC_RTC_HSE_DIV_4 – LL_RCC_RTC_HSE_DIV_8 – LL_RCC_RTC_HSE_DIV_16
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR RTCPRE LL_RCC_SetRTC_HSEPrescaler

LL_RCC_GetRTC_HSEPrescaler

Function name	**__STATIC_INLINE uint32_t LL_RCC_GetRTC_HSEPrescaler (void)**
Function description	Get the RTC divider (prescaler)
Return values	• **Returned:** value can be one of the following values: – LL_RCC_RTC_HSE_DIV_2 – LL_RCC_RTC_HSE_DIV_4 – LL_RCC_RTC_HSE_DIV_8 – LL_RCC_RTC_HSE_DIV_16
Reference Manual to LL API cross reference:	• CR RTCPRE LL_RCC_GetRTC_HSEPrescaler

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_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 = 0x00 and Max_Data = 0x1F
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 = 0x00 and Max_Data = 0x1F
Reference Manual to LL API cross reference:	• ICSCR HSITRIM LL_RCC_HSI_GetCalibTrimming

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:	• CSR 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:	• CSR 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:	• CSR 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:	• CSR LSEBYP LL_RCC_LSE_DisableBypass

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:	• CSR 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:	• CSR 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:	• CSR 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:	• CSR 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	• CSR LSION LL_RCC_LSI_Disable

reference:

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_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

Return values
- **None:**

Reference Manual to LL API cross reference:
- ICSCR 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

Reference Manual to LL API cross reference:
- ICSCR MSIRANGE LL_RCC_MSI_GetRange

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 = 0x00 and Max_Data = 0xFF

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 = 0x00 and Max_Data = 0xFF

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:** Min_Data = 0x00 and Max_Data = 0xFF

Reference Manual to LL API cross reference:
- ICSCR MSITRIM LL_RCC_MSI_GetCalibTrimming

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
- CFGR PPRE2 LL_RCC_GetAPB2Prescaler

reference:

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_HSI – LL_RCC_MCO1SOURCE_MSI – LL_RCC_MCO1SOURCE_HSE – LL_RCC_MCO1SOURCE_PLLCLK – LL_RCC_MCO1SOURCE_LSI – LL_RCC_MCO1SOURCE_LSE • **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_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
Return values	• **None:**
Notes	• Once the RTC clock source has been selected, it cannot be changed any more unless the Backup domain is reset, or unless a failure is detected on LSE (LSECSSD is set). The RTCRST bit can be used to reset them.
Reference Manual to LL API cross reference:	• CSR 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
Reference Manual to LL API cross reference:	• CSR 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:	• CSR 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:	• CSR 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:	• CSR 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:	• CSR RTCRST 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:	• CSR RTCRST 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 PLLMul, uint32_t PLLDiv)**

Function description	Configure PLL used for SYSCLK Domain.
Parameters	• **Source:** This parameter can be one of the following values: – LL_RCC_PLLSOURCE_HSI – LL_RCC_PLLSOURCE_HSE • **PLLMul:** This parameter can be one of the following values: – LL_RCC_PLL_MUL_3 – LL_RCC_PLL_MUL_4 – LL_RCC_PLL_MUL_6 – LL_RCC_PLL_MUL_8 – LL_RCC_PLL_MUL_12 – LL_RCC_PLL_MUL_16 – LL_RCC_PLL_MUL_24 – LL_RCC_PLL_MUL_32 – LL_RCC_PLL_MUL_48 • **PLLDiv:** This parameter can be one of the following values: – LL_RCC_PLL_DIV_2 – LL_RCC_PLL_DIV_3 – LL_RCC_PLL_DIV_4
Return values	• **None:**
Reference Manual to LL API cross reference:	• CFGR PLLSRC LL_RCC_PLL_ConfigDomain_SYS • CFGR PLLMUL LL_RCC_PLL_ConfigDomain_SYS • CFGR PLLDIV LL_RCC_PLL_ConfigDomain_SYS

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_HSI – LL_RCC_PLLSOURCE_HSE
Reference Manual to LL API cross reference:	• CFGR PLLSRC LL_RCC_PLL_GetMainSource

LL_RCC_PLL_GetMultiplicator

Function name	**__STATIC_INLINE uint32_t LL_RCC_PLL_GetMultiplicator (void)**
Function description	Get PLL multiplication Factor.
Return values	• **Returned:** value can be one of the following values: – LL_RCC_PLL_MUL_3 – LL_RCC_PLL_MUL_4 – LL_RCC_PLL_MUL_6 – LL_RCC_PLL_MUL_8 – LL_RCC_PLL_MUL_12 – LL_RCC_PLL_MUL_16 – LL_RCC_PLL_MUL_24 – LL_RCC_PLL_MUL_32

- LL_RCC_PLL_MUL_48

Reference Manual to LL API cross reference:
- CFGR PLLMUL LL_RCC_PLL_GetMultiplicator

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_PLL_DIV_2
  - LL_RCC_PLL_DIV_3
  - LL_RCC_PLL_DIV_4

Reference Manual to LL API cross reference:
- CFGR PLLDIV LL_RCC_PLL_GetDivider

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:
- CIR 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:
- CIR 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:
- CIR 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:	• CIR 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:	• CIR 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:	• CIR PLLRDYC LL_RCC_ClearFlag_PLLRDY

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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR PLLRDYF LL_RCC_IsActiveFlag_PLLRDY

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:	• CIR 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:	• CIR LSECSSF LL_RCC_IsActiveFlag_LSECSS

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_PORRST

Function name	**__STATIC_INLINE uint32_t LL_RCC_IsActiveFlag_PORRST (void)**
Function description	Check if RCC flag POR/PDR reset is set or not.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• CSR PORRSTF LL_RCC_IsActiveFlag_PORRST

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_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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR PLLRDYIE LL_RCC_EnableIT_PLLRDY

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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR PLLRDYIE LL_RCC_DisableIT_PLLRDY

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	• CIR LSECSSIE LL_RCC_DisableIT_LSECSS

LL API cross reference:

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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR 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:	• CIR PLLRDYIE LL_RCC_IsEnabledIT_PLLRDY

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:	• CIR 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 and PLL 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.

62.3 RCC Firmware driver defines

62.3.1 RCC

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_CIR_LSIRDYC	LSI Ready Interrupt Clear
LL_RCC_CIR_LSERDYC	LSE Ready Interrupt Clear
LL_RCC_CIR_HSIRDYC	HSI Ready Interrupt Clear
LL_RCC_CIR_HSERDYC	HSE Ready Interrupt Clear
LL_RCC_CIR_PLLRDYC	PLL Ready Interrupt Clear
LL_RCC_CIR_MSIRDYC	MSI Ready Interrupt Clear
LL_RCC_CIR_LSECSSC	LSE Clock Security System Interrupt Clear
LL_RCC_CIR_CSSC	Clock Security System Interrupt Clear

Get Flags Defines

LL_RCC_CIR_LSIRDYF	LSI Ready Interrupt flag
LL_RCC_CIR_LSERDYF	LSE Ready Interrupt flag
LL_RCC_CIR_HSIRDYF	HSI Ready Interrupt flag
LL_RCC_CIR_HSERDYF	HSE Ready Interrupt flag
LL_RCC_CIR_PLLRDYF	PLL Ready Interrupt flag
LL_RCC_CIR_MSIRDYF	MSI Ready Interrupt flag

LL_RCC_CIR_LSECSSF	LSE Clock Security System Interrupt flag
LL_RCC_CIR_CSSF	Clock Security System Interrupt flag
LL_RCC_CSR_OBLRSTF	OBL reset flag
LL_RCC_CSR_PINRSTF	PIN reset flag
LL_RCC_CSR_PORRSTF	POR/PDR 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_LPWRRSTF	Low-Power reset flag

IT Defines

LL_RCC_CIR_LSIRDYIE	LSI Ready Interrupt Enable
LL_RCC_CIR_LSERDYIE	LSE Ready Interrupt Enable
LL_RCC_CIR_HSIRDYIE	HSI Ready Interrupt Enable
LL_RCC_CIR_HSERDYIE	HSE Ready Interrupt Enable
LL_RCC_CIR_PLLRDYIE	PLL Ready Interrupt Enable
LL_RCC_CIR_MSIRDYIE	MSI Ready Interrupt Enable
LL_RCC_CIR_LSECSSIE	LSE CSS Interrupt Enable

MCO1 SOURCE selection

LL_RCC_MCO1SOURCE_NOCLOCK	MCO output disabled, no clock on MCO
LL_RCC_MCO1SOURCE_SYSCLK	SYSCLK selection as MCO source
LL_RCC_MCO1SOURCE_HSI	HSI selection as MCO source
LL_RCC_MCO1SOURCE_MSI	MSI selection as MCO source
LL_RCC_MCO1SOURCE_HSE	HSE selection as MCO source
LL_RCC_MCO1SOURCE_LSI	LSI selection as MCO source
LL_RCC_MCO1SOURCE_LSE	LSE selection as MCO source
LL_RCC_MCO1SOURCE_PLLCLK	PLLCLK selection as MCO source

MCO1 prescaler

LL_RCC_MCO1_DIV_1	MCO Clock divided by 1
LL_RCC_MCO1_DIV_2	MCO Clock divided by 2
LL_RCC_MCO1_DIV_4	MCO Clock divided by 4
LL_RCC_MCO1_DIV_8	MCO Clock divided by 8
LL_RCC_MCO1_DIV_16	MCO Clock divided by 16

MSI clock ranges

LL_RCC_MSIRANGE_0	MSI = 65.536 KHz
LL_RCC_MSIRANGE_1	MSI = 131.072 KHz
LL_RCC_MSIRANGE_2	MSI = 262.144 KHz

LL_RCC_MSIRANGE_3 MSI = 524.288 KHz

LL_RCC_MSIRANGE_4 MSI = 1.048 MHz

LL_RCC_MSIRANGE_5 MSI = 2.097 MHz

LL_RCC_MSIRANGE_6 MSI = 4.194 MHz

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

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 SOURCE

LL_RCC_PLLSOURCE_HSI HSI clock selected as PLL entry clock source

LL_RCC_PLLSOURCE_HSE HSE clock selected as PLL entry clock source

PLL division factor

LL_RCC_PLL_DIV_2 PLL clock output = PLLVCO / 2

LL_RCC_PLL_DIV_3 PLL clock output = PLLVCO / 3

LL_RCC_PLL_DIV_4 PLL clock output = PLLVCO / 4

PLL Multiplicator factor

LL_RCC_PLL_MUL_3 PLL input clock * 3

LL_RCC_PLL_MUL_4 PLL input clock * 4

LL_RCC_PLL_MUL_6 PLL input clock * 6

LL_RCC_PLL_MUL_8 PLL input clock * 8

LL_RCC_PLL_MUL_12 PLL input clock * 12

LL_RCC_PLL_MUL_16 PLL input clock * 16

LL_RCC_PLL_MUL_24 PLL input clock * 24

LL_RCC_PLL_MUL_32 PLL input clock * 32

LL_RCC_PLL_MUL_48 PLL input clock * 48

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 HSE oscillator clock divided by a programmable prescaler (selection through

RTC HSE Prescaler

LL_RCC_RTC_HSE_DIV_2 HSE is divided by 2 for RTC clock

LL_RCC_RTC_HSE_DIV_4	HSE is divided by 4 for RTC clock
LL_RCC_RTC_HSE_DIV_8	HSE is divided by 8 for RTC clock
LL_RCC_RTC_HSE_DIV_16	HSE is divided by 16 for RTC clock

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

Calculate frequencies

__LL_RCC_CALC_PLLCLK_FREQ

Description:

- Helper macro to calculate the PLLCLK frequency.

Parameters:

- __INPUTFREQ__: PLL Input frequency (based on MSI/HSE/HSI)
- __PLLMUL__: This parameter can be one of the following values:
  - LL_RCC_PLL_MUL_3
  - LL_RCC_PLL_MUL_4
  - LL_RCC_PLL_MUL_6
  - LL_RCC_PLL_MUL_8
  - LL_RCC_PLL_MUL_12
  - LL_RCC_PLL_MUL_16
  - LL_RCC_PLL_MUL_24
  - LL_RCC_PLL_MUL_32
  - LL_RCC_PLL_MUL_48
- __PLLDIV__: This parameter can be one of the

following values:
- LL_RCC_PLL_DIV_2
- LL_RCC_PLL_DIV_3
- LL_RCC_PLL_DIV_4

Return value:

- PLL: clock frequency (in Hz)

Notes:

- ex: __LL_RCC_CALC_PLLCLK_FREQ (HSE_VALUE, LL_RCC_PLL_GetMultiplicator (), LL_RCC_PLL_GetDivider ());

__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)

Notes:

- : __AHBPRESCALER__ be retrieved by LL_RCC_GetAHBPrescaler ex: __LL_RCC_CALC_HCLK_FREQ(LL_RCC_GetAHBPrescaler())

__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)

Notes:

- : __APB1PRESCALER__ be retrieved by LL_RCC_GetAPB1Prescaler ex: __LL_RCC_CALC_PCLK1_FREQ(LL_RCC_GetAPB1Prescaler())

__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)

Notes:

- : __APB2PRESCALER__ be retrieved by LL_RCC_GetAPB2Prescaler ex: __LL_RCC_CALC_PCLK2_FREQ(LL_RCC_GetAPB2Prescaler())

__LL_RCC_CALC_MSI_FREQ

Description:

- Helper macro to calculate the MSI frequency (in Hz)

Parameters:

- __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

Return value:

- MSI: clock frequency (in Hz)

Notes:

- : __MSIRANGE__can be retrieved by LL_RCC_MSI_GetRange ex: __LL_RCC_CALC_MSI_FREQ(LL_RCC_MSI_GetR

ange())

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

63 LL RTC Generic Driver

63.1 RTC Firmware driver registers structures

63.1.1 LL_RTC_InitTypeDef

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()**.

63.1.2 LL_RTC_TimeTypeDef

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()**.

63.1.3 LL_RTC_DateTypeDef

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()**.

63.1.4 LL_RTC_AlarmTypeDef

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.

63.2 RTC Firmware driver API description

63.2.1 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:	• 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:	• 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:	• 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:	• 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:	• TAFCR 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:	• TAFCR 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:
- 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:
- 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:
- 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:	• 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:	• 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:	• 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:	• 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:	• 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:	• 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:	• 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	• PRER PREDIV_S LL_RTC_GetSynchPrescaler

reference:

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:	• 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:	• WPR KEY LL_RTC_DisableWriteProtection

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:	• 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:	• 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:	• TR HT LL_RTC_TIME_SetHour • 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:
- TR HT LL_RTC_TIME_GetHour
- 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:
- TR MNT LL_RTC_TIME_SetMinute
- 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:
- TR MNT LL_RTC_TIME_GetMinute
- 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:	• TR ST LL_RTC_TIME_SetSecond • 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:	• TR ST LL_RTC_TIME_GetSecond • 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:
- TR PM LL_RTC_TIME_Config
- TR HT LL_RTC_TIME_Config
- TR HU LL_RTC_TIME_Config
- TR MNT LL_RTC_TIME_Config
- TR MNU LL_RTC_TIME_Config
- TR ST LL_RTC_TIME_Config
- 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:
- TR HT LL_RTC_TIME_Get
- TR HU LL_RTC_TIME_Get
- TR MNT LL_RTC_TIME_Get
- TR MNU LL_RTC_TIME_Get
- TR ST LL_RTC_TIME_Get
- 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:
- 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:
- 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:
- 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:
- 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:	• 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	• **Sub:** second value (number between 0 and 65535)
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:	• 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:
- SHIFTR ADD1S LL_RTC_TIME_Synchronize
- 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:
- DR YT LL_RTC_DATE_SetYear
- 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:
- DR YT LL_RTC_DATE_GetYear
- 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:
- 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:
- 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:
- DR MT LL_RTC_DATE_SetMonth
- 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:
- DR MT LL_RTC_DATE_GetMonth
- 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
- DR DT LL_RTC_DATE_SetDay

reference:
- 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:
- DR DT LL_RTC_DATE_GetDay
- 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:
- DR WDU LL_RTC_DATE_Config
- DR MT LL_RTC_DATE_Config
- DR MU LL_RTC_DATE_Config
- DR DT LL_RTC_DATE_Config
- DR DU LL_RTC_DATE_Config
- DR YT LL_RTC_DATE_Config
- 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:
- DR WDU LL_RTC_DATE_Get
- DR MT LL_RTC_DATE_Get
- DR MU LL_RTC_DATE_Get
- DR DT LL_RTC_DATE_Get
- DR DU LL_RTC_DATE_Get
- DR YT LL_RTC_DATE_Get
- 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:
- 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:	• 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:	• ALRMAR MSK4 LL_RTC_ALMA_SetMask • ALRMAR MSK3 LL_RTC_ALMA_SetMask • ALRMAR MSK2 LL_RTC_ALMA_SetMask • 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:	• ALRMAR MSK4 LL_RTC_ALMA_GetMask • ALRMAR MSK3 LL_RTC_ALMA_GetMask • ALRMAR MSK2 LL_RTC_ALMA_GetMask • 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:	• 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:	• 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:	• ALRMAR DT LL_RTC_ALMA_SetDay • 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:
- ALRMAR DT LL_RTC_ALMA_GetDay
- 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:
- 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:
- 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:	• 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:	• 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:	• ALRMAR HT LL_RTC_ALMA_SetHour • 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:	• ALRMAR HT LL_RTC_ALMA_GetHour • 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:	• ALRMAR MNT LL_RTC_ALMA_SetMinute • 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:	• ALRMAR MNT LL_RTC_ALMA_GetMinute • 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	• ALRMAR ST LL_RTC_ALMA_SetSecond

LL API cross reference:
- 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:
- ALRMAR ST LL_RTC_ALMA_GetSecond
- 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:
- ALRMAR PM LL_RTC_ALMA_ConfigTime
- ALRMAR HT LL_RTC_ALMA_ConfigTime
- ALRMAR HU LL_RTC_ALMA_ConfigTime
- ALRMAR MNT LL_RTC_ALMA_ConfigTime
- ALRMAR MNU LL_RTC_ALMA_ConfigTime
- ALRMAR ST LL_RTC_ALMA_ConfigTime
- 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:	• ALRMAR HT LL_RTC_ALMA_GetTime • ALRMAR HU LL_RTC_ALMA_GetTime • ALRMAR MNT LL_RTC_ALMA_GetTime • ALRMAR MNU LL_RTC_ALMA_GetTime • ALRMAR ST LL_RTC_ALMA_GetTime • 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:** Value between Min_Data=0x00 and Max_Data=0xF
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:	• 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	• **Value:** between Min_Data=0x00 and Max_Data=0xF
Reference Manual to LL API cross reference:	• 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	• ALRMASSR SS LL_RTC_ALMA_SetSubSecond

LL API cross reference:

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:	• 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:	• 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:	• 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:
- ALRMBR MSK4 LL_RTC_ALMB_SetMask
- ALRMBR MSK3 LL_RTC_ALMB_SetMask
- ALRMBR MSK2 LL_RTC_ALMB_SetMask
- 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:
- ALRMBR MSK4 LL_RTC_ALMB_GetMask
- ALRMBR MSK3 LL_RTC_ALMB_GetMask
- ALRMBR MSK2 LL_RTC_ALMB_GetMask
- 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:
- 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:	• 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:	• ALRMBR DT LL_RTC_ALMB_SetDay • 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:	• ALRMBR DT LL_RTC_ALMB_GetDay • 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:
- 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:
- 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:
- 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:	• 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:	• ALRMBR HT LL_RTC_ALMB_SetHour • 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:	• ALRMBR HT LL_RTC_ALMB_GetHour • 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:
- ALRMBR MNT LL_RTC_ALMB_SetMinute
- 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:
- ALRMBR MNT LL_RTC_ALMB_GetMinute
- 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:
- ALRMBR ST LL_RTC_ALMB_SetSecond
- 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:	• ALRMBR ST LL_RTC_ALMB_GetSecond • 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:	• ALRMBR PM LL_RTC_ALMB_ConfigTime • ALRMBR HT LL_RTC_ALMB_ConfigTime • ALRMBR HU LL_RTC_ALMB_ConfigTime • ALRMBR MNT LL_RTC_ALMB_ConfigTime • ALRMBR MNU LL_RTC_ALMB_ConfigTime • ALRMBR ST LL_RTC_ALMB_ConfigTime • 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:	• ALRMBR HT LL_RTC_ALMB_GetTime • ALRMBR HU LL_RTC_ALMB_GetTime • ALRMBR MNT LL_RTC_ALMB_GetTime • ALRMBR MNU LL_RTC_ALMB_GetTime • ALRMBR ST LL_RTC_ALMB_GetTime • 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:** Value between Min_Data=0x00 and Max_Data=0xF
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:	• 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	• **Value:** between Min_Data=0x00 and Max_Data=0xF
Reference Manual to LL API cross reference:	• 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:	• 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:	• ALRMBSSR SS LL_RTC_ALMB_GetSubSecond

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:	• CR TSE 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:	• CR TSE 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	• CR TSEDGE LL_RTC_TS_SetActiveEdge

reference:

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:	• CR TSEDGE 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:	• 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:	• TSTR HT LL_RTC_TS_GetHour • 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:	• TSTR MNT LL_RTC_TS_GetMinute • TSTR MNU 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:	• TSTR ST LL_RTC_TS_GetSecond • TSTR SU 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:	• TSTR HT LL_RTC_TS_GetTime • TSTR HU LL_RTC_TS_GetTime • TSTR MNT LL_RTC_TS_GetTime • TSTR MNU LL_RTC_TS_GetTime • TSTR ST LL_RTC_TS_GetTime • 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:
- 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:
- TSDR MT LL_RTC_TS_GetMonth
- 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:	• TSDR DT LL_RTC_TS_GetDay • 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:	• TSDR WDU LL_RTC_TS_GetDate • TSDR MT LL_RTC_TS_GetDate • TSDR MU LL_RTC_TS_GetDate • TSDR DT LL_RTC_TS_GetDate • 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	• **Value:** between Min_Data=0x00 and Max_Data=0xFFFF
Reference Manual to LL API cross reference:	• TSSSR SS LL_RTC_TS_GetSubSecond

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:	• TAFCR 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:	• TAFCR 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: (*) value not defined in all devices. – LL_RTC_TAMPER_1 – LL_RTC_TAMPER_2 (*) – LL_RTC_TAMPER_3 (*)
Return values	• **None:**
Reference Manual to LL API cross reference:	• TAFCR TAMP1E LL_RTC_TAMPER_Enable • TAFCR TAMP2E LL_RTC_TAMPER_Enable • TAFCR 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: (*) value not defined in all devices. – LL_RTC_TAMPER_1 – LL_RTC_TAMPER_2 (*) – LL_RTC_TAMPER_3 (*)
Return values	• **None:**
Reference Manual to LL API cross reference:	• TAFCR TAMP1E LL_RTC_TAMPER_Disable • TAFCR TAMP2E LL_RTC_TAMPER_Disable • TAFCR TAMP3E LL_RTC_TAMPER_Disable

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:	• TAFCR 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:	• TAFCR 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:	• TAFCR 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:
- TAFCR 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:
- TAFCR 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:
- TAFCR 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:
- TAFCR 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:
- TAFCR 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: (*) value not defined in all devices.
  - 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:
- TAFCR TAMP1TRG LL_RTC_TAMPER_EnableActiveLevel
- TAFCR TAMP2TRG LL_RTC_TAMPER_EnableActiveLevel
- TAFCR 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: (*) value not defined in all devices.
  - 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:
- TAFCR TAMP1TRG LL_RTC_TAMPER_DisableActiveLevel
- TAFCR TAMP2TRG LL_RTC_TAMPER_DisableActiveLevel
- TAFCR TAMP3TRG LL_RTC_TAMPER_DisableActiveLevel

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:
- 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:
- 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:
- 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:
- 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:
- 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:	• 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:	• WUTR WUT LL_RTC_WAKEUP_GetAutoReload

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: (*) value not defined in all devices. – 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: (*) value not defined in all devices.
  - 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_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: (*) value not defined in all devices.
  - 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:
- CR COE LL_RTC_CAL_SetOutputFreq
- 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: (*) value not defined in all devices.
  - LL_RTC_CALIB_OUTPUT_NONE
  - LL_RTC_CALIB_OUTPUT_1HZ (*)
  - LL_RTC_CALIB_OUTPUT_512HZ

Reference Manual to LL API cross
- CR COE LL_RTC_CAL_GetOutputFreq

reference:
- CR COSEL LL_RTC_CAL_GetOutputFreq

LL_RTC_CAL_EnableCoarseDigital

Function name: **__STATIC_INLINE void LL_RTC_CAL_EnableCoarseDigital (RTC_TypeDef * RTCx)**

Function description: Enable Coarse digital calibration.

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:
- CR DCE LL_RTC_CAL_EnableCoarseDigital

LL_RTC_CAL_DisableCoarseDigital

Function name: **__STATIC_INLINE void LL_RTC_CAL_DisableCoarseDigital (RTC_TypeDef * RTCx)**

Function description: Disable Coarse digital calibration.

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:
- CR DCE LL_RTC_CAL_DisableCoarseDigital

LL_RTC_CAL_ConfigCoarseDigital

Function name: **__STATIC_INLINE void LL_RTC_CAL_ConfigCoarseDigital (RTC_TypeDef * RTCx, uint32_t Sign, uint32_t Value)**

Function description: Set the coarse digital calibration.

Parameters:
- **RTCx:** RTC Instance
- **Sign:** This parameter can be one of the following values:
  - LL_RTC_CALIB_SIGN_POSITIVE
  - LL_RTC_CALIB_SIGN_NEGATIVE
- **Value:** value of coarse calibration expressed in ppm (coded on 5 bits)

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)
- This Calibration value should be between 0 and 63 when using negative sign with a 2-ppm step.
- This Calibration value should be between 0 and 126 when using positive sign with a 4-ppm step.

Reference Manual to LL API cross reference:
- CALIBR DCS LL_RTC_CAL_ConfigCoarseDigital
- CALIBR DC LL_RTC_CAL_ConfigCoarseDigital

LL_RTC_CAL_GetCoarseDigitalValue

Function name: **__STATIC_INLINE uint32_t LL_RTC_CAL_GetCoarseDigitalValue (RTC_TypeDef * RTCx)**

Function description: Get the coarse digital calibration value.

Parameters:
- **RTCx:** RTC Instance

Return values:
- **value:** of coarse calibration expressed in ppm (coded on 5 bits)

Reference Manual to LL API cross reference:
- CALIBR DC LL_RTC_CAL_GetCoarseDigitalValue

LL_RTC_CAL_GetCoarseDigitalSign

Function name: **__STATIC_INLINE uint32_t LL_RTC_CAL_GetCoarseDigitalSign (RTC_TypeDef * RTCx)**

Function description: Get the coarse digital calibration sign.

Parameters:
- **RTCx:** RTC Instance

Return values:
- **Returned:** value can be one of the following values:
  - LL_RTC_CALIB_SIGN_POSITIVE
  - LL_RTC_CALIB_SIGN_NEGATIVE

Reference Manual to LL API cross reference:
- CALIBR DCS LL_RTC_CAL_GetCoarseDigitalSign

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 in RTC_ISR

Reference Manual to LL API cross reference:
- 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:
- 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 in RTC_ISR

Reference Manual to LL API cross reference:
- CALR CALW8 LL_RTC_CAL_SetPeriod
- 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:	• CALR CALW8 LL_RTC_CAL_GetPeriod • 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 in RTC_ISR
Reference Manual to LL API cross reference:	• 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:	• CALR CALM LL_RTC_CAL_GetMinus

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_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	• ISR INITF LL_RTC_IsActiveFlag_INIT

reference:

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:	• 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:	• 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:	• 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:	• 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:	• 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:	• 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:	• 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:	• CR ALRAIE LL_RTC_DisableIT_ALRA

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:	• TAFCR 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:	• TAFCR 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_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:	• TAFCR 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 doesn't 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.

63.3 RTC Firmware driver defines

63.3.1 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, when mapped on PC13, 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

Coarse digital calibration sign

LL_RTC_CALIB_SIGN_POSITIVE	Positive calibration: calendar update frequency is increased
LL_RTC_CALIB_SIGN_NEGATIVE	Negative calibration: calendar update frequency is decreased

FORMAT

LL_RTC_FORMAT_BIN	Binary data format
LL_RTC_FORMAT_BCD	BCD data format

Get Flags Defines

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_TAFCR_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

64 LL SPI Generic Driver

64.1 SPI Firmware driver registers structures

64.1.1 LL_SPI_InitTypeDef

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()**.

64.2 SPI Firmware driver API description

64.2.1 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	• CR1 SPE LL_SPI_IsEnabled

reference:

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
- CR2 FRF LL_SPI_SetStandard

reference:

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_8BIT – LL_SPI_DATAWIDTH_16BIT
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 DFF 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_8BIT – LL_SPI_DATAWIDTH_16BIT
Reference Manual to LL API cross reference:	• CR1 DFF LL_SPI_GetDataWidth

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_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_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_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	• SR OVR LL_SPI_ClearFlag_OVR

LL API cross reference:

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_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 IP 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:**

64.3 SPI Firmware driver defines

64.3.1 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
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
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
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
LL_SPI_LSB_FIRST	Data is transmitted/received with the LSB first
LL_SPI_MSB_FIRST	Data is transmitted/received with the MSB first
LL_SPI_LSB_FIRST	Data is transmitted/received with the LSB first
LL_SPI_MSB_FIRST	Data is transmitted/received with the MSB first
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
LL_SPI_CRCCALCULATION_DISABLE	CRC calculation disabled
LL_SPI_CRCCALCULATION_ENABLE	CRC calculation enabled
LL_SPI_CRCCALCULATION_DISABLE	CRC calculation disabled
LL_SPI_CRCCALCULATION_ENABLE	CRC calculation enabled
LL_SPI_CRCCALCULATION_DISABLE	CRC calculation disabled
LL_SPI_CRCCALCULATION_ENABLE	CRC calculation enabled

Datawidth

LL_SPI_DATAWIDTH_8BIT	Data length for SPI transfer: 8 bits
LL_SPI_DATAWIDTH_16BIT	Data length for SPI transfer: 16 bits
LL_SPI_DATAWIDTH_8BIT	Data length for SPI transfer: 8 bits
LL_SPI_DATAWIDTH_16BIT	Data length for SPI transfer: 16 bits
LL_SPI_DATAWIDTH_8BIT	Data length for SPI transfer: 8 bits
LL_SPI_DATAWIDTH_16BIT	Data length for SPI transfer: 16 bits
LL_SPI_DATAWIDTH_8BIT	Data length for SPI transfer: 8 bits
LL_SPI_DATAWIDTH_16BIT	Data length for SPI transfer: 16 bits

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
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
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
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
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
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
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
LL_SPI_MODE_MASTER	Master configuration
LL_SPI_MODE_SLAVE	Slave configuration
LL_SPI_MODE_MASTER	Master configuration
LL_SPI_MODE_SLAVE	Slave configuration
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
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
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
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
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
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
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
LL_SPI_POLARITY_LOW	Clock to 0 when idle
LL_SPI_POLARITY_HIGH	Clock to 1 when idle
LL_SPI_POLARITY_LOW	Clock to 0 when idle
LL_SPI_POLARITY_HIGH	Clock to 1 when idle
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
LL_SPI_PROTOCOL_MOTOROLA	Motorola mode. Used as default value
LL_SPI_PROTOCOL_TI	TI mode
LL_SPI_PROTOCOL_MOTOROLA	Motorola mode. Used as default value
LL_SPI_PROTOCOL_TI	TI mode
LL_SPI_PROTOCOL_MOTOROLA	Motorola mode. Used as default value
LL_SPI_PROTOCOL_TI	TI mode

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
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
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
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

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

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

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

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

65 LL SYSTEM Generic Driver

65.1 SYSTEM Firmware driver API description

65.1.1 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: (*) value not defined in all devices – LL_SYSCFG_REMAP_FLASH – LL_SYSCFG_REMAP_SYSTEMFLASH – LL_SYSCFG_REMAP_SRAM – LL_SYSCFG_REMAP_FMC (*)
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: (*) value not defined in all devices. – LL_SYSCFG_REMAP_FLASH – LL_SYSCFG_REMAP_SYSTEMFLASH – LL_SYSCFG_REMAP_SRAM – LL_SYSCFG_REMAP_FMC (*)
Reference Manual to LL API cross reference:	• SYSCFG_MEMRMP MEM_MODE LL_SYSCFG_GetRemapMemory

LL_SYSCFG_GetBootMode

Function name	**__STATIC_INLINE uint32_t LL_SYSCFG_GetBootMode (void)**
Function description	Return the boot mode as configured by user.
Return values	• **Returned:** value can be one of the following values: (*) value not defined in all devices. – LL_SYSCFG_BOOTMODE_FLASH – LL_SYSCFG_BOOTMODE_SYSTEMFLASH – LL_SYSCFG_BOOTMODE_FSMC (*)

- LL_SYSCFG_BOOTMODE_SRAM

Reference Manual to LL API cross reference:

- SYSCFG_MEMRMP BOOT_MODE LL_SYSCFG_GetBootMode

LL_SYSCFG_EnableUSBPullUp

Function name **__STATIC_INLINE void LL_SYSCFG_EnableUSBPullUp (void)**

Function description Enable internal pull-up on USB DP line.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_PMC USB_PU LL_SYSCFG_EnableUSBPullUp

LL_SYSCFG_DisableUSBPullUp

Function name **__STATIC_INLINE void LL_SYSCFG_DisableUSBPullUp (void)**

Function description Disable internal pull-up on USB DP line.

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_PMC USB_PU LL_SYSCFG_DisableUSBPullUp

LL_SYSCFG_EnableLCDCapacitanceConnection

Function name **__STATIC_INLINE void LL_SYSCFG_EnableLCDCapacitanceConnection (uint32_t Pin)**

Function description Enable decoupling capacitance connection.

Parameters

- **Pin:** This parameter can be a combination of the following values:
  - LL_SYSCFG_LCDCAPA_PB2
  - LL_SYSCFG_LCDCAPA_PB12
  - LL_SYSCFG_LCDCAPA_PB0
  - LL_SYSCFG_LCDCAPA_PE11
  - LL_SYSCFG_LCDCAPA_PE12

Return values

- **None:**

Reference Manual to LL API cross reference:

- SYSCFG_PMC LCD_CAPA LL_SYSCFG_EnableLCDCapacitanceConnection

LL_SYSCFG_DisableLCDCapacitanceConnection

Function name **__STATIC_INLINE void LL_SYSCFG_DisableLCDCapacitanceConnection (uint32_t Pin)**

Function description
DIsable decoupling capacitance connection.

Parameters
- **Pin:** This parameter can be a combination of the following values:
  - LL_SYSCFG_LCDCAPA_PB2
  - LL_SYSCFG_LCDCAPA_PB12
  - LL_SYSCFG_LCDCAPA_PB0
  - LL_SYSCFG_LCDCAPA_PE11
  - LL_SYSCFG_LCDCAPA_PE12

Return values
- **None:**

Reference Manual to LL API cross reference:
- SYSCFG_PMC LCD_CAPA LL_SYSCFG_DisableLCDCapacitanceConnection

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: (*) value not defined in all devices.
  - 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
- **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 EXTI0 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI1 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI2 LL_SYSCFG_SetEXTISource

- SYSCFG_EXTICR1 EXTI3 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI4 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI5 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI6 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI7 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI8 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI9 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI10 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI11 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI12 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI13 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI14 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR1 EXTI15 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI0 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI1 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI2 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI3 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI4 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI5 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI6 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI7 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI8 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI9 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI10 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI11 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI12 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI13 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI14 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR2 EXTI15 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI0 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI1 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI2 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI3 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI4 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI5 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI6 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI7 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI8 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI9 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI10 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI11 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI12 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI13 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI14 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR3 EXTI15 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI0 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI1 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI2 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI3 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI4 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI5 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI6 LL_SYSCFG_SetEXTISource

- SYSCFG_EXTICR4 EXTI7 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI8 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI9 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI10 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI11 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI12 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI13 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI14 LL_SYSCFG_SetEXTISource
- SYSCFG_EXTICR4 EXTI15 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: (*) value not defined in all devices.
  - 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

Reference Manual to LL API cross reference:
- SYSCFG_EXTICR1 EXTI0 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI1 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI2 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI3 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI4 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI5 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI6 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI7 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI8 LL_SYSCFG_GetEXTISource

- SYSCFG_EXTICR1 EXTI9 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI10 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI11 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI12 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI13 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI14 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR1 EXTI15 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI0 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI1 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI2 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI3 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI4 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI5 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI6 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI7 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI8 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI9 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI10 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI11 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI12 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI13 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI14 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR2 EXTI15 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI0 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI1 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI2 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI3 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI4 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI5 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI6 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI7 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI8 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI9 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI10 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI11 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI12 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI13 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI14 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR3 EXTI15 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI0 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI1 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI2 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI3 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI4 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI5 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI6 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI7 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI8 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI9 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI10 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI11 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI12 LL_SYSCFG_GetEXTISource

- SYSCFG_EXTICR4 EXTI13 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI14 LL_SYSCFG_GetEXTISource
- SYSCFG_EXTICR4 EXTI15 LL_SYSCFG_GetEXTISource

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=0xFFF
Notes	• 0x416: Cat.1 device 0x429: Cat.2 device 0x427: Cat.3 device 0x436: Cat.4 device or Cat.3 device(1) 0x437: Cat.5 device
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. For example, it is read as Cat.1 RevA -> 0x1000, Cat.2 Rev Z -> 0x1018...
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 (*) value not defined in all devices.

Return values
- **None:**

Reference Manual to LL API cross
- APB1_FZ DBG_TIM2_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_TIM3_STOP

reference:
- LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_TIM4_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_TIM5_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_TIM6_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_TIM7_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_RTC_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_WWDG_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_IWDG_STOP LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_I2C1_SMBUS_TIMEOUT LL_DBGMCU_APB1_GRP1_FreezePeriph
- APB1_FZ DBG_I2C2_SMBUS_TIMEOUT LL_DBGMCU_APB1_GRP1_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 (*) value not defined in all devices.

Return values:
- **None:**

Reference Manual to LL API cross reference:
- APB1_FZ DBG_TIM2_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_TIM3_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_TIM4_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_TIM5_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_TIM6_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_TIM7_STOP

LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_RTC_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_WWDG_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_IWDG_STOP LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_I2C1_SMBUS_TIMEOUT LL_DBGMCU_APB1_GRP1_UnFreezePeriph
- APB1_FZ DBG_I2C2_SMBUS_TIMEOUT LL_DBGMCU_APB1_GRP1_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_TIM9_STOP
  - LL_DBGMCU_APB2_GRP1_TIM10_STOP
  - LL_DBGMCU_APB2_GRP1_TIM11_STOP

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2_FZ DBG_TIM9_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph
- APB2_FZ DBG_TIM10_STOP LL_DBGMCU_APB2_GRP1_FreezePeriph
- APB2_FZ DBG_TIM11_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_TIM9_STOP
  - LL_DBGMCU_APB2_GRP1_TIM10_STOP
  - LL_DBGMCU_APB2_GRP1_TIM11_STOP

Return values
- **None:**

Reference Manual to LL API cross reference:
- APB2_FZ DBG_TIM9_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph
- APB2_FZ DBG_TIM10_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph
- APB2_FZ DBG_TIM11_STOP LL_DBGMCU_APB2_GRP1_UnFreezePeriph

LL_RI_SetRemapInputCapture_TIM

Function name

__STATIC_INLINE void LL_RI_SetRemapInputCapture_TIM (uint32_t TIM_Select, uint32_t InputCaptureChannel, uint32_t Input)

Function description

Configures the routing interface to map Input Capture x of TIMx to a selected I/O pin.

Parameters

- **TIM_Select:** This parameter can be one of the following values:
  - LL_RI_TIM_SELECT_NONE
  - LL_RI_TIM_SELECT_TIM2
  - LL_RI_TIM_SELECT_TIM3
  - LL_RI_TIM_SELECT_TIM4
- **InputCaptureChannel:** This parameter can be one of the following values:
  - LL_RI_INPUTCAPTURE_1
  - LL_RI_INPUTCAPTURE_2
  - LL_RI_INPUTCAPTURE_3
  - LL_RI_INPUTCAPTURE_4
- **Input:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_INPUTCAPTUREROUTING_0
  - LL_RI_INPUTCAPTUREROUTING_1
  - LL_RI_INPUTCAPTUREROUTING_2
  - LL_RI_INPUTCAPTUREROUTING_3
  - LL_RI_INPUTCAPTUREROUTING_4
  - LL_RI_INPUTCAPTUREROUTING_5
  - LL_RI_INPUTCAPTUREROUTING_6
  - LL_RI_INPUTCAPTUREROUTING_7
  - LL_RI_INPUTCAPTUREROUTING_8
  - LL_RI_INPUTCAPTUREROUTING_9
  - LL_RI_INPUTCAPTUREROUTING_10
  - LL_RI_INPUTCAPTUREROUTING_11
  - LL_RI_INPUTCAPTUREROUTING_12 (*)
  - LL_RI_INPUTCAPTUREROUTING_13 (*)
  - LL_RI_INPUTCAPTUREROUTING_14 (*)
  - LL_RI_INPUTCAPTUREROUTING_15 (*)

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_ICR IC1OS LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC2OS LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC3OS LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC4OS LL_RI_SetRemapInputCapture_TIM
- RI_ICR TIM LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC1 LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC2 LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC3 LL_RI_SetRemapInputCapture_TIM
- RI_ICR IC4 LL_RI_SetRemapInputCapture_TIM

LL_RI_DisableRemapInputCapture_TIM

Function name

__STATIC_INLINE void

LL_RI_DisableRemapInputCapture_TIM (uint32_t InputCaptureChannel)

Function description: Disable the TIM Input capture remap (select the standard AF)

Parameters:
- **InputCaptureChannel:** This parameter can be a combination of the following values:
  - LL_RI_INPUTCAPTURE_1
  - LL_RI_INPUTCAPTURE_2
  - LL_RI_INPUTCAPTURE_3
  - LL_RI_INPUTCAPTURE_4

Return values:
- **None:**

Reference Manual to LL API cross reference:
- RI_ICR IC1 LL_RI_DisableRemapInputCapture_TIM
- RI_ICR IC2 LL_RI_DisableRemapInputCapture_TIM
- RI_ICR IC3 LL_RI_DisableRemapInputCapture_TIM
- RI_ICR IC4 LL_RI_DisableRemapInputCapture_TIM

LL_RI_CloseIOSwitchLinkedToADC

Function name: **__STATIC_INLINE void LL_RI_CloseIOSwitchLinkedToADC (uint32_t IOSwitch)**

Function description: Close the routing interface Input Output switches linked to ADC.

Parameters:
- **IOSwitch:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_RI_IOSWITCH_CH0
  - LL_RI_IOSWITCH_CH1
  - LL_RI_IOSWITCH_CH2
  - LL_RI_IOSWITCH_CH3
  - LL_RI_IOSWITCH_CH4
  - LL_RI_IOSWITCH_CH5
  - LL_RI_IOSWITCH_CH6
  - LL_RI_IOSWITCH_CH7
  - LL_RI_IOSWITCH_CH8
  - LL_RI_IOSWITCH_CH9
  - LL_RI_IOSWITCH_CH10
  - LL_RI_IOSWITCH_CH11
  - LL_RI_IOSWITCH_CH12
  - LL_RI_IOSWITCH_CH13
  - LL_RI_IOSWITCH_CH14
  - LL_RI_IOSWITCH_CH15
  - LL_RI_IOSWITCH_CH18
  - LL_RI_IOSWITCH_CH19
  - LL_RI_IOSWITCH_CH20
  - LL_RI_IOSWITCH_CH21
  - LL_RI_IOSWITCH_CH22
  - LL_RI_IOSWITCH_CH23
  - LL_RI_IOSWITCH_CH24
  - LL_RI_IOSWITCH_CH25
  - LL_RI_IOSWITCH_VCOMP
  - LL_RI_IOSWITCH_CH27 (*)
  - LL_RI_IOSWITCH_CH28 (*)
  - LL_RI_IOSWITCH_CH29 (*)

- LL_RI_IOSWITCH_CH30 (*)
- LL_RI_IOSWITCH_CH31 (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- RI_ASCR1 CH LL_RI_CloseIOSwitchLinkedToADC
- RI_ASCR1 VCOMP LL_RI_CloseIOSwitchLinkedToADC

LL_RI_OpenIOSwitchLinkedToADC

Function name
__STATIC_INLINE void LL_RI_OpenIOSwitchLinkedToADC (uint32_t IOSwitch)

Function description
Open the routing interface Input Output switches linked to ADC.

Parameters
- **IOSwitch:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_RI_IOSWITCH_CH0
  - LL_RI_IOSWITCH_CH1
  - LL_RI_IOSWITCH_CH2
  - LL_RI_IOSWITCH_CH3
  - LL_RI_IOSWITCH_CH4
  - LL_RI_IOSWITCH_CH5
  - LL_RI_IOSWITCH_CH6
  - LL_RI_IOSWITCH_CH7
  - LL_RI_IOSWITCH_CH8
  - LL_RI_IOSWITCH_CH9
  - LL_RI_IOSWITCH_CH10
  - LL_RI_IOSWITCH_CH11
  - LL_RI_IOSWITCH_CH12
  - LL_RI_IOSWITCH_CH13
  - LL_RI_IOSWITCH_CH14
  - LL_RI_IOSWITCH_CH15
  - LL_RI_IOSWITCH_CH18
  - LL_RI_IOSWITCH_CH19
  - LL_RI_IOSWITCH_CH20
  - LL_RI_IOSWITCH_CH21
  - LL_RI_IOSWITCH_CH22
  - LL_RI_IOSWITCH_CH23
  - LL_RI_IOSWITCH_CH24
  - LL_RI_IOSWITCH_CH25
  - LL_RI_IOSWITCH_VCOMP
  - LL_RI_IOSWITCH_CH27 (*)
  - LL_RI_IOSWITCH_CH28 (*)
  - LL_RI_IOSWITCH_CH29 (*)
  - LL_RI_IOSWITCH_CH30 (*)
  - LL_RI_IOSWITCH_CH31 (*)

Return values
- **None:**

Reference Manual to LL API cross reference:
- RI_ASCR1 CH LL_RI_OpenIOSwitchLinkedToADC
- RI_ASCR1 VCOMP LL_RI_OpenIOSwitchLinkedToADC

LL_RI_EnableSwitchControlMode

Function name	**__STATIC_INLINE void LL_RI_EnableSwitchControlMode (void)**
Function description	Enable the switch control mode.
Return values	• **None:**
Reference Manual to LL API cross reference:	• RI_ASCR1 SCM LL_RI_EnableSwitchControlMode

LL_RI_DisableSwitchControlMode

Function name	**__STATIC_INLINE void LL_RI_DisableSwitchControlMode (void)**
Function description	Disable the switch control mode.
Return values	• **None:**
Reference Manual to LL API cross reference:	• RI_ASCR1 SCM LL_RI_DisableSwitchControlMode

LL_RI_CloseIOSwitchNotLinkedToADC

Function name	**__STATIC_INLINE void LL_RI_CloseIOSwitchNotLinkedToADC (uint32_t IOSwitch)**
Function description	Close the routing interface Input Output switches not linked to ADC.
Parameters	• **IOSwitch:** This parameter can be a combination of the following values: (*) value not defined in all devices. – LL_RI_IOSWITCH_GR10_1 – LL_RI_IOSWITCH_GR10_2 – LL_RI_IOSWITCH_GR10_3 – LL_RI_IOSWITCH_GR10_4 – LL_RI_IOSWITCH_GR6_1 – LL_RI_IOSWITCH_GR6_2 – LL_RI_IOSWITCH_GR5_1 – LL_RI_IOSWITCH_GR5_2 – LL_RI_IOSWITCH_GR5_3 – LL_RI_IOSWITCH_GR4_1 – LL_RI_IOSWITCH_GR4_2 – LL_RI_IOSWITCH_GR4_3 – LL_RI_IOSWITCH_CH0b (*) – LL_RI_IOSWITCH_CH1b (*) – LL_RI_IOSWITCH_CH2b (*) – LL_RI_IOSWITCH_CH3b (*) – LL_RI_IOSWITCH_CH6b (*) – LL_RI_IOSWITCH_CH7b (*) – LL_RI_IOSWITCH_CH8b (*) – LL_RI_IOSWITCH_CH9b (*) – LL_RI_IOSWITCH_CH10b (*) – LL_RI_IOSWITCH_CH11b (*)

- LL_RI_IOSWITCH_CH12b (*)
- LL_RI_IOSWITCH_GR6_3
- LL_RI_IOSWITCH_GR6_4

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_ASCR2 GR10_1 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR10_2 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR10_3 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR10_4 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_1 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_2 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR5_1 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR5_2 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR5_3 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_1 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_2 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_3 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_4 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH0b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH1b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH2b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH3b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH6b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH7b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH8b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH9b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH10b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH11b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 CH12b LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_3 LL_RI_CloseIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_4 LL_RI_CloseIOSwitchNotLinkedToADC

LL_RI_OpenIOSwitchNotLinkedToADC

Function name

__STATIC_INLINE void LL_RI_OpenIOSwitchNotLinkedToADC (uint32_t IOSwitch)

Function description

Open the routing interface Input Output switches not linked to ADC.

Parameters

- **IOSwitch:** This parameter can be a combination of the following values: (*) value not defined in all devices.
  - LL_RI_IOSWITCH_GR10_1
  - LL_RI_IOSWITCH_GR10_2
  - LL_RI_IOSWITCH_GR10_3
  - LL_RI_IOSWITCH_GR10_4
  - LL_RI_IOSWITCH_GR6_1
  - LL_RI_IOSWITCH_GR6_2
  - LL_RI_IOSWITCH_GR5_1
  - LL_RI_IOSWITCH_GR5_2
  - LL_RI_IOSWITCH_GR5_3
  - LL_RI_IOSWITCH_GR4_1
  - LL_RI_IOSWITCH_GR4_2
  - LL_RI_IOSWITCH_GR4_3

- LL_RI_IOSWITCH_CH0b (*)
- LL_RI_IOSWITCH_CH1b (*)
- LL_RI_IOSWITCH_CH2b (*)
- LL_RI_IOSWITCH_CH3b (*)
- LL_RI_IOSWITCH_CH6b (*)
- LL_RI_IOSWITCH_CH7b (*)
- LL_RI_IOSWITCH_CH8b (*)
- LL_RI_IOSWITCH_CH9b (*)
- LL_RI_IOSWITCH_CH10b (*)
- LL_RI_IOSWITCH_CH11b (*)
- LL_RI_IOSWITCH_CH12b (*)
- LL_RI_IOSWITCH_GR6_3
- LL_RI_IOSWITCH_GR6_4

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_ASCR2 GR10_1 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR10_2 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR10_3 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR10_4 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_1 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_2 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR5_1 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR5_2 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR5_3 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_1 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_2 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_3 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR4_4 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH0b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH1b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH2b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH3b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH6b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH7b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH8b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH9b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH10b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH11b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 CH12b LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_3 LL_RI_OpenIOSwitchNotLinkedToADC
- RI_ASCR2 GR6_4 LL_RI_OpenIOSwitchNotLinkedToADC

LL_RI_EnableHysteresis

Function name

__STATIC_INLINE void LL_RI_EnableHysteresis (uint32_t Port, uint32_t Pin)

Function description

Enable Hysteresis of the input schmitt triger of the port X.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_HSYTERESIS_PORT_A
  - LL_RI_HSYTERESIS_PORT_B
  - LL_RI_HSYTERESIS_PORT_C

  - LL_RI_HSYTERESIS_PORT_D
  - LL_RI_HSYTERESIS_PORT_E (*)
  - LL_RI_HSYTERESIS_PORT_F (*)
  - LL_RI_HSYTERESIS_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8
  - LL_RI_PIN_9
  - LL_RI_PIN_10
  - LL_RI_PIN_11
  - LL_RI_PIN_12
  - LL_RI_PIN_13
  - LL_RI_PIN_14
  - LL_RI_PIN_15
  - LL_RI_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_HYSCR1 PA LL_RI_EnableHysteresis
- RI_HYSCR1 PB LL_RI_EnableHysteresis
- RI_HYSCR1 PC LL_RI_EnableHysteresis
- RI_HYSCR1 PD LL_RI_EnableHysteresis
- RI_HYSCR1 PE LL_RI_EnableHysteresis
- RI_HYSCR1 PF LL_RI_EnableHysteresis
- RI_HYSCR1 PG LL_RI_EnableHysteresis
- RI_HYSCR2 PA LL_RI_EnableHysteresis
- RI_HYSCR2 PB LL_RI_EnableHysteresis
- RI_HYSCR2 PC LL_RI_EnableHysteresis
- RI_HYSCR2 PD LL_RI_EnableHysteresis
- RI_HYSCR2 PE LL_RI_EnableHysteresis
- RI_HYSCR2 PF LL_RI_EnableHysteresis
- RI_HYSCR2 PG LL_RI_EnableHysteresis
- RI_HYSCR3 PA LL_RI_EnableHysteresis
- RI_HYSCR3 PB LL_RI_EnableHysteresis
- RI_HYSCR3 PC LL_RI_EnableHysteresis
- RI_HYSCR3 PD LL_RI_EnableHysteresis
- RI_HYSCR3 PE LL_RI_EnableHysteresis
- RI_HYSCR3 PF LL_RI_EnableHysteresis
- RI_HYSCR3 PG LL_RI_EnableHysteresis
- RI_HYSCR4 PA LL_RI_EnableHysteresis
- RI_HYSCR4 PB LL_RI_EnableHysteresis
- RI_HYSCR4 PC LL_RI_EnableHysteresis
- RI_HYSCR4 PD LL_RI_EnableHysteresis
- RI_HYSCR4 PE LL_RI_EnableHysteresis
- RI_HYSCR4 PF LL_RI_EnableHysteresis

- RI_HYSCR4 PG LL_RI_EnableHysteresis

LL_RI_DisableHysteresis

Function name

__STATIC_INLINE void LL_RI_DisableHysteresis (uint32_t Port, uint32_t Pin)

Function description

Disable Hysteresis of the input schmitt triger of the port X.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_HSYTERESIS_PORT_A
  - LL_RI_HSYTERESIS_PORT_B
  - LL_RI_HSYTERESIS_PORT_C
  - LL_RI_HSYTERESIS_PORT_D
  - LL_RI_HSYTERESIS_PORT_E (*)
  - LL_RI_HSYTERESIS_PORT_F (*)
  - LL_RI_HSYTERESIS_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8
  - LL_RI_PIN_9
  - LL_RI_PIN_10
  - LL_RI_PIN_11
  - LL_RI_PIN_12
  - LL_RI_PIN_13
  - LL_RI_PIN_14
  - LL_RI_PIN_15
  - LL_RI_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_HYSCR1 PA LL_RI_DisableHysteresis
- RI_HYSCR1 PB LL_RI_DisableHysteresis
- RI_HYSCR1 PC LL_RI_DisableHysteresis
- RI_HYSCR1 PD LL_RI_DisableHysteresis
- RI_HYSCR1 PE LL_RI_DisableHysteresis
- RI_HYSCR1 PF LL_RI_DisableHysteresis
- RI_HYSCR1 PG LL_RI_DisableHysteresis
- RI_HYSCR2 PA LL_RI_DisableHysteresis
- RI_HYSCR2 PB LL_RI_DisableHysteresis
- RI_HYSCR2 PC LL_RI_DisableHysteresis
- RI_HYSCR2 PD LL_RI_DisableHysteresis
- RI_HYSCR2 PE LL_RI_DisableHysteresis
- RI_HYSCR2 PF LL_RI_DisableHysteresis
- RI_HYSCR2 PG LL_RI_DisableHysteresis
- RI_HYSCR3 PA LL_RI_DisableHysteresis

- RI_HYSCR3 PB LL_RI_DisableHysteresis
- RI_HYSCR3 PC LL_RI_DisableHysteresis
- RI_HYSCR3 PD LL_RI_DisableHysteresis
- RI_HYSCR3 PE LL_RI_DisableHysteresis
- RI_HYSCR3 PF LL_RI_DisableHysteresis
- RI_HYSCR3 PG LL_RI_DisableHysteresis
- RI_HYSCR4 PA LL_RI_DisableHysteresis
- RI_HYSCR4 PB LL_RI_DisableHysteresis
- RI_HYSCR4 PC LL_RI_DisableHysteresis
- RI_HYSCR4 PD LL_RI_DisableHysteresis
- RI_HYSCR4 PE LL_RI_DisableHysteresis
- RI_HYSCR4 PF LL_RI_DisableHysteresis
- RI_HYSCR4 PG LL_RI_DisableHysteresis

LL_RI_ControlSwitchByADC

Function name **__STATIC_INLINE void LL_RI_ControlSwitchByADC (uint32_t Port, uint32_t Pin)**

Function description Control analog switches of port X through the ADC interface or RI_ASCRx registers.

Parameters
- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_PORT_A
  - LL_RI_PORT_B
  - LL_RI_PORT_C
  - LL_RI_PORT_F (*)
  - LL_RI_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8
  - LL_RI_PIN_9
  - LL_RI_PIN_10
  - LL_RI_PIN_11
  - LL_RI_PIN_12
  - LL_RI_PIN_13
  - LL_RI_PIN_14
  - LL_RI_PIN_15
  - LL_RI_PIN_ALL

Return values
- **None:**

Reference Manual to LL API cross reference:
- RI_ASMR1 PA LL_RI_ControlSwitchByADC
- RI_ASMR1 PB LL_RI_ControlSwitchByADC
- RI_ASMR1 PC LL_RI_ControlSwitchByADC
- RI_ASMR1 PF LL_RI_ControlSwitchByADC

- RI_ASMR1 PG LL_RI_ControlSwitchByADC
- RI_ASMR2 PA LL_RI_ControlSwitchByADC
- RI_ASMR2 PB LL_RI_ControlSwitchByADC
- RI_ASMR2 PC LL_RI_ControlSwitchByADC
- RI_ASMR2 PF LL_RI_ControlSwitchByADC
- RI_ASMR2 PG LL_RI_ControlSwitchByADC
- RI_ASMR3 PA LL_RI_ControlSwitchByADC
- RI_ASMR3 PB LL_RI_ControlSwitchByADC
- RI_ASMR3 PC LL_RI_ControlSwitchByADC
- RI_ASMR3 PF LL_RI_ControlSwitchByADC
- RI_ASMR3 PG LL_RI_ControlSwitchByADC
- RI_ASMR4 PA LL_RI_ControlSwitchByADC
- RI_ASMR4 PB LL_RI_ControlSwitchByADC
- RI_ASMR4 PC LL_RI_ControlSwitchByADC
- RI_ASMR4 PF LL_RI_ControlSwitchByADC
- RI_ASMR4 PG LL_RI_ControlSwitchByADC
- RI_ASMR5 PA LL_RI_ControlSwitchByADC
- RI_ASMR5 PB LL_RI_ControlSwitchByADC
- RI_ASMR5 PC LL_RI_ControlSwitchByADC
- RI_ASMR5 PF LL_RI_ControlSwitchByADC
- RI_ASMR5 PG LL_RI_ControlSwitchByADC

LL_RI_ControlSwitchByTIM

Function name **__STATIC_INLINE void LL_RI_ControlSwitchByTIM (uint32_t Port, uint32_t Pin)**

Function description Control analog switches of port X by the timer OC.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_PORT_A
  - LL_RI_PORT_B
  - LL_RI_PORT_C
  - LL_RI_PORT_F (*)
  - LL_RI_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8
  - LL_RI_PIN_9
  - LL_RI_PIN_10
  - LL_RI_PIN_11
  - LL_RI_PIN_12
  - LL_RI_PIN_13
  - LL_RI_PIN_14
  - LL_RI_PIN_15

- LL_RI_PIN_ALL

Return values
- **None:**

Reference Manual to LL API cross reference:
- RI_ASMR1 PA LL_RI_ControlSwitchByTIM
- RI_ASMR1 PB LL_RI_ControlSwitchByTIM
- RI_ASMR1 PC LL_RI_ControlSwitchByTIM
- RI_ASMR1 PF LL_RI_ControlSwitchByTIM
- RI_ASMR1 PG LL_RI_ControlSwitchByTIM
- RI_ASMR2 PA LL_RI_ControlSwitchByTIM
- RI_ASMR2 PB LL_RI_ControlSwitchByTIM
- RI_ASMR2 PC LL_RI_ControlSwitchByTIM
- RI_ASMR2 PF LL_RI_ControlSwitchByTIM
- RI_ASMR2 PG LL_RI_ControlSwitchByTIM
- RI_ASMR3 PA LL_RI_ControlSwitchByTIM
- RI_ASMR3 PB LL_RI_ControlSwitchByTIM
- RI_ASMR3 PC LL_RI_ControlSwitchByTIM
- RI_ASMR3 PF LL_RI_ControlSwitchByTIM
- RI_ASMR3 PG LL_RI_ControlSwitchByTIM
- RI_ASMR4 PA LL_RI_ControlSwitchByTIM
- RI_ASMR4 PB LL_RI_ControlSwitchByTIM
- RI_ASMR4 PC LL_RI_ControlSwitchByTIM
- RI_ASMR4 PF LL_RI_ControlSwitchByTIM
- RI_ASMR4 PG LL_RI_ControlSwitchByTIM
- RI_ASMR5 PA LL_RI_ControlSwitchByTIM
- RI_ASMR5 PB LL_RI_ControlSwitchByTIM
- RI_ASMR5 PC LL_RI_ControlSwitchByTIM
- RI_ASMR5 PF LL_RI_ControlSwitchByTIM
- RI_ASMR5 PG LL_RI_ControlSwitchByTIM

LL_RI_MaskChannelDuringAcquisition

Function name
__STATIC_INLINE void LL_RI_MaskChannelDuringAcquisition (uint32_t Port, uint32_t Pin)

Function description
Mask the input of port X during the capacitive sensing acquisition.

Parameters
- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_PORT_A
  - LL_RI_PORT_B
  - LL_RI_PORT_C
  - LL_RI_PORT_F (*)
  - LL_RI_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8

- LL_RI_PIN_9
- LL_RI_PIN_10
- LL_RI_PIN_11
- LL_RI_PIN_12
- LL_RI_PIN_13
- LL_RI_PIN_14
- LL_RI_PIN_15
- LL_RI_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_CMR1 PA LL_RI_MaskChannelDuringAcquisition
- RI_CMR1 PB LL_RI_MaskChannelDuringAcquisition
- RI_CMR1 PC LL_RI_MaskChannelDuringAcquisition
- RI_CMR1 PF LL_RI_MaskChannelDuringAcquisition
- RI_CMR1 PG LL_RI_MaskChannelDuringAcquisition
- RI_CMR2 PA LL_RI_MaskChannelDuringAcquisition
- RI_CMR2 PB LL_RI_MaskChannelDuringAcquisition
- RI_CMR2 PC LL_RI_MaskChannelDuringAcquisition
- RI_CMR2 PF LL_RI_MaskChannelDuringAcquisition
- RI_CMR2 PG LL_RI_MaskChannelDuringAcquisition
- RI_CMR3 PA LL_RI_MaskChannelDuringAcquisition
- RI_CMR3 PB LL_RI_MaskChannelDuringAcquisition
- RI_CMR3 PC LL_RI_MaskChannelDuringAcquisition
- RI_CMR3 PF LL_RI_MaskChannelDuringAcquisition
- RI_CMR3 PG LL_RI_MaskChannelDuringAcquisition
- RI_CMR4 PA LL_RI_MaskChannelDuringAcquisition
- RI_CMR4 PB LL_RI_MaskChannelDuringAcquisition
- RI_CMR4 PC LL_RI_MaskChannelDuringAcquisition
- RI_CMR4 PF LL_RI_MaskChannelDuringAcquisition
- RI_CMR4 PG LL_RI_MaskChannelDuringAcquisition
- RI_CMR5 PA LL_RI_MaskChannelDuringAcquisition
- RI_CMR5 PB LL_RI_MaskChannelDuringAcquisition
- RI_CMR5 PC LL_RI_MaskChannelDuringAcquisition
- RI_CMR5 PF LL_RI_MaskChannelDuringAcquisition
- RI_CMR5 PG LL_RI_MaskChannelDuringAcquisition

LL_RI_UnmaskChannelDuringAcquisition

Function name

__STATIC_INLINE void LL_RI_UnmaskChannelDuringAcquisition (uint32_t Port, uint32_t Pin)

Function description

Unmask the input of port X during the capacitive sensing acquisition.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_PORT_A
  - LL_RI_PORT_B
  - LL_RI_PORT_C
  - LL_RI_PORT_F (*)
  - LL_RI_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:

- LL_RI_PIN_0
- LL_RI_PIN_1
- LL_RI_PIN_2
- LL_RI_PIN_3
- LL_RI_PIN_4
- LL_RI_PIN_5
- LL_RI_PIN_6
- LL_RI_PIN_7
- LL_RI_PIN_8
- LL_RI_PIN_9
- LL_RI_PIN_10
- LL_RI_PIN_11
- LL_RI_PIN_12
- LL_RI_PIN_13
- LL_RI_PIN_14
- LL_RI_PIN_15
- LL_RI_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_CMR1 PA LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR1 PB LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR1 PC LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR1 PF LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR1 PG LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR2 PA LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR2 PB LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR2 PC LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR2 PF LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR2 PG LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR3 PA LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR3 PB LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR3 PC LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR3 PF LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR3 PG LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR4 PA LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR4 PB LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR4 PC LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR4 PF LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR4 PG LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR5 PA LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR5 PB LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR5 PC LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR5 PF LL_RI_UnmaskChannelDuringAcquisition
- RI_CMR5 PG LL_RI_UnmaskChannelDuringAcquisition

LL_RI_IdentifyChannelIO

Function name

__STATIC_INLINE void LL_RI_IdentifyChannelIO (uint32_t Port, uint32_t Pin)

Function description

Identify channel for timer input capture.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.

  - LL_RI_PORT_A
  - LL_RI_PORT_B
  - LL_RI_PORT_C
  - LL_RI_PORT_F (*)
  - LL_RI_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8
  - LL_RI_PIN_9
  - LL_RI_PIN_10
  - LL_RI_PIN_11
  - LL_RI_PIN_12
  - LL_RI_PIN_13
  - LL_RI_PIN_14
  - LL_RI_PIN_15
  - LL_RI_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_CICR1 PA LL_RI_IdentifyChannelIO
- RI_CICR1 PB LL_RI_IdentifyChannelIO
- RI_CICR1 PC LL_RI_IdentifyChannelIO
- RI_CICR1 PF LL_RI_IdentifyChannelIO
- RI_CICR1 PG LL_RI_IdentifyChannelIO
- RI_CICR2 PA LL_RI_IdentifyChannelIO
- RI_CICR2 PB LL_RI_IdentifyChannelIO
- RI_CICR2 PC LL_RI_IdentifyChannelIO
- RI_CICR2 PF LL_RI_IdentifyChannelIO
- RI_CICR2 PG LL_RI_IdentifyChannelIO
- RI_CICR3 PA LL_RI_IdentifyChannelIO
- RI_CICR3 PB LL_RI_IdentifyChannelIO
- RI_CICR3 PC LL_RI_IdentifyChannelIO
- RI_CICR3 PF LL_RI_IdentifyChannelIO
- RI_CICR3 PG LL_RI_IdentifyChannelIO
- RI_CICR4 PA LL_RI_IdentifyChannelIO
- RI_CICR4 PB LL_RI_IdentifyChannelIO
- RI_CICR4 PC LL_RI_IdentifyChannelIO
- RI_CICR4 PF LL_RI_IdentifyChannelIO
- RI_CICR4 PG LL_RI_IdentifyChannelIO
- RI_CICR5 PA LL_RI_IdentifyChannelIO
- RI_CICR5 PB LL_RI_IdentifyChannelIO
- RI_CICR5 PC LL_RI_IdentifyChannelIO
- RI_CICR5 PF LL_RI_IdentifyChannelIO
- RI_CICR5 PG LL_RI_IdentifyChannelIO

LL_RI_IdentifySamplingCapacitorIO

Function name

__STATIC_INLINE void LL_RI_IdentifySamplingCapacitorIO (uint32_t Port, uint32_t Pin)

Function description

Identify sampling capacitor for timer input capture.

Parameters

- **Port:** This parameter can be one of the following values: (*) value not defined in all devices.
  - LL_RI_PORT_A
  - LL_RI_PORT_B
  - LL_RI_PORT_C
  - LL_RI_PORT_F (*)
  - LL_RI_PORT_G (*)
- **Pin:** This parameter can be a combination of the following values:
  - LL_RI_PIN_0
  - LL_RI_PIN_1
  - LL_RI_PIN_2
  - LL_RI_PIN_3
  - LL_RI_PIN_4
  - LL_RI_PIN_5
  - LL_RI_PIN_6
  - LL_RI_PIN_7
  - LL_RI_PIN_8
  - LL_RI_PIN_9
  - LL_RI_PIN_10
  - LL_RI_PIN_11
  - LL_RI_PIN_12
  - LL_RI_PIN_13
  - LL_RI_PIN_14
  - LL_RI_PIN_15
  - LL_RI_PIN_ALL

Return values

- **None:**

Reference Manual to LL API cross reference:

- RI_CICR1 PA LL_RI_IdentifySamplingCapacitorIO
- RI_CICR1 PB LL_RI_IdentifySamplingCapacitorIO
- RI_CICR1 PC LL_RI_IdentifySamplingCapacitorIO
- RI_CICR1 PF LL_RI_IdentifySamplingCapacitorIO
- RI_CICR1 PG LL_RI_IdentifySamplingCapacitorIO
- RI_CICR2 PA LL_RI_IdentifySamplingCapacitorIO
- RI_CICR2 PB LL_RI_IdentifySamplingCapacitorIO
- RI_CICR2 PC LL_RI_IdentifySamplingCapacitorIO
- RI_CICR2 PF LL_RI_IdentifySamplingCapacitorIO
- RI_CICR2 PG LL_RI_IdentifySamplingCapacitorIO
- RI_CICR3 PA LL_RI_IdentifySamplingCapacitorIO
- RI_CICR3 PB LL_RI_IdentifySamplingCapacitorIO
- RI_CICR3 PC LL_RI_IdentifySamplingCapacitorIO
- RI_CICR3 PF LL_RI_IdentifySamplingCapacitorIO
- RI_CICR3 PG LL_RI_IdentifySamplingCapacitorIO
- RI_CICR4 PA LL_RI_IdentifySamplingCapacitorIO
- RI_CICR4 PB LL_RI_IdentifySamplingCapacitorIO
- RI_CICR4 PC LL_RI_IdentifySamplingCapacitorIO
- RI_CICR4 PF LL_RI_IdentifySamplingCapacitorIO

- RI_CICR4 PG LL_RI_IdentifySamplingCapacitorIO
- RI_CICR5 PA LL_RI_IdentifySamplingCapacitorIO
- RI_CICR5 PB LL_RI_IdentifySamplingCapacitorIO
- RI_CICR5 PC LL_RI_IdentifySamplingCapacitorIO
- RI_CICR5 PF LL_RI_IdentifySamplingCapacitorIO
- RI_CICR5 PG LL_RI_IdentifySamplingCapacitorIO

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

Return values
- **None:**

Notes
- Latetency can be modified only when ACC64 is set. (through function LL_FLASH_Enable64bitAccess)

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

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:**

Notes
- Prefetch can be enabled only when ACC64 is set. (through function LL_FLASH_Enable64bitAccess)

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:**
Notes	• Prefetch can be disabled only when ACC64 is set. (through function LL_FLASH_Enable64bitAccess)
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_Enable64bitAccess

Function name	**__STATIC_INLINE void LL_FLASH_Enable64bitAccess (void)**
Function description	Enable 64-bit access.
Return values	• **None:**
Reference Manual to LL API cross reference:	• FLASH_ACR ACC64 LL_FLASH_Enable64bitAccess

LL_FLASH_Disable64bitAccess

Function name	**__STATIC_INLINE void LL_FLASH_Disable64bitAccess (void)**
Function description	Disable 64-bit access.
Return values	• **None:**
Reference Manual to LL API cross reference:	• FLASH_ACR ACC64 LL_FLASH_Disable64bitAccess

LL_FLASH_Is64bitAccessEnabled

Function name	**__STATIC_INLINE uint32_t LL_FLASH_Is64bitAccessEnabled (void)**
Function description	Check if 64-bit access is enabled.
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• FLASH_ACR ACC64 LL_FLASH_Is64bitAccessEnabled

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

65.2 SYSTEM Firmware driver defines

65.2.1 SYSTEM

DBGMCU APB1 GRP1 STOP IP

LL_DBGMCU_APB1_GRP1_TIM2_STOP	TIM2 counter stopped when core is halted
LL_DBGMCU_APB1_GRP1_TIM3_STOP	TIM3 counter stopped when core is halted
LL_DBGMCU_APB1_GRP1_TIM4_STOP	TIM4 counter stopped when core is halted
LL_DBGMCU_APB1_GRP1_TIM5_STOP	TIM5 counter stopped when core is halted
LL_DBGMCU_APB1_GRP1_TIM6_STOP	TIM6 counter stopped when core is halted
LL_DBGMCU_APB1_GRP1_TIM7_STOP	TIM7 counter stopped when core is halted
LL_DBGMCU_APB1_GRP1_RTC_STOP	RTC Counter stopped when Core is halted
LL_DBGMCU_APB1_GRP1_WWDG_STOP	Debug Window Watchdog stopped when Core is halted
LL_DBGMCU_APB1_GRP1_IWDG_STOP	Debug Independent Watchdog stopped when Core is halted
LL_DBGMCU_APB1_GRP1_I2C1_STOP	I2C1 SMBUS timeout mode stopped when Core is halted
LL_DBGMCU_APB1_GRP1_I2C2_STOP	I2C2 SMBUS timeout mode stopped when Core is halted

DBGMCU APB2 GRP1 STOP IP

LL_DBGMCU_APB2_GRP1_TIM9_STOP	TIM9 counter stopped when core is halted
LL_DBGMCU_APB2_GRP1_TIM10_STOP	TIM10 counter stopped when core is halted
LL_DBGMCU_APB2_GRP1_TIM11_STOP	TIM11 counter stopped when core is halted

SYSCFG BOOT MODE

LL_SYSCFG_BOOTMODE_FLASH

LL_SYSCFG_BOOTMODE_SYSTEMFLASH

LL_SYSCFG_BOOTMODE_FSMC

LL_SYSCFG_BOOTMODE_SRAM

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

RI HSYTERESIS PORT

LL_RI_HSYTERESIS_PORT_A	HYSTERESIS PORT A
LL_RI_HSYTERESIS_PORT_B	HYSTERESIS PORT B
LL_RI_HSYTERESIS_PORT_C	HYSTERESIS PORT C
LL_RI_HSYTERESIS_PORT_D	HYSTERESIS PORT D
LL_RI_HSYTERESIS_PORT_E	HYSTERESIS PORT E
LL_RI_HSYTERESIS_PORT_F	HYSTERESIS PORT F
LL_RI_HSYTERESIS_PORT_G	HYSTERESIS PORT G

RI Input Capture number

LL_RI_INPUTCAPTURE_1	Input Capture 1 select output
LL_RI_INPUTCAPTURE_2	Input Capture 2 select output
LL_RI_INPUTCAPTURE_3	Input Capture 3 select output
LL_RI_INPUTCAPTURE_4	Input Capture 4 select output

RI Input Capture Routing

LL_RI_INPUTCAPTUREROUTING_0	PA0 PA1 PA2 PA3
LL_RI_INPUTCAPTUREROUTING_1	PA4 PA5 PA6 PA7
LL_RI_INPUTCAPTUREROUTING_2	PA8 PA9 PA10 PA11
LL_RI_INPUTCAPTUREROUTING_3	PA12 PA13 PA14 PA15
LL_RI_INPUTCAPTUREROUTING_4	PC0 PC1 PC2 PC3
LL_RI_INPUTCAPTUREROUTING_5	PC4 PC5 PC6 PC7
LL_RI_INPUTCAPTUREROUTING_6	PC8 PC9 PC10 PC11
LL_RI_INPUTCAPTUREROUTING_7	PC12 PC13 PC14 PC15
LL_RI_INPUTCAPTUREROUTING_8	PD0 PD1 PD2 PD3
LL_RI_INPUTCAPTUREROUTING_9	PD4 PD5 PD6 PD7
LL_RI_INPUTCAPTUREROUTING_10	PD8 PD9 PD10 PD11
LL_RI_INPUTCAPTUREROUTING_11	PD12 PD13 PD14 PD15
LL_RI_INPUTCAPTUREROUTING_12	PE0 PE1 PE2 PE3
LL_RI_INPUTCAPTUREROUTING_13	PE4 PE5 PE6 PE7
LL_RI_INPUTCAPTUREROUTING_14	PE8 PE9 PE10 PE11
LL_RI_INPUTCAPTUREROUTING_15	PE12 PE13 PE14 PE15

RI IO Switch linked to ADC

LL_RI_IOSWITCH_CH0	CH[3:0] GR1[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH1	CH[3:0] GR1[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH2	CH[3:0] GR1[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH3	CH[3:0] GR1[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH4	CH4: Analog switch control
LL_RI_IOSWITCH_CH5	CH5: Comparator 1 analog switch
LL_RI_IOSWITCH_CH6	CH[7:6] GR2[2:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH7	CH[7:6] GR2[2:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH8	CH[9:8] GR3[2:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH9	CH[9:8] GR3[2:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH10	CH[13:10] GR8[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH11	CH[13:10] GR8[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH12	CH[13:10] GR8[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH13	CH[13:10] GR8[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH14	CH[15:14] GR9[2:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH15	CH[15:14] GR9[2:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH18	CH[21:18]/GR7[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH19	CH[21:18]/GR7[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH20	CH[21:18]/GR7[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH21	CH[21:18]/GR7[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH22	Analog I/O switch control of channels CH22
LL_RI_IOSWITCH_CH23	Analog I/O switch control of channels CH23
LL_RI_IOSWITCH_CH24	Analog I/O switch control of channels CH24
LL_RI_IOSWITCH_CH25	Analog I/O switch control of channels CH25
LL_RI_IOSWITCH_VCOMP	VCOMP (ADC channel 26) is an internal switch used to connect selected channel to COMP1 non inverting input
LL_RI_IOSWITCH_CH27	CH[30:27]/GR11[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH28	CH[30:27]/GR11[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH29	CH[30:27]/GR11[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH30	CH[30:27]/GR11[4:1]: I/O Analog switch control
LL_RI_IOSWITCH_CH31	CH31/GR11-5 I/O Analog switch control

RI IO Switch not linked to ADC

LL_RI_IOSWITCH_GR10_1	GR10-1 I/O analog switch control
LL_RI_IOSWITCH_GR10_2	GR10-2 I/O analog switch control
LL_RI_IOSWITCH_GR10_3	GR10-3 I/O analog switch control
LL_RI_IOSWITCH_GR10_4	GR10-4 I/O analog switch control
LL_RI_IOSWITCH_GR6_1	GR6-1 I/O analog switch control

LL_RI_IOSWITCH_GR6_2	GR6-2 I/O analog switch control
LL_RI_IOSWITCH_GR5_1	GR5-1 I/O analog switch control
LL_RI_IOSWITCH_GR5_2	GR5-2 I/O analog switch control
LL_RI_IOSWITCH_GR5_3	GR5-3 I/O analog switch control
LL_RI_IOSWITCH_GR4_1	GR4-1 I/O analog switch control
LL_RI_IOSWITCH_GR4_2	GR4-2 I/O analog switch control
LL_RI_IOSWITCH_GR4_3	GR4-3 I/O analog switch control
LL_RI_IOSWITCH_CH0b	CH0b-GR03-3 I/O analog switch control
LL_RI_IOSWITCH_CH1b	CH1b-GR03-4 I/O analog switch control
LL_RI_IOSWITCH_CH2b	CH2b-GR03-5 I/O analog switch control
LL_RI_IOSWITCH_CH3b	CH3b-GR09-3 I/O analog switch control
LL_RI_IOSWITCH_CH6b	CH6b-GR09-4 I/O analog switch control
LL_RI_IOSWITCH_CH7b	CH7b-GR02-3 I/O analog switch control
LL_RI_IOSWITCH_CH8b	CH8b-GR02-4 I/O analog switch control
LL_RI_IOSWITCH_CH9b	CH9b-GR02-5 I/O analog switch control
LL_RI_IOSWITCH_CH10b	CH10b-GR07-5 I/O analog switch control
LL_RI_IOSWITCH_CH11b	CH11b-GR07-6 I/O analog switch control
LL_RI_IOSWITCH_CH12b	CH12b-GR07-7 I/O analog switch control
LL_RI_IOSWITCH_GR6_3	GR6-3 I/O analog switch control
LL_RI_IOSWITCH_GR6_4	GR6-4 I/O analog switch control

FLASH LATENCY

LL_FLASH_LATENCY_0	FLASH Zero Latency cycle
LL_FLASH_LATENCY_1	FLASH One Latency cycle

SYSCFG LCD capacitance connection

LL_SYSCFG_LCDCAPA_PB2

LL_SYSCFG_LCDCAPA_PB12

LL_SYSCFG_LCDCAPA_PB0

LL_SYSCFG_LCDCAPA_PE11

LL_SYSCFG_LCDCAPA_PE12

RI PIN

LL_RI_PIN_0	Pin 0 selected
LL_RI_PIN_1	Pin 1 selected
LL_RI_PIN_2	Pin 2 selected
LL_RI_PIN_3	Pin 3 selected
LL_RI_PIN_4	Pin 4 selected
LL_RI_PIN_5	Pin 5 selected

LL_RI_PIN_6	Pin 6 selected
LL_RI_PIN_7	Pin 7 selected
LL_RI_PIN_8	Pin 8 selected
LL_RI_PIN_9	Pin 9 selected
LL_RI_PIN_10	Pin 10 selected
LL_RI_PIN_11	Pin 11 selected
LL_RI_PIN_12	Pin 12 selected
LL_RI_PIN_13	Pin 13 selected
LL_RI_PIN_14	Pin 14 selected
LL_RI_PIN_15	Pin 15 selected
LL_RI_PIN_ALL	All pins selected

RI PORT

LL_RI_PORT_A	PORT A
LL_RI_PORT_B	PORT B
LL_RI_PORT_C	PORT C
LL_RI_PORT_F	PORT F
LL_RI_PORT_G	PORT G

SYSCFG REMAP

LL_SYSCFG_REMAP_FLASH

LL_SYSCFG_REMAP_SYSTEMFLASH

LL_SYSCFG_REMAP_SRAM

LL_SYSCFG_REMAP_FMC

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

RI TIM selection

LL_RI_TIM_SELECT_NONE	No timer selected
LL_RI_TIM_SELECT_TIM2	Timer 2 selected
LL_RI_TIM_SELECT_TIM3	Timer 3 selected
LL_RI_TIM_SELECT_TIM4	Timer 4 selected

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

66 LL TIM Generic Driver

66.1 TIM Firmware driver registers structures

66.1.1 LL_TIM_InitTypeDef

Data Fields

- ***uint16_t Prescaler***
- ***uint32_t CounterMode***
- ***uint32_t Autoreload***
- ***uint32_t ClockDivision***

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()**.

66.1.2 LL_TIM_OC_InitTypeDef

Data Fields

- ***uint32_t OCMode***
- ***uint32_t OCState***
- ***uint32_t CompareValue***
- ***uint32_t OCPolarity***

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::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()**.

66.1.3 LL_TIM_IC_InitTypeDef

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()**.

66.1.4 LL_TIM_ENCODER_InitTypeDef

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()**.

66.2 TIM Firmware driver API description

66.2.1 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	• **State:** of bit (1 or 0).
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.

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_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_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_CH2
- LL_TIM_CHANNEL_CH3
- LL_TIM_CHANNEL_CH4

Return values
- **None:**

Reference Manual to LL API cross reference:
- CCER CC1E LL_TIM_CC_EnableChannel
- CCER CC2E LL_TIM_CC_EnableChannel
- CCER CC3E LL_TIM_CC_EnableChannel
- CCER CC4E 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_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4

Return values
- **None:**

Reference Manual to LL API cross reference:
- CCER CC1E LL_TIM_CC_DisableChannel
- CCER CC2E LL_TIM_CC_DisableChannel
- CCER CC3E LL_TIM_CC_DisableChannel
- CCER CC4E 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_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4

Return values
- **State:** of bit (1 or 0).

Reference Manual to LL API cross reference:
- CCER CC1E LL_TIM_CC_IsEnabledChannel
- CCER CC2E LL_TIM_CC_IsEnabledChannel
- CCER CC3E LL_TIM_CC_IsEnabledChannel
- CCER CC4E 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
- **Configuration:** This parameter must be a combination of all the following values:
  - LL_TIM_OCPOLARITY_HIGH or LL_TIM_OCPOLARITY_LOW

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
- CCER CC1P LL_TIM_OC_ConfigOutput
- CCER CC2P LL_TIM_OC_ConfigOutput
- CCER CC3P LL_TIM_OC_ConfigOutput
- CCER CC4P 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
- **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

Return values
- **None:**

Reference Manual to
- CCMR1 OC1M LL_TIM_OC_SetMode

LL API cross reference:
- CCMR1 OC2M LL_TIM_OC_SetMode
- CCMR2 OC3M LL_TIM_OC_SetMode
- CCMR2 OC4M 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

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

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

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_CH2
  - LL_TIM_CHANNEL_CH3
  - LL_TIM_CHANNEL_CH4
- **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 CC2P LL_TIM_OC_SetPolarity
- CCER CC3P LL_TIM_OC_SetPolarity
- CCER CC4P 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_CH2 – LL_TIM_CHANNEL_CH3 – LL_TIM_CHANNEL_CH4
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 CC2P LL_TIM_OC_GetPolarity • CCER CC3P LL_TIM_OC_GetPolarity • CCER CC4P LL_TIM_OC_GetPolarity

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
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

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

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

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

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
-

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

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

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

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

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

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
-

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

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

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

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

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

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
- CCMR1 OC1CE LL_TIM_OC_IsEnabledClear

LL API cross reference:
- CCMR1 OC2CE LL_TIM_OC_IsEnabledClear
- CCMR2 OC3CE LL_TIM_OC_IsEnabledClear
- CCMR2 OC4CE LL_TIM_OC_IsEnabledClear
-

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_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_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
- CCMR1 CC1S LL_TIM_IC_Config

LL API cross reference:

- 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_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

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_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_CCR1
  - LL_TIM_DMABURST_BASEADDR_CCR2
  - LL_TIM_DMABURST_BASEADDR_CCR3
  - LL_TIM_DMABURST_BASEADDR_CCR4
  - LL_TIM_DMABURST_BASEADDR_OR
- **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 params 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.
- Option registers are available only for cat.3, cat.4 and cat.5 devices

Reference Manual to LL API cross reference:
- TIM2_OR ITR1_RMP LL_TIM_SetRemap
- TIM3_OR ITR2_RMP LL_TIM_SetRemap
- TIM9_OR TI1_RMP LL_TIM_SetRemap
- TIM9_OR ITR1_RMP LL_TIM_SetRemap
- TIM10_OR TI1_RMP LL_TIM_SetRemap
- TIM10_OR ETR_RMP LL_TIM_SetRemap
- TIM10_OR TI1_RMP_RI LL_TIM_SetRemap
- TIM11_OR TI1_RMP LL_TIM_SetRemap
- TIM11_OR ETR_RMP LL_TIM_SetRemap
- TIM11_OR TI1_RMP_RI LL_TIM_SetRemap

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_OCREF_CLR – 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. • the ETR signal can be connected to the output of a comparator to be used for current handling
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_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_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_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_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_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	• DIER CC1DE LL_TIM_DisableDMAReq_CC1

reference:

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	• DIER CC2DE LL_TIM_IsEnabledDMAReq_CC2

reference:

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	• DIER CC4DE LL_TIM_EnableDMAReq_CC4

reference:

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_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	• DIER TDE LL_TIM_DisableDMAReq_TRIG

reference:

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_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_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
- **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

66.3 TIM Firmware driver defines

66.3.1 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

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

Channel

LL_TIM_CHANNEL_CH1	Timer input/output channel 1
LL_TIM_CHANNEL_CH2	Timer input/output channel 2
LL_TIM_CHANNEL_CH3	Timer input/output channel 3
LL_TIM_CHANNEL_CH4	Timer input/output channel 4

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 inpu t
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_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_OR	TIMx_OR 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	Encoder mode 1 - Counter counts up/down on TI2FP2 edge depending on TI1FP1 level
LL_TIM_ENCODERMODE_X2_TI2	Encoder mode 2 - Counter counts up/down on TI1FP1 edge depending on TI2FP2 level
LL_TIM_ENCODERMODE_X4_TI12	Encoder mode 3 - Counter counts up/down on both TI1FP1 and TI2FP2 edges depending on the level of the other input l

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_TIF	Trigger 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

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_TIE	Trigger interrupt enable

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

Output Configuration Polarity

LL_TIM_OCPOLARITY_HIGH	OCxactive high
LL_TIM_OCPOLARITY_LOW	OCxactive low

OCREF clear input selection

LL_TIM_OCREF_CLR_INT_OCREF_CLR	OCREF_CLR_INT is connected to the OCREF_CLR input
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

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

TIM10 ETR remap

LL_TIM_TIM10_ETR_RMP_LSE	TIM10 ETR input is connected to LSE
LL_TIM_TIM10_ETR_RMP_TIM9_TGO	TIM10 ETR input is connected to TIM9 TGO

TIM10 input 1 remapping capability

LL_TIM_TIM10_TI1_RMP_GPIO	TIM10 channel1 is connected to GPIO
LL_TIM_TIM10_TI1_RMP_LSI	TIM10 channel1 is connected to LSI internal clock
LL_TIM_TIM10_TI1_RMP_LSE	TIM10 channel1 is connected to LSE internal clock
LL_TIM_TIM10_TI1_RMP_RTC	TIM10 channel1 is connected to RTC wakeup interrupt signal

TIM10 Input 1 remap for Routing Interface (RI)

LL_TIM_TIM10_TI1_RMP	TIM10 Channel1 connection depends on TI1_RMP[1:0] bit values
LL_TIM_TIM10_TI1_RMP_RI	TIM10 channel1 is connected to RI

TIM11 ETR remap

LL_TIM_TIM11_ETR_RMP_LSE	TIM11 ETR input is connected to LSE
LL_TIM_TIM11_ETR_RMP_TIM9_TGO	TIM11 ETR input is connected to TIM9 TGO clock

TIM11 input 1 remapping capability

LL_TIM_TIM11_TI1_RMP_GPIO	TIM11 channel1 is connected to GPIO
LL_TIM_TIM11_TI1_RMP_MSI	TIM11 channel1 is connected to MSI internal clock
LL_TIM_TIM11_TI1_RMP_HSE_RTC	TIM11 channel1 is connected to HSE RTC clock
LL_TIM_TIM11_TI1_RMP_GPIO1	TIM11 channel1 is connected to GPIO

TIM11 Input 1 remap for Routing Interface (RI)

LL_TIM_TIM11_TI1_RMP	TIM11 Channel1 connection depends on TI1_RMP[1:0] bit values
LL_TIM_TIM11_TI1_RMP_RI	TIM11 channel1 is connected to RI

TIM2 internal trigger 1 remap

LL_TIM_TIM2_TIR1_RMP_TIM10_OC	TIM2 ITR1 input is connected to TIM10 OC
LL_TIM_TIM2_TIR1_RMP_TIM5_TGO	TIM2 ITR1 input is connected to TIM5 TGO

TIM3 internal trigger 2 remap

LL_TIM_TIM3_TIR2_RMP_TIM11_OC	TIM3 ITR2 input is connected to TIM11 OC
LL_TIM_TIM3_TIR2_RMP_TIM5_TGO	TIM3 ITR2 input is connected to TIM5 TGO

TIM9 ITR1 remap

LL_TIM_TIM9_ITR1_RMP_TIM3_TGO	TIM9 channel1 is connected to TIM3 TGO signal
LL_TIM_TIM9_ITR1_RMP_TOUCH_IO	TIM9 channel1 is connected to touch sensing I/O

TIM9 Input 1 remap

LL_TIM_TIM9_TI1_RMP_GPIO	TIM9 channel1 is connected to GPIO
LL_TIM_TIM9_TI1_RMP_LSE	TIM9 channel1 is connected to LSE internal clock
LL_TIM_TIM9_TI1_RMP_GPIO1	TIM9 channel1 is connected to GPIO
LL_TIM_TIM9_TI1_RMP_GPIO2	TIM9 channel1 is connected to GPIO

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 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_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

67 LL USART Generic Driver

67.1 USART Firmware driver registers structures

67.1.1 LL_USART_InitTypeDef

Data Fields

- ***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::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()**.

67.1.2 LL_USART_ClockInitTypeDef

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.

67.2 USART Firmware driver API description

67.2.1 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_SR 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_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	• CR1 RE LL_USART_GetTransferDirection • CR1 TE LL_USART_GetTransferDirection

reference:

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_8B
  - LL_USART_DATAWIDTH_9B

Return values
- **None:**

Reference Manual to LL API cross reference:
- CR1 M 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_8B
  - LL_USART_DATAWIDTH_9B

Reference Manual to LL API cross reference:
- CR1 M LL_USART_GetDataWidth

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_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_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 M LL_USART_ConfigCharacter
- CR2 STOP LL_USART_ConfigCharacter

LL_USART_SetNodeAddress

Function name **__STATIC_INLINE void LL_USART_SetNodeAddress (USART_TypeDef * USARTx, uint32_t NodeAddress)**

Function description Set Address of the USART node.

Parameters

- **USARTx:** USART Instance
- **NodeAddress:** 4 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.

Reference Manual to LL API cross reference:
- CR2 ADD LL_USART_SetNodeAddress

LL_USART_GetNodeAddress

Function name: **__STATIC_INLINE uint32_t LL_USART_GetNodeAddress (USART_TypeDef * USARTx)**

Function description: Return 4 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:
- only 4bits (b3-b0) of returned value are relevant (b31-b4 are not relevant)

Reference Manual to LL API cross reference:
- CR2 ADD LL_USART_GetNodeAddress

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
- CR3 RTSE LL_USART_DisableRTSHWFlowCtrl

reference:

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_SetBaudRate

Function name: **__STATIC_INLINE void LL_USART_SetBaudRate (USART_TypeDef * USARTx, uint32_t PeriphClk, 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)

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 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.
Reference Manual to LL API cross reference:	• BRR BRR LL_USART_GetBaudRate

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	• CR3 IREN LL_USART_IsEnabledIrda

reference:

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
- CR3 SCEN LL_USART_DisableSmartcard

reference:

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_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_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_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:	• SR 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:	• SR 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:	• SR NF 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:	• SR 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:	• SR IDLE LL_USART_IsActiveFlag_IDLE

LL_USART_IsActiveFlag_RXNE

Function name	**__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_RXNE (USART_TypeDef * USARTx)**
Function description	Check if the USART Read Data Register Not Empty Flag is set or not.
Parameters	• **USARTx:** USART Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• SR RXNE LL_USART_IsActiveFlag_RXNE

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:	• SR TC LL_USART_IsActiveFlag_TC

LL_USART_IsActiveFlag_TXE

Function name	**__STATIC_INLINE uint32_t LL_USART_IsActiveFlag_TXE (USART_TypeDef * USARTx)**
Function description	Check if the USART Transmit Data Register Empty Flag is set or not.
Parameters	• **USARTx:** USART Instance
Return values	• **State:** of bit (1 or 0).
Reference Manual to LL API cross reference:	• SR TXE LL_USART_IsActiveFlag_TXE

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:	• SR LBD 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 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:	• SR CTS LL_USART_IsActiveFlag_nCTS

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:	• CR1 SBK 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:	• CR1 RWU LL_USART_IsActiveFlag_RWU

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:**
Notes	• Clearing this flag is done by a read access to the USARTx_SR register followed by a read access to the USARTx_DR register. • Please also consider that when clearing this flag, other flags as NE, FE, ORE, IDLE would also be cleared.
Reference Manual to LL API cross reference:	• SR PE 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:**
Notes	• Clearing this flag is done by a read access to the USARTx_SR register followed by a read access to the USARTx_DR register. • Please also consider that when clearing this flag, other flags as PE, NE, ORE, IDLE would also be cleared.
Reference Manual to LL API cross reference:	• SR FE LL_USART_ClearFlag_FE

LL_USART_ClearFlag_NE

Function name	**__STATIC_INLINE void LL_USART_ClearFlag_NE (USART_TypeDef * USARTx)**
Function description	Clear Noise detected Flag.
Parameters	• **USARTx:** USART Instance
Return values	• **None:**
Notes	• Clearing this flag is done by a read access to the USARTx_SR register followed by a read access to the

USARTx_DR register.
- Please also consider that when clearing this flag, other flags as PE, FE, ORE, IDLE would also be cleared.

Reference Manual to LL API cross reference:
- SR NF 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:**

Notes
- Clearing this flag is done by a read access to the USARTx_SR register followed by a read access to the USARTx_DR register.
- Please also consider that when clearing this flag, other flags as PE, NE, FE, IDLE would also be cleared.

Reference Manual to LL API cross reference:
- SR ORE 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:**

Notes
- Clearing this flag is done by a read access to the USARTx_SR register followed by a read access to the USARTx_DR register.
- Please also consider that when clearing this flag, other flags as PE, NE, FE, ORE would also be cleared.

Reference Manual to LL API cross reference:
- SR IDLE LL_USART_ClearFlag_IDLE

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:	• SR TC LL_USART_ClearFlag_TC

LL_USART_ClearFlag_RXNE

Function name	**__STATIC_INLINE void LL_USART_ClearFlag_RXNE (USART_TypeDef * USARTx)**
Function description	Clear RX Not Empty Flag.
Parameters	• **USARTx:** USART Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• SR RXNE LL_USART_ClearFlag_RXNE

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:	• SR LBD 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:	• SR CTS LL_USART_ClearFlag_nCTS

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

Function name	**__STATIC_INLINE void LL_USART_EnableIT_RXNE (USART_TypeDef * USARTx)**
Function description	Enable RX Not Empty Interrupt.
Parameters	• **USARTx:** USART Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 RXNEIE LL_USART_EnableIT_RXNE

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

Function name	**__STATIC_INLINE void LL_USART_EnableIT_TXE (USART_TypeDef * USARTx)**
Function description	Enable TX Empty Interrupt.
Parameters	• **USARTx:** USART Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 TXEIE LL_USART_EnableIT_TXE

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_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_SR register). 0: Interrupt is inhibited 1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the USARTx_SR 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_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

Function name **__STATIC_INLINE void LL_USART_DisableIT_RXNE (USART_TypeDef * USARTx)**

Function description Disable RX Not Empty Interrupt.

Parameters
- **USARTx:** USART Instance

Return values
- **None:**

Reference Manual to LL API cross reference:
- CR1 RXNEIE LL_USART_DisableIT_RXNE

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

Function name **__STATIC_INLINE void LL_USART_DisableIT_TXE (USART_TypeDef * USARTx)**

Function description Disable TX Empty Interrupt.

Parameters
- **USARTx:** USART Instance

Return values
- **None:**

Reference Manual to LL API cross reference:	• CR1 TXEIE LL_USART_DisableIT_TXE

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_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_SR register). 0: Interrupt is inhibited 1: An interrupt is generated when FE=1 or ORE=1 or NF=1 in the USARTx_SR 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_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

Function name	**__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_RXNE (USART_TypeDef * USARTx)**
Function description	Check if the USART RX Not Empty 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 RXNEIE LL_USART_IsEnabledIT_RXNE

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

Function name	**__STATIC_INLINE uint32_t LL_USART_IsEnabledIT_TXE (USART_TypeDef * USARTx)**
Function description	Check if the USART TX Empty 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 TXEIE LL_USART_IsEnabledIT_TXE

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_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_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_DMA_GetRegAddr

Function name	**__STATIC_INLINE uint32_t LL_USART_DMA_GetRegAddr (USART_TypeDef * USARTx)**
Function description	Get the data register address used for DMA transfer.

Parameters	• **USARTx:** USART Instance
Return values	• **Address:** of data register
Notes	• Address of Data Register is valid for both Transmit and Receive transfers.
Reference Manual to LL API cross reference:	• DR DR 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:	• DR DR 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:	• DR DR 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:	• DR DR 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:	• DR DR LL_USART_TransmitData9

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:	• CR1 SBK LL_USART_RequestBreakSending

LL_USART_RequestEnterMuteMode

Function name	**__STATIC_INLINE void LL_USART_RequestEnterMuteMode (USART_TypeDef * USARTx)**
Function description	Put USART in Mute mode.
Parameters	• **USARTx:** USART Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 RWU LL_USART_RequestEnterMuteMode

LL_USART_RequestExitMuteMode

Function name	**__STATIC_INLINE void LL_USART_RequestExitMuteMode (USART_TypeDef * USARTx)**
Function description	Put USART in Active mode.
Parameters	• **USARTx:** USART Instance
Return values	• **None:**
Reference Manual to LL API cross reference:	• CR1 RWU LL_USART_RequestExitMuteMode

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 IP 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 IP 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:**

67.3 USART Firmware driver defines

67.3.1 USART

Clock Signal

LL_USART_CLOCK_DISABLE Clock signal not provided

LL_USART_CLOCK_ENABLE Clock signal provided

Datawidth

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

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

Get Flags Defines

LL_USART_SR_PE Parity error flag

LL_USART_SR_FE Framing error flag

LL_USART_SR_NE Noise detected flag

LL_USART_SR_ORE Overrun error flag

LL_USART_SR_IDLE Idle line detected flag

LL_USART_SR_RXNE	Read data register not empty flag
LL_USART_SR_TC	Transmission complete flag
LL_USART_SR_TXE	Transmit data register empty flag
LL_USART_SR_LBD	LIN break detection flag
LL_USART_SR_CTS	CTS 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	Read data register not empty interrupt enable
LL_USART_CR1_TCIE	Transmission complete interrupt enable
LL_USART_CR1_TXEIE	Transmit data register empty interrupt enable
LL_USART_CR1_PEIE	Parity error
LL_USART_CR2_LBDIE	LIN break detection interrupt enable
LL_USART_CR3_EIE	Error interrupt enable
LL_USART_CR3_CTSIE	CTS 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

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

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

Exported_Macros_Helper

__LL_USART_DIV_SAMPLING8_100

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_DIVMANT_SAMPLING8

__LL_USART_DIVFRAQ_SAMPLING8

__LL_USART_DIV_SAMPLING8

__LL_USART_DIV_SAMPLING16_100

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

__LL_USART_DIVMANT_SAMPLING16

__LL_USART_DIVFRAQ_SAMPLING16

__LL_USART_DIV_SAMPLING16

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

68 LL UTILS Generic Driver

68.1 UTILS Firmware driver registers structures

68.1.1 LL_UTILS_PLLInitTypeDef

Data Fields

- ***uint32_t PLLMul***
- ***uint32_t PLLDiv***

Field Documentation

- ***uint32_t LL_UTILS_PLLInitTypeDef::PLLMul***
  Multiplication factor for PLL VCO input clock. This parameter can be a value of ***RCC_LL_EC_PLL_MUL***This feature can be modified afterwards using unitary function **LL_RCC_PLL_ConfigDomain_SYS()**.
- ***uint32_t LL_UTILS_PLLInitTypeDef::PLLDiv***
  Division factor for PLL VCO output clock. This parameter can be a value of ***RCC_LL_EC_PLL_DIV***This feature can be modified afterwards using unitary function **LL_RCC_PLL_ConfigDomain_SYS()**.

68.1.2 LL_UTILS_ClkInitTypeDef

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()**.

68.2 UTILS Firmware driver API description

68.2.1 System Configuration functions

System, AHB and APB buses clocks configuration

- The maximum frequency of the SYSCLK, HCLK, PCLK1 and PCLK2 is 32000000 Hz.

This section contains the following APIs:

- ***LL_SetSystemCoreClock()***
- ***LL_PLL_ConfigSystemClock_HSI()***

- ***LL_PLL_ConfigSystemClock_HSE()***

68.2.2 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]:**

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]:**

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]:**

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
- For DEV_ID = 0x416 or 0x427 or 0x429 or 0x437, this field value indicates the Flash memory size of the device in Kbytes. Example: 0x0080 = 128 Kbytes. For DEV_ID = 0x436, the field value can be '0' or '1', with '0' for 384 Kbytes and '1' for 256 Kbytes.
- For DEV_ID = 0x429, only LSB part of F_SIZE: F_SIZE[7:0] is valid. The MSB part F_SIZE[15:8] is reserved and must be ignored.

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_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 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 is disabled.
- Function is based on the following formula: PLL output frequency = ((HSI frequency * PLLMul) / PLLDiv)PLLMul: The application software must set correctly the PLL multiplication factor to avoid exceeding 96 MHz as PLLVCO when the product is in range 1,48 MHz as PLLVCO when the product is in range 2,24 MHz when the product is in range 3
- FLASH latency can be modified through this function.
- If this latency increases to 1WS, FLASH 64-bit access will be automatically enabled. A decrease of FLASH latency to 0WS will not disable 64-bit access. If needed, user should call the following function LL_FLASH_Disable64bitAccess.

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 = 1000000 and Max_Data = 24000000
- **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 is disabled.
- Function is based on the following formula: PLL output frequency = ((HSE frequency * PLLMul) / PLLDiv)PLLMul: The application software must set correctly the PLL multiplication factor to avoid exceeding 96 MHz as PLLVCO when the product is in range 1,48 MHz as PLLVCO when the product is in range 2,24 MHz when the product is in range 3
- FLASH latency can be modified through this function.
- If this latency increases to 1WS, FLASH 64-bit access will be

automatically enabled. A decrease of FLASH latency to 0WS will not disable 64-bit access. If needed, user should call the following function LL_FLASH_Disable64bitAccess.

68.3 UTILS Firmware driver defines

68.3.1 UTILS

HSE Bypass activation

LL_UTILS_HSEBYPASS_OFF	HSE Bypass is not enabled
LL_UTILS_HSEBYPASS_ON	HSE Bypass is enabled

69 LL WWDG Generic Driver

69.1 WWDG Firmware driver API description

69.1.1 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

69.2 WWDG Firmware driver defines

69.2.1 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

70 Correspondence between API registers and API low-layer driver functions

70.1 ADC

Table 25: Correspondence between ADC registers and ADC low-layer driver functions

Register	Field	Function
CCR	ADCPRE	*LL_ADC_GetCommonClock*
		LL_ADC_SetCommonClock
	TSVREFE	*LL_ADC_GetCommonPathInternalCh*
		LL_ADC_SetCommonPathInternalCh
CR1	AWD1CH	*LL_ADC_GetAnalogWDMonitChannels*
		LL_ADC_SetAnalogWDMonitChannels
	AWD1EN	*LL_ADC_GetAnalogWDMonitChannels*
		LL_ADC_SetAnalogWDMonitChannels
	AWD1SGL	*LL_ADC_GetAnalogWDMonitChannels*
		LL_ADC_SetAnalogWDMonitChannels
	AWDIE	*LL_ADC_EnableIT_AWD1*
	DISCEN	*LL_ADC_INJ_SetSequencerDiscont*
		LL_ADC_REG_GetSequencerDiscont
		LL_ADC_REG_SetSequencerDiscont
	DISCNUM	*LL_ADC_REG_GetSequencerDiscont*
		LL_ADC_REG_SetSequencerDiscont
	EOCIE	*LL_ADC_DisableIT_EOCS*
		LL_ADC_EnableIT_EOCS
		LL_ADC_IsEnabledIT_EOCS
	JAUTO	*LL_ADC_INJ_GetTrigAuto*
		LL_ADC_INJ_SetTrigAuto
	JEOCIE	*LL_ADC_EnableIT_JEOS*
	OVRIE	*LL_ADC_DisableIT_OVR*
		LL_ADC_EnableIT_OVR
		LL_ADC_IsEnabledIT_OVR
	PDD	*LL_ADC_GetLowPowerModeAutoPowerOff*
	PDI	*LL_ADC_GetLowPowerModeAutoPowerOff*
	RES	*LL_ADC_GetResolution*
		LL_ADC_SetResolution
	SCAN	*LL_ADC_GetSequencersScanMode*

Register	Field	Function
		LL_ADC_SetSequencersScanMode
CR2	ADC_CFG	*LL_ADC_GetChannelsBank*
		LL_ADC_SetChannelsBank
	ADON	*LL_ADC_Disable*
		LL_ADC_Enable
		LL_ADC_IsEnabled
	ALIGN	*LL_ADC_SetDataAlignment*
	CONT	*LL_ADC_REG_GetContinuousMode*
		LL_ADC_REG_SetContinuousMode
	DDS	*LL_ADC_REG_GetDMATransfer*
		LL_ADC_REG_SetDMATransfer
	DELS	*LL_ADC_GetLowPowerModeAutoWait*
		LL_ADC_SetLowPowerModeAutoWait
	DMA	*LL_ADC_REG_GetDMATransfer*
		LL_ADC_REG_SetDMATransfer
	EOCS	*LL_ADC_REG_GetFlagEndOfConversion*
		LL_ADC_REG_SetFlagEndOfConversion
	EXTEN	*LL_ADC_REG_GetTriggerEdge*
		LL_ADC_REG_GetTriggerSource
		LL_ADC_REG_IsTriggerSourceSWStart
		LL_ADC_REG_SetTriggerSource
		LL_ADC_REG_StartConversionExtTrig
		LL_ADC_REG_StopConversionExtTrig
	EXTSEL	*LL_ADC_REG_GetTriggerSource*
		LL_ADC_REG_SetTriggerSource
	JEXTEN	*LL_ADC_INJ_GetTriggerEdge*
		LL_ADC_INJ_GetTriggerSource
		LL_ADC_INJ_IsTriggerSourceSWStart
		LL_ADC_INJ_SetTriggerSource
		LL_ADC_INJ_StartConversionExtTrig
		LL_ADC_INJ_StopConversionExtTrig
	JEXTSEL	*LL_ADC_INJ_GetTriggerSource*
		LL_ADC_INJ_SetTriggerSource
	JSWSTART	*LL_ADC_INJ_StartConversionSWStart*
	SWSTART	*LL_ADC_REG_StartConversionSWStart*
CSR	FCH3	*LL_ADC_GetChannelRouting*

Register	Field	Function
		LL_ADC_SetChannelRouting
	FCH8	*LL_ADC_GetChannelRouting*
		LL_ADC_SetChannelRouting
	RCH13	*LL_ADC_GetChannelRouting*
		LL_ADC_SetChannelRouting
DR	DATA	*LL_ADC_DMA_GetRegAddr*
	RDATA	*LL_ADC_REG_ReadConversionData10*
		LL_ADC_REG_ReadConversionData12
		LL_ADC_REG_ReadConversionData32
		LL_ADC_REG_ReadConversionData6
		LL_ADC_REG_ReadConversionData8
HTR	HT	*LL_ADC_GetAnalogWDThresholds*
		LL_ADC_SetAnalogWDThresholds
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
		LL_ADC_INJ_ReadConversionData6
		LL_ADC_INJ_ReadConversionData8
JOFR1	JOFFSET1	*LL_ADC_INJ_GetOffset*
		LL_ADC_INJ_SetOffset
JOFR2	JOFFSET2	*LL_ADC_INJ_GetOffset*

Register	Field	Function
		LL_ADC_INJ_SetOffset
JOFR3	JOFFSET3	*LL_ADC_INJ_GetOffset*
		LL_ADC_INJ_SetOffset
JOFR4	JOFFSET4	*LL_ADC_INJ_GetOffset*
		LL_ADC_INJ_SetOffset
JSQR	JL	*LL_ADC_INJ_GetSequencerLength*
		LL_ADC_INJ_SetSequencerLength
	JSQ1	*LL_ADC_INJ_SetSequencerRanks*
	JSQ2	*LL_ADC_INJ_SetSequencerRanks*
	JSQ3	*LL_ADC_INJ_SetSequencerRanks*
	JSQ4	*LL_ADC_INJ_SetSequencerRanks*
LTR	LT	*LL_ADC_GetAnalogWDThresholds*
		LL_ADC_SetAnalogWDThresholds
SMPR0	SMP30	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP31	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
SMPR1	SMP20	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP21	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP22	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP23	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP24	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP25	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP26	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP27	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP28	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP29	*LL_ADC_GetChannelSamplingTime*

Register	Field	Function
		LL_ADC_SetChannelSamplingTime
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
	SMP19	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
SMPR3	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*

Register	Field	Function
		LL_ADC_SetChannelSamplingTime
	SMP8	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
	SMP9	*LL_ADC_GetChannelSamplingTime*
		LL_ADC_SetChannelSamplingTime
SQR1	L	*LL_ADC_REG_SetSequencerLength*
	SQ25	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ26	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ27	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ28	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
SQR2	SQ19	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ20	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ21	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ22	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ23	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ24	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
SQR3	SQ13	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ14	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ15	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ16	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ17	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks

Register	Field	Function
	SQ18	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
SQR4	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
	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
SQR5	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
	SQ5	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
	SQ6	*LL_ADC_REG_GetSequencerRanks*
		LL_ADC_REG_SetSequencerRanks
SR	ADONS	*LL_ADC_IsActiveFlag_ADRDY*
	AWD	*LL_ADC_ClearFlag_AWD1*
		LL_ADC_IsActiveFlag_AWD1
	EOC	*LL_ADC_ClearFlag_EOCS*
		LL_ADC_IsActiveFlag_EOCS
	JEOC	*LL_ADC_ClearFlag_JEOS*
		LL_ADC_IsActiveFlag_JEOS
	OVR	*LL_ADC_ClearFlag_OVR*
		LL_ADC_IsActiveFlag_OVR

70.2 BUS

Table 26: Correspondence between BUS registers and BUS low-layer driver functions

Register	Field	Function
AHBENR	AESEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	CRCEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	DMA1EN	*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
	FLITFEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	FSMCEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOAEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOBEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOCEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIODEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOEEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOFEN	*LL_AHB1_GRP1_DisableClock*

Register	Field	Function
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOGEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
	GPIOHEN	*LL_AHB1_GRP1_DisableClock*
		LL_AHB1_GRP1_EnableClock
		LL_AHB1_GRP1_IsEnabledClock
AHBLPENR	AESLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	CRCLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	DMA1LPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	DMA2LPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	FLITFLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	FSMCLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOALPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOBLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOCLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIODLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOELPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOFLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOGLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
	GPIOHLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep

Register	Field	Function
	SRAMLPEN	*LL_AHB1_GRP1_DisableClockSleep*
		LL_AHB1_GRP1_EnableClockSleep
AHBRSTR	AESRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	CRCRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	DMA1RST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	DMA2RST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	FLITFRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	FSMCRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOARST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOBRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOCRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIODRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOERST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOFRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOGRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
	GPIOHRST	*LL_AHB1_GRP1_ForceReset*
		LL_AHB1_GRP1_ReleaseReset
APB1ENR	COMPEN	*LL_APB1_GRP1_DisableClock*
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock
	DACEN	*LL_APB1_GRP1_DisableClock*
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock

Register	Field	Function
	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
	LCDEN	*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
	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*
		LL_APB1_GRP1_EnableClock
		LL_APB1_GRP1_IsEnabledClock

Register	Field	Function
	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
	USBEN	*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
APB1LPENR	COMPLPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	DACLPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	I2C1LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	I2C2LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	LCDLPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	PWRLPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	SPI2LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	SPI3LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	TIM2LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep

Register	Field	Function
	TIM3LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	TIM4LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	TIM5LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	TIM6LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	TIM7LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	UART4LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	UART5LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	USART2LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	USART3LPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	USBLPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
	WWDGLPEN	*LL_APB1_GRP1_DisableClockSleep*
		LL_APB1_GRP1_EnableClockSleep
APB1RSTR	COMPRST	*LL_APB1_GRP1_ForceReset*
		LL_APB1_GRP1_ReleaseReset
	DACRST	*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
	LCDRST	*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

Register	Field	Function
	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
	USART3RST	*LL_APB1_GRP1_ForceReset*
		LL_APB1_GRP1_ReleaseReset
	USBRST	*LL_APB1_GRP1_ForceReset*
		LL_APB1_GRP1_ReleaseReset
	WWDGRST	*LL_APB1_GRP1_ForceReset*
		LL_APB1_GRP1_ReleaseReset
APB2ENR	ADC1EN	*LL_APB2_GRP1_DisableClock*
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	SDIOEN	*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*

Register	Field	Function
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM10EN	*LL_APB2_GRP1_DisableClock*
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM11EN	*LL_APB2_GRP1_DisableClock*
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	TIM9EN	*LL_APB2_GRP1_DisableClock*
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
	USART1EN	*LL_APB2_GRP1_DisableClock*
		LL_APB2_GRP1_EnableClock
		LL_APB2_GRP1_IsEnabledClock
APB2LPENR	ADC1LPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	SDIOLPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	SPI1LPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	SYSCFGLPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	TIM10LPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	TIM11LPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	TIM9LPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
	USART1LPEN	*LL_APB2_GRP1_DisableClockSleep*
		LL_APB2_GRP1_EnableClockSleep
APB2RSTR	ADC1RST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset
	SDIORST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset
	SPI1RST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset

Register	Field	Function
	SYSCFGRST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset
	TIM10RST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset
	TIM11RST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset
	TIM9RST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset
	USART1RST	*LL_APB2_GRP1_ForceReset*
		LL_APB2_GRP1_ReleaseReset

70.3 COMP

Table 27: Correspondence between COMP registers and COMP low-layer driver functions

Register	Field	Function
COMP2_CSR	SPEED	*LL_COMP_GetPowerMode*
		LL_COMP_SetPowerMode
CSR	10KPD	*LL_COMP_SetInputPullingResistor*
	10KPU	*LL_COMP_SetInputPullingResistor*
	400KPD	*LL_COMP_SetInputPullingResistor*
	400KPU	*LL_COMP_SetInputPullingResistor*
	CMP1OUT	*LL_COMP_ReadOutputLevel*
	CMP2OUT	*LL_COMP_ReadOutputLevel*
	COMP1EN	*LL_COMP_Disable*
		LL_COMP_Enable
		LL_COMP_IsEnabled
	COMP_CSR_INSEL	*LL_COMP_Disable*
		LL_COMP_Enable
		LL_COMP_IsEnabled
		LL_COMP_SetInputMinus
	OUTSEL	*LL_COMP_GetOutputSelection*
		LL_COMP_SetOutputSelection
	WNDWE	*LL_COMP_GetCommonWindowMode*
		LL_COMP_SetCommonWindowMode
RI	RI_ASCR1_CH	*LL_COMP_GetInputPlus*
		LL_COMP_SetInputPlus
	RI_ASCR2_GR6	*LL_COMP_GetInputPlus*

Register	Field	Function
		LL_COMP_SetInputPlus

70.4 CORTEX

Table 28: 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*
	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*

Register	Field	Function
	TICKINT	*LL_SYSTICK_DisableIT*
		LL_SYSTICK_EnableIT
		LL_SYSTICK_IsEnabledIT

70.5 CRC

Table 29: Correspondence between CRC registers and CRC low-layer driver functions

Register	Field	Function
CR	RESET	*LL_CRC_ResetCRCCalculationUnit*
DR	DR	*LL_CRC_FeedData32*
		LL_CRC_ReadData32
IDR	IDR	*LL_CRC_Read_IDR*
		LL_CRC_Write_IDR

70.6 DAC

Table 30: Correspondence between DAC registers and DAC low-layer driver functions

Register	Field	Function
CR	BOFF1	*LL_DAC_GetOutputBuffer*
		LL_DAC_SetOutputBuffer
	BOFF2	*LL_DAC_GetOutputBuffer*
		LL_DAC_SetOutputBuffer
	DMAEN1	*LL_DAC_DisableDMAReq*
		LL_DAC_EnableDMAReq
		LL_DAC_IsDMAReqEnabled
	DMAEN2	*LL_DAC_DisableDMAReq*
		LL_DAC_EnableDMAReq
		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

Register	Field	Function
	EN2	*LL_DAC_Disable*
		LL_DAC_Enable
		LL_DAC_IsEnabled
	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
	TEN1	*LL_DAC_DisableTrigger*
		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*

Register	Field	Function
	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*
SR	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*

70.7 DMA

Table 31: 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*
		LL_DMA_GetMemoryIncMode

Register	Field	Function
		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
IFCR	CGIF1	*LL_DMA_ClearFlag_GI1*
	CGIF2	*LL_DMA_ClearFlag_GI2*
	CGIF3	*LL_DMA_ClearFlag_GI3*
	CGIF4	*LL_DMA_ClearFlag_GI4*
	CGIF5	*LL_DMA_ClearFlag_GI5*

Register	Field	Function
	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*

Register	Field	Function
	HTIF7	*LL_DMA_IsActiveFlag_HT7*
	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*

70.8 EXTI

Table 32: Correspondence between EXTI registers and EXTI low-layer driver functions

Register	Field	Function
EMR	EMx	*LL_EXTI_DisableEvent_0_31*
		LL_EXTI_EnableEvent_0_31
		LL_EXTI_IsEnabledEvent_0_31
FTSR	FTx	*LL_EXTI_DisableFallingTrig_0_31*
		LL_EXTI_EnableFallingTrig_0_31
		LL_EXTI_IsEnabledFallingTrig_0_31
IMR	IMx	*LL_EXTI_DisableIT_0_31*
		LL_EXTI_EnableIT_0_31
		LL_EXTI_IsEnabledIT_0_31
PR	PIFx	*LL_EXTI_ClearFlag_0_31*
		LL_EXTI_IsActiveFlag_0_31
		LL_EXTI_ReadFlag_0_31
RTSR	RTx	*LL_EXTI_DisableRisingTrig_0_31*
		LL_EXTI_EnableRisingTrig_0_31
		LL_EXTI_IsEnabledRisingTrig_0_31
SWIER	SWIx	*LL_EXTI_GenerateSWI_0_31*

70.9 GPIO

Table 33: 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	BRy	*LL_GPIO_ResetOutputPin*
	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

70.10 I2C

Table 34: Correspondence between I2C registers and I2C low-layer driver functions

Register	Field	Function
CCR	CCR	*LL_I2C_ConfigSpeed*
		LL_I2C_GetClockPeriod
		LL_I2C_SetClockPeriod
	DUTY	*LL_I2C_ConfigSpeed*
		LL_I2C_GetDutyCycle
		LL_I2C_SetDutyCycle

Register	Field	Function
	FS	*LL_I2C_ConfigSpeed*
		LL_I2C_GetClockSpeedMode
		LL_I2C_SetClockSpeedMode
CR1	ACK	*LL_I2C_AcknowledgeNextData*
	ALERT	*LL_I2C_DisableSMBusAlert*
		LL_I2C_EnableSMBusAlert
		LL_I2C_IsEnabledSMBusAlert
	ENARP	*LL_I2C_GetMode*
		LL_I2C_SetMode
	ENGC	*LL_I2C_DisableGeneralCall*
		LL_I2C_EnableGeneralCall
		LL_I2C_IsEnabledGeneralCall
	ENPEC	*LL_I2C_DisableSMBusPEC*
		LL_I2C_EnableSMBusPEC
		LL_I2C_IsEnabledSMBusPEC
	NOSTRETCH	*LL_I2C_DisableClockStretching*
		LL_I2C_EnableClockStretching
		LL_I2C_IsEnabledClockStretching
	PE	*LL_I2C_ClearFlag_STOP*
		LL_I2C_Disable
		LL_I2C_Enable
		LL_I2C_IsEnabled
	PEC	*LL_I2C_DisableSMBusPECCompare*
		LL_I2C_EnableSMBusPECCompare
		LL_I2C_IsEnabledSMBusPECCompare
	POS	*LL_I2C_DisableBitPOS*
		LL_I2C_EnableBitPOS
		LL_I2C_IsEnabledBitPOS
	SMBTYPE	*LL_I2C_GetMode*
		LL_I2C_SetMode
	SMBUS	*LL_I2C_GetMode*
		LL_I2C_SetMode
	START	*LL_I2C_GenerateStartCondition*
	STOP	*LL_I2C_GenerateStopCondition*
	SWRST	*LL_I2C_DisableReset*
		LL_I2C_EnableReset

Register	Field	Function
		LL_I2C_IsResetEnabled
CR2	DMAEN	*LL_I2C_DisableDMAReq_RX*
		LL_I2C_DisableDMAReq_TX
		LL_I2C_EnableDMAReq_RX
		LL_I2C_EnableDMAReq_TX
		LL_I2C_IsEnabledDMAReq_RX
		LL_I2C_IsEnabledDMAReq_TX
	FREQ	*LL_I2C_ConfigSpeed*
		LL_I2C_GetPeriphClock
		LL_I2C_SetPeriphClock
	ITBUFEN	*LL_I2C_DisableIT_BUF*
		LL_I2C_DisableIT_RX
		LL_I2C_DisableIT_TX
		LL_I2C_EnableIT_BUF
		LL_I2C_EnableIT_RX
		LL_I2C_EnableIT_TX
		LL_I2C_IsEnabledIT_BUF
		LL_I2C_IsEnabledIT_RX
		LL_I2C_IsEnabledIT_TX
	ITERREN	*LL_I2C_DisableIT_ERR*
		LL_I2C_EnableIT_ERR
		LL_I2C_IsEnabledIT_ERR
	ITEVTEN	*LL_I2C_DisableIT_EVT*
		LL_I2C_DisableIT_RX
		LL_I2C_DisableIT_TX
		LL_I2C_EnableIT_EVT
		LL_I2C_EnableIT_RX
		LL_I2C_EnableIT_TX
		LL_I2C_IsEnabledIT_EVT
		LL_I2C_IsEnabledIT_RX
		LL_I2C_IsEnabledIT_TX
	LAST	*LL_I2C_DisableLastDMA*
		LL_I2C_EnableLastDMA
		LL_I2C_IsEnabledLastDMA
DR	DR	*LL_I2C_DMA_GetRegAddr*
		LL_I2C_ReceiveData8

Register	Field	Function
		LL_I2C_TransmitData8
OAR1	ADD0	*LL_I2C_SetOwnAddress1*
	ADD1_7	*LL_I2C_SetOwnAddress1*
	ADD8_9	*LL_I2C_SetOwnAddress1*
	ADDMODE	*LL_I2C_SetOwnAddress1*
OAR2	ADD2	*LL_I2C_SetOwnAddress2*
	ENDUAL	*LL_I2C_DisableOwnAddress2*
		LL_I2C_EnableOwnAddress2
		LL_I2C_IsEnabledOwnAddress2
SR1	ADD10	*LL_I2C_IsActiveFlag_ADD10*
	ADDR	*LL_I2C_ClearFlag_ADDR*
		LL_I2C_IsActiveFlag_ADDR
	AF	*LL_I2C_ClearFlag_AF*
		LL_I2C_IsActiveFlag_AF
	ARLO	*LL_I2C_ClearFlag_ARLO*
		LL_I2C_IsActiveFlag_ARLO
	BERR	*LL_I2C_ClearFlag_BERR*
		LL_I2C_IsActiveFlag_BERR
	BTF	*LL_I2C_IsActiveFlag_BTF*
	OVR	*LL_I2C_ClearFlag_OVR*
		LL_I2C_IsActiveFlag_OVR
	PECERR	*LL_I2C_ClearSMBusFlag_PECERR*
		LL_I2C_IsActiveSMBusFlag_PECERR
	RXNE	*LL_I2C_IsActiveFlag_RXNE*
	SB	*LL_I2C_IsActiveFlag_SB*
	SMBALERT	*LL_I2C_ClearSMBusFlag_ALERT*
		LL_I2C_IsActiveSMBusFlag_ALERT
	STOPF	*LL_I2C_ClearFlag_STOP*
		LL_I2C_IsActiveFlag_STOP
	TIMEOUT	*LL_I2C_ClearSMBusFlag_TIMEOUT*
		LL_I2C_IsActiveSMBusFlag_TIMEOUT
	TXE	*LL_I2C_IsActiveFlag_TXE*
SR2	BUSY	*LL_I2C_IsActiveFlag_BUSY*
	DUALF	*LL_I2C_IsActiveFlag_DUAL*
	GENCALL	*LL_I2C_IsActiveFlag_GENCALL*
	MSL	*LL_I2C_IsActiveFlag_MSL*

Register	Field	Function
	PEC	*LL_I2C_GetSMBusPEC*
	SMBDEFAULT	*LL_I2C_IsActiveSMBusFlag_SMBDEFAULT*
	SMBHOST	*LL_I2C_IsActiveSMBusFlag_SMBHOST*
	TRA	*LL_I2C_GetTransferDirection*
TRISE	TRISE	*LL_I2C_ConfigSpeed*
		LL_I2C_GetRiseTime
		LL_I2C_SetRiseTime

70.11 I2S

Table 35: Correspondence between I2S registers and I2S low-layer driver functions

Register	Field	Function
CR2	ERRIE	*LL_I2S_DisableIT_ERR*
		LL_I2S_EnableIT_ERR
		LL_I2S_IsEnabledIT_ERR
	RXDMAEN	*LL_I2S_DisableDMAReq_RX*
		LL_I2S_EnableDMAReq_RX
		LL_I2S_IsEnabledDMAReq_RX
	RXNEIE	*LL_I2S_DisableIT_RXNE*
		LL_I2S_EnableIT_RXNE
		LL_I2S_IsEnabledIT_RXNE
	TXDMAEN	*LL_I2S_DisableDMAReq_TX*
		LL_I2S_EnableDMAReq_TX
		LL_I2S_IsEnabledDMAReq_TX
	TXEIE	*LL_I2S_DisableIT_TXE*
		LL_I2S_EnableIT_TXE
		LL_I2S_IsEnabledIT_TXE
DR	DR	*LL_I2S_ReceiveData16*
		LL_I2S_TransmitData16
I2SCFGR	CHLEN	*LL_I2S_GetDataFormat*
		LL_I2S_SetDataFormat
	CKPOL	*LL_I2S_GetClockPolarity*
		LL_I2S_SetClockPolarity
	DATLEN	*LL_I2S_GetDataFormat*
		LL_I2S_SetDataFormat
	I2SCFG	*LL_I2S_GetTransferMode*
		LL_I2S_SetTransferMode

Register	Field	Function
	I2SE	*LL_I2S_Disable*
		LL_I2S_Enable
		LL_I2S_IsEnabled
	I2SMOD	*LL_I2S_Enable*
	I2SSTD	*LL_I2S_GetStandard*
		LL_I2S_SetStandard
	PCMSYNC	*LL_I2S_GetStandard*
		LL_I2S_SetStandard
I2SPR	I2SDIV	*LL_I2S_GetPrescalerLinear*
		LL_I2S_SetPrescalerLinear
	MCKOE	*LL_I2S_DisableMasterClock*
		LL_I2S_EnableMasterClock
		LL_I2S_IsEnabledMasterClock
	ODD	*LL_I2S_GetPrescalerParity*
		LL_I2S_SetPrescalerParity
SR	BSY	*LL_I2S_IsActiveFlag_BSY*
	CHSIDE	*LL_I2S_IsActiveFlag_CHSIDE*
	FRE	*LL_I2S_ClearFlag_FRE*
		LL_I2S_IsActiveFlag_FRE
	OVR	*LL_I2S_ClearFlag_OVR*
		LL_I2S_IsActiveFlag_OVR
	RXNE	*LL_I2S_IsActiveFlag_RXNE*
	TXE	*LL_I2S_IsActiveFlag_TXE*
	UDR	*LL_I2S_ClearFlag_UDR*
		LL_I2S_IsActiveFlag_UDR

70.12 IWDG

Table 36: Correspondence between IWDG registers and IWDG low-layer driver functions

Register	Field	Function
KR	KEY	*LL_IWDG_DisableWriteAccess*
		LL_IWDG_Enable
		LL_IWDG_EnableWriteAccess
		LL_IWDG_ReloadCounter
PR	PR	*LL_IWDG_GetPrescaler*
		LL_IWDG_SetPrescaler
RLR	RL	*LL_IWDG_GetReloadCounter*

Register	Field	Function
		LL_IWDG_SetReloadCounter
SR	PVU	*LL_IWDG_IsActiveFlag_PVU*
		LL_IWDG_IsReady
	RVU	*LL_IWDG_IsActiveFlag_RVU*
		LL_IWDG_IsReady

70.13 OPAMP

Table 37: Correspondence between OPAMP registers and OPAMP low-layer driver functions

Register	Field	Function
CSR	ANAWSELx	*LL_OPAMP_SetInputInverting*
	AOP_RANGE	*LL_OPAMP_GetCommonPowerRange*
		LL_OPAMP_SetCommonPowerRange
	OPA1CAL_H	*LL_OPAMP_SetCalibrationSelection*
	OPA1CAL_L	*LL_OPAMP_SetCalibrationSelection*
	OPA1LPM	*LL_OPAMP_GetPowerMode*
		LL_OPAMP_SetPowerMode
	OPA2LPM	*LL_OPAMP_GetPowerMode*
		LL_OPAMP_SetPowerMode
	OPA3LPM	*LL_OPAMP_GetPowerMode*
		LL_OPAMP_SetPowerMode
	OPAxCALOUT	*LL_OPAMP_IsCalibrationOutputSet*
	OPAxPD	*LL_OPAMP_Disable*
		LL_OPAMP_Enable
		LL_OPAMP_IsEnabled
	S3SELx	*LL_OPAMP_GetFunctionalMode*
		LL_OPAMP_SetFunctionalMode
		LL_OPAMP_SetMode
	S4SELx	*LL_OPAMP_SetInputInverting*
		LL_OPAMP_SetMode
	S5SELx	*LL_OPAMP_GetInputNonInverting*
		LL_OPAMP_SetInputNonInverting
		LL_OPAMP_SetMode
	S6SELx	*LL_OPAMP_GetInputNonInverting*
		LL_OPAMP_SetInputNonInverting
		LL_OPAMP_SetMode
	S7SEL2	*LL_OPAMP_GetInputNonInverting*

Register	Field	Function
		LL_OPAMP_SetInputNonInverting
		LL_OPAMP_SetMode
LPOTR	AOx_OPT_OFFSET_TRIM_LP_HIGH	*LL_OPAMP_GetTrimmingValue*
		LL_OPAMP_SetTrimmingValue
	AOx_OPT_OFFSET_TRIM_LP_LOW	*LL_OPAMP_GetTrimmingValue*
		LL_OPAMP_SetTrimmingValue
OTR	AOx_OPT_OFFSET_TRIM_HIGH	*LL_OPAMP_GetTrimmingValue*
		LL_OPAMP_SetTrimmingValue
	AOx_OPT_OFFSET_TRIM_LOW	*LL_OPAMP_GetTrimmingValue*
		LL_OPAMP_SetTrimmingValue
	OT_USER	*LL_OPAMP_GetCommonTrimmingMode*
		LL_OPAMP_SetCommonTrimmingMode

70.14 PWR

Table 38: Correspondence between PWR registers and PWR low-layer driver functions

Register	Field	Function
CR	CSBF	*LL_PWR_ClearFlag_SB*
	CWUF	*LL_PWR_ClearFlag_WU*
	DBP	*LL_PWR_DisableBkUpAccess*
		LL_PWR_EnableBkUpAccess
		LL_PWR_IsEnabledBkUpAccess
	FWU	*LL_PWR_DisableFastWakeUp*
		LL_PWR_EnableFastWakeUp
		LL_PWR_IsEnabledFastWakeUp
	LPRUN	*LL_PWR_DisableLowPowerRunMode*
		LL_PWR_EnableLowPowerRunMode
		LL_PWR_EnterLowPowerRunMode
		LL_PWR_ExitLowPowerRunMode
		LL_PWR_IsEnabledLowPowerRunMode
	LPSDSR	*LL_PWR_EnterLowPowerRunMode*
		LL_PWR_ExitLowPowerRunMode
		LL_PWR_GetRegulModeLP
		LL_PWR_SetRegulModeLP
	PDDS	*LL_PWR_GetPowerMode*
		LL_PWR_SetPowerMode
	PLS	*LL_PWR_GetPVDLevel*

Register	Field	Function
		LL_PWR_SetPVDLevel
	PVDE	*LL_PWR_DisablePVD*
		LL_PWR_EnablePVD
		LL_PWR_IsEnabledPVD
	ULP	*LL_PWR_DisableUltraLowPower*
		LL_PWR_EnableUltraLowPower
		LL_PWR_IsEnabledUltraLowPower
	VOS	*LL_PWR_GetRegulVoltageScaling*
		LL_PWR_SetRegulVoltageScaling
CSR	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
	PVDO	*LL_PWR_IsActiveFlag_PVDO*
	REGLPF	*LL_PWR_IsActiveFlag_REGLPF*
	SBF	*LL_PWR_IsActiveFlag_SB*
	VOSF	*LL_PWR_IsActiveFlag_VOS*
	VREFINTRDYF	*LL_PWR_IsActiveFlag_VREFINTRDY*
	WUF	*LL_PWR_IsActiveFlag_WU*

70.15 RCC

Table 39: Correspondence between RCC registers and RCC low-layer driver functions

Register	Field	Function
CFGR	HPRE	*LL_RCC_GetAHBPrescaler*
		LL_RCC_SetAHBPrescaler
	MCOPRE	*LL_RCC_ConfigMCO*
	MCOSEL	*LL_RCC_ConfigMCO*
	PLLDIV	*LL_RCC_PLL_ConfigDomain_SYS*
		LL_RCC_PLL_GetDivider
	PLLMUL	*LL_RCC_PLL_ConfigDomain_SYS*
		LL_RCC_PLL_GetMultiplicator

Register	Field	Function
	PLLSRC	*LL_RCC_PLL_ConfigDomain_SYS*
		LL_RCC_PLL_GetMainSource
	PPRE1	*LL_RCC_GetAPB1Prescaler*
		LL_RCC_SetAPB1Prescaler
	PPRE2	*LL_RCC_GetAPB2Prescaler*
		LL_RCC_SetAPB2Prescaler
	SW	*LL_RCC_SetSysClkSource*
	SWS	*LL_RCC_GetSysClkSource*
CIR	CSSC	*LL_RCC_ClearFlag_HSECSS*
	CSSF	*LL_RCC_IsActiveFlag_HSECSS*
	HSERDYC	*LL_RCC_ClearFlag_HSERDY*
	HSERDYF	*LL_RCC_IsActiveFlag_HSERDY*
	HSERDYIE	*LL_RCC_DisableIT_HSERDY*
		LL_RCC_EnableIT_HSERDY
		LL_RCC_IsEnabledIT_HSERDY
	HSIRDYC	*LL_RCC_ClearFlag_HSIRDY*
	HSIRDYF	*LL_RCC_IsActiveFlag_HSIRDY*
	HSIRDYIE	*LL_RCC_DisableIT_HSIRDY*
		LL_RCC_EnableIT_HSIRDY
		LL_RCC_IsEnabledIT_HSIRDY
	LSECSSC	*LL_RCC_ClearFlag_LSECSS*
	LSECSSF	*LL_RCC_IsActiveFlag_LSECSS*
	LSECSSIE	*LL_RCC_DisableIT_LSECSS*
		LL_RCC_EnableIT_LSECSS
		LL_RCC_IsEnabledIT_LSECSS
	LSERDYC	*LL_RCC_ClearFlag_LSERDY*
	LSERDYF	*LL_RCC_IsActiveFlag_LSERDY*
	LSERDYIE	*LL_RCC_DisableIT_LSERDY*
		LL_RCC_EnableIT_LSERDY
		LL_RCC_IsEnabledIT_LSERDY
	LSIRDYC	*LL_RCC_ClearFlag_LSIRDY*
	LSIRDYF	*LL_RCC_IsActiveFlag_LSIRDY*
	LSIRDYIE	*LL_RCC_DisableIT_LSIRDY*
		LL_RCC_EnableIT_LSIRDY
		LL_RCC_IsEnabledIT_LSIRDY
	MSIRDYC	*LL_RCC_ClearFlag_MSIRDY*

Register	Field	Function
	MSIRDYF	*LL_RCC_IsActiveFlag_MSIRDY*
	MSIRDYIE	*LL_RCC_DisableIT_MSIRDY*
		LL_RCC_EnableIT_MSIRDY
		LL_RCC_IsEnabledIT_MSIRDY
	PLLRDYC	*LL_RCC_ClearFlag_PLLRDY*
	PLLRDYF	*LL_RCC_IsActiveFlag_PLLRDY*
	PLLRDYIE	*LL_RCC_DisableIT_PLLRDY*
		LL_RCC_EnableIT_PLLRDY
		LL_RCC_IsEnabledIT_PLLRDY
CR	CSSON	*LL_RCC_HSE_DisableCSS*
		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*
	HSION	*LL_RCC_HSI_Disable*
		LL_RCC_HSI_Enable
	HSIRDY	*LL_RCC_HSI_IsReady*
	MSION	*LL_RCC_MSI_Disable*
		LL_RCC_MSI_Enable
	MSIRDY	*LL_RCC_MSI_IsReady*
	PLLON	*LL_RCC_PLL_Disable*
		LL_RCC_PLL_Enable
	PLLRDY	*LL_RCC_PLL_IsReady*
	RTCPRE	*LL_RCC_GetRTC_HSEPrescaler*
		LL_RCC_SetRTC_HSEPrescaler
CSR	IWDGRSTF	*LL_RCC_IsActiveFlag_IWDGRST*
	LPWRRSTF	*LL_RCC_IsActiveFlag_LPWRRST*
	LSEBYP	*LL_RCC_LSE_DisableBypass*
		LL_RCC_LSE_EnableBypass
	LSECSSD	*LL_RCC_LSE_IsCSSDetected*
	LSECSSON	*LL_RCC_LSE_DisableCSS*
		LL_RCC_LSE_EnableCSS
	LSEON	*LL_RCC_LSE_Disable*
		LL_RCC_LSE_Enable

Register	Field	Function
	LSERDY	*LL_RCC_LSE_IsReady*
	LSION	*LL_RCC_LSI_Disable*
		LL_RCC_LSI_Enable
	LSIRDY	*LL_RCC_LSI_IsReady*
	OBLRSTF	*LL_RCC_IsActiveFlag_OBLRST*
	PINRSTF	*LL_RCC_IsActiveFlag_PINRST*
	PORRSTF	*LL_RCC_IsActiveFlag_PORRST*
	RMVF	*LL_RCC_ClearResetFlags*
	RTCEN	*LL_RCC_DisableRTC*
		LL_RCC_EnableRTC
		LL_RCC_IsEnabledRTC
	RTCRST	*LL_RCC_ForceBackupDomainReset*
		LL_RCC_ReleaseBackupDomainReset
	RTCSEL	*LL_RCC_GetRTCClockSource*
		LL_RCC_SetRTCClockSource
	SFTRSTF	*LL_RCC_IsActiveFlag_SFTRST*
	WWDGRSTF	*LL_RCC_IsActiveFlag_WWDGRST*
ICSCR	HSICAL	*LL_RCC_HSI_GetCalibration*
	HSITRIM	*LL_RCC_HSI_GetCalibTrimming*
		LL_RCC_HSI_SetCalibTrimming
	MSICAL	*LL_RCC_MSI_GetCalibration*
	MSIRANGE	*LL_RCC_MSI_GetRange*
		LL_RCC_MSI_SetRange
	MSITRIM	*LL_RCC_MSI_GetCalibTrimming*
		LL_RCC_MSI_SetCalibTrimming

70.16 RTC

Table 40: Correspondence between RTC registers and RTC low-layer driver functions

Register	Field	Function
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*

Register	Field	Function
		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
	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

Register	Field	Function
ALRMASSR	MASKSS	*LL_RTC_ALMA_GetSubSecondMask*
		LL_RTC_ALMA_SetSubSecondMask
	SS	*LL_RTC_ALMA_GetSubSecond*
		LL_RTC_ALMA_SetSubSecond
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*
		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

Register	Field	Function
		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
ALRMBSSR	MASKSS	*LL_RTC_ALMB_GetSubSecondMask*
		LL_RTC_ALMB_SetSubSecondMask
	SS	*LL_RTC_ALMB_GetSubSecond*
		LL_RTC_ALMB_SetSubSecond
BKPxR	BKP	*LL_RTC_BAK_GetRegister*
		LL_RTC_BAK_SetRegister
CALIBR	DC	*LL_RTC_CAL_ConfigCoarseDigital*
		LL_RTC_CAL_GetCoarseDigitalValue
	DCS	*LL_RTC_CAL_ConfigCoarseDigital*
		LL_RTC_CAL_GetCoarseDigitalSign
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
	CALW8	*LL_RTC_CAL_GetPeriod*
		LL_RTC_CAL_SetPeriod
CR	ADD1H	*LL_RTC_TIME_IncHour*
	ALRAE	*LL_RTC_ALMA_Disable*
		LL_RTC_ALMA_Enable
	ALRAIE	*LL_RTC_DisableIT_ALRA*
		LL_RTC_EnableIT_ALRA
		LL_RTC_IsEnabledIT_ALRA
	ALRBE	*LL_RTC_ALMB_Disable*

Register	Field	Function
		LL_RTC_ALMB_Enable
	ALRBIE	*LL_RTC_DisableIT_ALRB*
		LL_RTC_EnableIT_ALRB
		LL_RTC_IsEnabledIT_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
	DCE	*LL_RTC_CAL_DisableCoarseDigital*
		LL_RTC_CAL_EnableCoarseDigital
	FMT	*LL_RTC_GetHourFormat*
		LL_RTC_SetHourFormat
	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*
	TSE	*LL_RTC_TS_Disable*
		LL_RTC_TS_Enable
	TSEDGE	*LL_RTC_TS_GetActiveEdge*
		LL_RTC_TS_SetActiveEdge
	TSIE	*LL_RTC_DisableIT_TS*
		LL_RTC_EnableIT_TS
		LL_RTC_IsEnabledIT_TS
	WUCKSEL	*LL_RTC_WAKEUP_GetClock*
		LL_RTC_WAKEUP_SetClock
	WUTE	*LL_RTC_WAKEUP_Disable*
		LL_RTC_WAKEUP_Enable

Register	Field	Function
		LL_RTC_WAKEUP_IsEnabled
	WUTIE	*LL_RTC_DisableIT_WUT*
		LL_RTC_EnableIT_WUT
		LL_RTC_IsEnabledIT_WUT
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
ISR	ALRAF	*LL_RTC_ClearFlag_ALRA*
		LL_RTC_IsActiveFlag_ALRA
	ALRAWF	*LL_RTC_IsActiveFlag_ALRAW*
	ALRBF	*LL_RTC_ClearFlag_ALRB*

Register	Field	Function
		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*
	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*
		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*
PRER	PREDIV_A	*LL_RTC_GetAsynchPrescaler*
		LL_RTC_SetAsynchPrescaler
	PREDIV_S	*LL_RTC_GetSynchPrescaler*
		LL_RTC_SetSynchPrescaler
SHIFTR	ADD1S	*LL_RTC_TIME_Synchronize*
	SUBFS	*LL_RTC_TIME_Synchronize*
SSR	SS	*LL_RTC_TIME_GetSubSecond*
TAFCR	ALARMOUTTYPE	*LL_RTC_GetAlarmOutputType*
		LL_RTC_SetAlarmOutputType
	TAMP1E	*LL_RTC_TAMPER_Disable*
		LL_RTC_TAMPER_Enable
	TAMP1TRG	*LL_RTC_TAMPER_DisableActiveLevel*
		LL_RTC_TAMPER_EnableActiveLevel

Register	Field	Function
	TAMP2E	*LL_RTC_TAMPER_Disable*
		LL_RTC_TAMPER_Enable
	TAMP2TRG	*LL_RTC_TAMPER_DisableActiveLevel*
		LL_RTC_TAMPER_EnableActiveLevel
	TAMP3E	*LL_RTC_TAMPER_Disable*
		LL_RTC_TAMPER_Enable
	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
	TAMPTS	*LL_RTC_TS_DisableOnTamper*
		LL_RTC_TS_EnableOnTamper
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

Register	Field	Function
		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
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
	MU	*LL_RTC_TS_GetDate*
		LL_RTC_TS_GetMonth
	WDU	*LL_RTC_TS_GetDate*
		LL_RTC_TS_GetWeekDay
TSSSR	SS	*LL_RTC_TS_GetSubSecond*
TSTR	HT	*LL_RTC_TS_GetHour*
		LL_RTC_TS_GetTime
	HU	*LL_RTC_TS_GetHour*
		LL_RTC_TS_GetTime
	MNT	*LL_RTC_TS_GetMinute*
		LL_RTC_TS_GetTime
	MNU	*LL_RTC_TS_GetMinute*
		LL_RTC_TS_GetTime
	PM	*LL_RTC_TS_GetTimeFormat*
	ST	*LL_RTC_TS_GetSecond*
		LL_RTC_TS_GetTime
	SU	*LL_RTC_TS_GetSecond*
		LL_RTC_TS_GetTime

Register	Field	Function
WPR	KEY	*LL_RTC_DisableWriteProtection*
		LL_RTC_EnableWriteProtection
WUTR	WUT	*LL_RTC_WAKEUP_GetAutoReload*
		LL_RTC_WAKEUP_SetAutoReload

70.17 SPI

Table 41: 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*
		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
	CRCNEXT	*LL_SPI_SetCRCNext*
	DFF	*LL_SPI_GetDataWidth*
		LL_SPI_SetDataWidth
	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*

Register	Field	Function
		LL_SPI_SetNSSMode
CR2	ERRIE	*LL_SPI_DisableIT_ERR*
		LL_SPI_EnableIT_ERR
		LL_SPI_IsEnabledIT_ERR
	FRF	*LL_SPI_GetStandard*
		LL_SPI_SetStandard
	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
	MODF	*LL_SPI_ClearFlag_MODF*
		LL_SPI_IsActiveFlag_MODF
	OVR	*LL_SPI_ClearFlag_OVR*

Register	Field	Function
		LL_SPI_IsActiveFlag_OVR
	RXNE	*LL_SPI_IsActiveFlag_RXNE*
	TXE	*LL_SPI_IsActiveFlag_TXE*
TXCRCR	TXCRC	*LL_SPI_GetTxCRC*

70.18 SYSTEM

Table 42: Correspondence between SYSTEM registers and SYSTEM low-layer driver functions

Register	Field	Function
APB1_FZ	DBG_I2C1_SMBUS_TIMEOUT	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_I2C2_SMBUS_TIMEOUT	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_IWDG_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_RTC_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM2_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM3_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM4_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM5_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM6_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_TIM7_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
	DBG_WWDG_STOP	*LL_DBGMCU_APB1_GRP1_FreezePeriph*
		LL_DBGMCU_APB1_GRP1_UnFreezePeriph
APB2_FZ	DBG_TIM10_STOP	*LL_DBGMCU_APB2_GRP1_FreezePeriph*
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph
	DBG_TIM11_STOP	*LL_DBGMCU_APB2_GRP1_FreezePeriph*
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph
	DBG_TIM9_STOP	*LL_DBGMCU_APB2_GRP1_FreezePeriph*
		LL_DBGMCU_APB2_GRP1_UnFreezePeriph

Register	Field	Function
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	ACC64	*LL_FLASH_Disable64bitAccess*
		LL_FLASH_Enable64bitAccess
		LL_FLASH_Is64bitAccessEnabled
	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
FLASH_PDKEYR	PDKEY1	*LL_FLASH_DisableRunPowerDown*
		LL_FLASH_EnableRunPowerDown
	PDKEY2	*LL_FLASH_DisableRunPowerDown*
		LL_FLASH_EnableRunPowerDown
RI_ASCR1	CH	*LL_RI_CloseIOSwitchLinkedToADC*
		LL_RI_OpenIOSwitchLinkedToADC
	SCM	*LL_RI_DisableSwitchControlMode*
		LL_RI_EnableSwitchControlMode
	VCOMP	*LL_RI_CloseIOSwitchLinkedToADC*
		LL_RI_OpenIOSwitchLinkedToADC
RI_ASCR2	CH0b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC

Register	Field	Function
	CH10b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH11b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH12b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH1b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH2b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH3b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH6b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH7b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH8b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	CH9b	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR10_1	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR10_2	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR10_3	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR10_4	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR4_1	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR4_2	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR4_3	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR4_4	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC

Register	Field	Function
	GR5_1	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR5_2	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR5_3	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR6_1	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR6_2	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR6_3	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
	GR6_4	*LL_RI_CloseIOSwitchNotLinkedToADC*
		LL_RI_OpenIOSwitchNotLinkedToADC
RI_ASMR1	PA	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PB	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PC	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PF	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PG	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
RI_ASMR2	PA	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PB	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PC	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PF	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PG	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
RI_ASMR3	PA	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM

Register	Field	Function
	PB	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PC	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PF	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PG	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
RI_ASMR4	PA	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PB	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PC	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PF	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PG	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
RI_ASMR5	PA	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PB	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PC	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PF	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
	PG	*LL_RI_ControlSwitchByADC*
		LL_RI_ControlSwitchByTIM
RI_CICR1	PA	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PB	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PC	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PF	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO

Register	Field	Function
	PG	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
RI_CICR2	PA	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PB	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PC	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PF	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PG	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
RI_CICR3	PA	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PB	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PC	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PF	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PG	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
RI_CICR4	PA	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PB	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PC	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PF	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PG	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
RI_CICR5	PA	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PB	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO

Register	Field	Function
	PC	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PF	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
	PG	*LL_RI_IdentifyChannelIO*
		LL_RI_IdentifySamplingCapacitorIO
RI_CMR1	PA	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PB	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PC	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PF	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PG	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
RI_CMR2	PA	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PB	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PC	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PF	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PG	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
RI_CMR3	PA	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PB	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PC	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PF	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PG	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition

Register	Field	Function
RI_CMR4	PA	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PB	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PC	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PF	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PG	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
RI_CMR5	PA	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PB	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PC	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PF	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
	PG	*LL_RI_MaskChannelDuringAcquisition*
		LL_RI_UnmaskChannelDuringAcquisition
RI_HYSCR1	PA	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PB	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PC	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PD	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PE	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PF	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PG	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
RI_HYSCR2	PA	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis

Register	Field	Function
	PB	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PC	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PD	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PE	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PF	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PG	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
RI_HYSCR3	PA	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PB	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PC	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PD	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PE	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PF	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PG	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
RI_HYSCR4	PA	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PB	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PC	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PD	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PE	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis

Register	Field	Function
	PF	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
	PG	*LL_RI_DisableHysteresis*
		LL_RI_EnableHysteresis
RI_ICR	IC1	*LL_RI_DisableRemapInputCapture_TIM*
		LL_RI_SetRemapInputCapture_TIM
	IC1OS	*LL_RI_SetRemapInputCapture_TIM*
	IC2	*LL_RI_DisableRemapInputCapture_TIM*
		LL_RI_SetRemapInputCapture_TIM
	IC2OS	*LL_RI_SetRemapInputCapture_TIM*
	IC3	*LL_RI_DisableRemapInputCapture_TIM*
		LL_RI_SetRemapInputCapture_TIM
	IC3OS	*LL_RI_SetRemapInputCapture_TIM*
	IC4	*LL_RI_DisableRemapInputCapture_TIM*
		LL_RI_SetRemapInputCapture_TIM
	IC4OS	*LL_RI_SetRemapInputCapture_TIM*
	TIM	*LL_RI_SetRemapInputCapture_TIM*
SYSCFG_EXTICR1	EXTI0	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI1	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI10	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI11	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI12	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI13	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI14	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI15	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI2	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI3	*LL_SYSCFG_GetEXTISource*

Register	Field	Function
		LL_SYSCFG_SetEXTISource
	EXTI4	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI5	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI6	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI7	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI8	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI9	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR2	EXTI0	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI1	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI10	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI11	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI12	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI13	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI14	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI15	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI2	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI3	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI4	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI5	*LL_SYSCFG_GetEXTISource*

Register	Field	Function
		LL_SYSCFG_SetEXTISource
	EXTI6	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI7	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI8	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI9	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR3	EXTI0	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI1	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI10	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI11	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI12	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI13	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI14	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI15	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI2	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI3	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI4	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI5	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI6	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI7	*LL_SYSCFG_GetEXTISource*

Register	Field	Function
		LL_SYSCFG_SetEXTISource
	EXTI8	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI9	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
SYSCFG_EXTICR4	EXTI0	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI1	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI10	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI11	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI12	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI13	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI14	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI15	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI2	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI3	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI4	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI5	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI6	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI7	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI8	*LL_SYSCFG_GetEXTISource*
		LL_SYSCFG_SetEXTISource
	EXTI9	*LL_SYSCFG_GetEXTISource*

Register	Field	Function
		LL_SYSCFG_SetEXTISource
SYSCFG_MEMRMP	BOOT_MODE	*LL_SYSCFG_GetBootMode*
	MEM_MODE	*LL_SYSCFG_GetRemapMemory*
		LL_SYSCFG_SetRemapMemory
SYSCFG_PMC	LCD_CAPA	*LL_SYSCFG_DisableLCDCapacitanceConnection*
		LL_SYSCFG_EnableLCDCapacitanceConnection
	USB_PU	*LL_SYSCFG_DisableUSBPullUp*
		LL_SYSCFG_EnableUSBPullUp

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Table 43: Correspondence between TIM registers and TIM low-layer driver functions

Register	Field	Function
ARR	ARR	*LL_TIM_GetAutoReload*
		LL_TIM_SetAutoReload
CCER	CC1E	*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
	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
	CC2NP	*LL_TIM_IC_Config*
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_SetPolarity
	CC2P	*LL_TIM_IC_Config*
		LL_TIM_IC_GetPolarity

Register	Field	Function
		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
	CC3NP	*LL_TIM_IC_Config*
		LL_TIM_IC_GetPolarity
		LL_TIM_IC_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
		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

Register	Field	Function
	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
	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

Register	Field	Function
		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
		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*

Register	Field	Function
		LL_TIM_OC_SetMode
	OC4PE	*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
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
	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

Register	Field	Function
	URS	*LL_TIM_GetUpdateSource*
		LL_TIM_SetUpdateSource
CR2	CCDS	*LL_TIM_CC_GetDMAReqTrigger*
		LL_TIM_CC_SetDMAReqTrigger
	MMS	*LL_TIM_SetTriggerOutput*
	TI1S	*LL_TIM_IC_DisableXORCombination*
		LL_TIM_IC_EnableXORCombination
		LL_TIM_IC_IsEnabledXORCombination
DCR	DBA	*LL_TIM_ConfigDMABurst*
	DBL	*LL_TIM_ConfigDMABurst*
DIER	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
	TDE	*LL_TIM_DisableDMAReq_TRIG*
		LL_TIM_EnableDMAReq_TRIG

Register	Field	Function
		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	CC1G	*LL_TIM_GenerateEvent_CC1*
	CC2G	*LL_TIM_GenerateEvent_CC2*
	CC3G	*LL_TIM_GenerateEvent_CC3*
	CC4G	*LL_TIM_GenerateEvent_CC4*
	TG	*LL_TIM_GenerateEvent_TRIG*
	UG	*LL_TIM_GenerateEvent_UPDATE*
PSC	PSC	*LL_TIM_GetPrescaler*
		LL_TIM_SetPrescaler
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	CC1IF	*LL_TIM_ClearFlag_CC1*
		LL_TIM_IsActiveFlag_CC1
	CC1OF	*LL_TIM_ClearFlag_CC1OVR*

Register	Field	Function
		LL_TIM_IsActiveFlag_CC1OVR
	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
	TIF	*LL_TIM_ClearFlag_TRIG*
		LL_TIM_IsActiveFlag_TRIG
	UIF	*LL_TIM_ClearFlag_UPDATE*
		LL_TIM_IsActiveFlag_UPDATE
TIM10_OR	ETR_RMP	*LL_TIM_SetRemap*
	TI1_RMP	*LL_TIM_SetRemap*
	TI1_RMP_RI	*LL_TIM_SetRemap*
TIM11_OR	ETR_RMP	*LL_TIM_SetRemap*
	TI1_RMP	*LL_TIM_SetRemap*
	TI1_RMP_RI	*LL_TIM_SetRemap*
TIM2_OR	ITR1_RMP	*LL_TIM_SetRemap*
TIM3_OR	ITR2_RMP	*LL_TIM_SetRemap*
TIM9_OR	ITR1_RMP	*LL_TIM_SetRemap*
	TI1_RMP	*LL_TIM_SetRemap*

70.20 USART

Table 44: Correspondence between USART registers and USART low-layer driver functions

Register	Field	Function
BRR	BRR	*LL_USART_GetBaudRate*
		LL_USART_SetBaudRate
CR1	IDLEIE	*LL_USART_DisableIT_IDLE*
		LL_USART_EnableIT_IDLE
		LL_USART_IsEnabledIT_IDLE

Register	Field	Function
	M	*LL_USART_ConfigCharacter*
		LL_USART_GetDataWidth
		LL_USART_SetDataWidth
	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
	RWU	*LL_USART_IsActiveFlag_RWU*
		LL_USART_RequestEnterMuteMode
		LL_USART_RequestExitMuteMode
	RXNEIE	*LL_USART_DisableIT_RXNE*
		LL_USART_EnableIT_RXNE
		LL_USART_IsEnabledIT_RXNE
	SBK	*LL_USART_IsActiveFlag_SBK*
		LL_USART_RequestBreakSending
	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	*LL_USART_DisableIT_TXE*
		LL_USART_EnableIT_TXE
		LL_USART_IsEnabledIT_TXE

Register	Field	Function
	UE	*LL_USART_Disable*
		LL_USART_Enable
		LL_USART_IsEnabled
	WAKE	*LL_USART_GetWakeUpMethod*
		LL_USART_SetWakeUpMethod
CR2	ADD	*LL_USART_GetNodeAddress*
		LL_USART_SetNodeAddress
	CLKEN	*LL_USART_ConfigAsyncMode*
		LL_USART_ConfigHalfDuplexMode
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		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
	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

Register	Field	Function
		LL_USART_ConfigSmartcardMode
		LL_USART_ConfigSyncMode
		LL_USART_DisableLIN
		LL_USART_EnableLIN
		LL_USART_IsEnabledLIN
	STOP	*LL_USART_ConfigCharacter*
		LL_USART_ConfigIrdaMode
		LL_USART_ConfigLINMode
		LL_USART_ConfigSmartcardMode
		LL_USART_GetStopBitsLength
		LL_USART_SetStopBitsLength
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
	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
	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

Register	Field	Function
		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
	RTSE	*LL_USART_DisableRTSHWFlowCtrl*
		LL_USART_EnableRTSHWFlowCtrl
		LL_USART_GetHWFlowCtrl
		LL_USART_SetHWFlowCtrl
	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
DR	DR	*LL_USART_DMA_GetRegAddr*
		LL_USART_ReceiveData8
		LL_USART_ReceiveData9
		LL_USART_TransmitData8

Register	Field	Function
		LL_USART_TransmitData9
GTPR	GT	*LL_USART_GetSmartcardGuardTime*
		LL_USART_SetSmartcardGuardTime
	PSC	*LL_USART_GetIrdaPrescaler*
		LL_USART_GetSmartcardPrescaler
		LL_USART_SetIrdaPrescaler
		LL_USART_SetSmartcardPrescaler
SR	CTS	*LL_USART_ClearFlag_nCTS*
		LL_USART_IsActiveFlag_nCTS
	FE	*LL_USART_ClearFlag_FE*
		LL_USART_IsActiveFlag_FE
	IDLE	*LL_USART_ClearFlag_IDLE*
		LL_USART_IsActiveFlag_IDLE
	LBD	*LL_USART_ClearFlag_LBD*
		LL_USART_IsActiveFlag_LBD
	NF	*LL_USART_ClearFlag_NE*
		LL_USART_IsActiveFlag_NE
	ORE	*LL_USART_ClearFlag_ORE*
		LL_USART_IsActiveFlag_ORE
	PE	*LL_USART_ClearFlag_PE*
		LL_USART_IsActiveFlag_PE
	RXNE	*LL_USART_ClearFlag_RXNE*
		LL_USART_IsActiveFlag_RXNE
	TC	*LL_USART_ClearFlag_TC*
		LL_USART_IsActiveFlag_TC
	TXE	*LL_USART_IsActiveFlag_TXE*

70.21 WWDG

Table 45: 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

Register	Field	Function
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

71 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 STM32L1 devices are supported by the HAL drivers?

The HAL drivers are developed to support all STM32L1 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 2.4: "Devices supported by 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: stm32l1xx_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 driver folders (stm32l1xx_hal_conf_template.c).

Which header files should I include in my application to use the HAL drivers?

Only stm32l1xx_hal.h file has to be included.

What is the difference between stm32l1xx_hal_ppp.c/.h and stm32l1xx_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 (stm32l1xx_hal_ppp.c): It includes the common set of APIs across all the STM32 product lines
- The extension APIs (stm32l1xx_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_stm32l1xx.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 stm32l1xx_hal_msp.c. A template is provided in the HAL driver folders (stm32l1xx_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() in stm32l1xx_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 stm32l1xx_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 stm32l1xx_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.

72 Revision history

Table 46: Document revision history

Date	Revision	Changes
18-Nov-2014	1	Initial release.
13-Feb-2015	2	Updated list of PPP_TypeDef structures in *Section 2.5.1: "HAL API naming rules"*. Updated *Table 5: "List of devices supported by HAL drivers"*. Updated , and *Section 18.1.2: "FLASH_OBProgramInitTypeDef"*.
21-Apr-2015	3	Changed path for compilation under Unix environment.Updated drivers to be C++ compliant. Updated common macros in *Section 2.9: "HAL common resources"*. Added interface to access MPU features (refer to stm32l1xx_hal_cortex.h). *Section 12: "HAL CRYP Generic Driver"*: added instance field in CRYP_HandleTypeDef. *Section 17: "HAL FLASH Generic Driver"*: changed field name of NOR_CFITypeDef (CFI1X changed to CFI1_X). *Section 30: "HAL PCD Generic Driver"*: • HAL_PCD_ActiveRemoteWakeup renamed HAL_PCD_ActivateRemoteWakeup • HAL_PCD_DeActiveRemoteWakeup renamed to HAL_PCD_DeActivateRemoteWakeup • HAL_PCD_ActiveRemoteWakeup renamed HAL_PCD_ActivateRemoteWakeup • HAL_PCD_DeActiveRemoteWakeup renamed to HAL_PCD_DeActivateRemoteWakeup. *Section 32: "HAL PWR Generic Driver"*: – HAL_PWR_PVDConfig renamed HAL_PWR_ConfigPVD. – Added new interfaces: – void HAL_PWR_EnableSleepOnExit(void); – void HAL_PWR_DisableSleepOnExit(void); – void HAL_PWR_EnableSEVOnPend(void); – void HAL_PWR_DisableSEVOnPend(void); – void HAL_PWR_EnableSleepOnExit(void); – uint32_t HAL_PWREx_GetVoltageRange(void); *Section 34: "HAL RCC Generic Driver"*: • HAL_RCC_CCSCallback renamed to HAL_RCC_CSSCallback. • Added HAL_RCCEx_GetPeriphCLKFreq interface. *Section 39: "HAL SMARTCARD Generic Driver"*: Removed HAL_SMARTCARD_ReInit interface. *Section 40: "HAL SPI Generic Driver"*: HAL_SPI_GetError now returns a uint32_t instead of HAL_SPI_ErrorTypeDef. *Section 43: "HAL TIM Generic Driver"*: added HAL_TIM_SlaveConfigSynchronization_IT interface. *Section 45: "HAL UART Generic Driver"*: Changed ErrorCode field of UART_HandleTypeDef from HAL_UART_ErrorTypeDef to uint32_t. *Section 46: "HAL USART Generic Driver"*: Changed ErrorCode field of UART_HandleTypeDef from HAL_UART_ErrorTypeDef to uint32_t.

Date	Revision	Changes
7-Jul-2016	4	Added low-layer driver APIs. *Section 16: "HAL DMA Generic Driver"*: added new HAL_DMA_Abort_IT function to abort DMA transfers in Interrupt mode. *Section 25: "HAL IWDG Generic Driver"*: driver simplified by removing HAL_IWDG_Start(), HAL_IWDG_MspInit() and HAL_IWDG_GetState() APIs. API functions are: • HAL_IWDG_Init() function, which performs IWDG counter configuration and start • HAL_IWDG_Refresh() function, which performs the IWDG counter reloading. *Section 47: "HAL WWDG Generic Driver"*: • Driver simplified by removing HAL_WWDG_Start(), HAL_WWDG_Start_IT(), HAL_WWDG_MspDeInit() and HAL_WWDG_GetState() APIs. API functions are: HAL_WWDG_Init(), HAL_WWDG_MspInit(), HAL_WWDG_Refresh(), HAL_WWDG_IRQHandler() and HAL_WWDG_EarlyWakeupCallback() • Updated HAL_WWDG_Refresh() API to remove counter parameter • Added new EWIMode field in WWDG_InitTypeDef to select Early Wakeup Interrupt.
31-May-2017	5	Enhanced HAL delay and time base implementation: Added new templates stm32l1xx_hal_timebase_tim_template.c which can be used to override the native HAL time base functions (defined as weak) and to use Timer as time base tick source. Updated the following functions: • HAL Cortex: – updated: Updated HAL_MPU_Disable function to clear whole CR register • LL DMA: – Improved CPAR and CMAR registers access in LL_DMA_ConfigAddresses function • HAL FLASH: – Updated HAL_FLASHEx_Erase_IT() function to check the FLASH is ready before starting Erase by IT • HAL/LL GPIO: – Renamed GPIO_AFRL_AFRLx and GPIO_AFRL_AFRHx bit to GPIO_AFRL_AFSELx • HAL/LL I2C: – Added LL_I2C_DisableReset() function to allow the disable of SWRST • HAL PCD: – Corrected double buffer implementation in PCD_SET_EP_DBUF1_CNT() macro – Added missing USB_CNTR_SOFM in the setting of wInterrupt_Mask global variable used in HAL_PCD_Init – Removed lock/unlock from receive and transmit endpoints • HAL/LL PWR: – Replaced HAL_PWREx_GetVoltageRange() function by direct register access to remove dependency with HAL PWR – Renamed the LL_PWR_IsActiveFlag_VOSF() API to LL_PWR_IsActiveFlag_VOS() in order to remove reference to PWR flag name and to refer to the Power feature • HAL/LL RTC: – Renamed RTC_CR_BCK bits in RTC_CR register to RTC_CR_BKP, to be aligned with others series • HAL/LL SPI: – Removed LL_SPI_SR_UDR define which is available only for I2S feature

Date	Revision	Changes
31-May-2017	5	– Updated LL_SPI_TransmitData16() et LL_SPI_TransmitData8 functions • HAL/LL TIM: – Corrected error in LL_TIM_EnableUpdateEvent() and LL_TIM_DisableUpdateEvent() functions

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