

## STM32L433xx/443xx device errata

## Applicability

This document applies to the part numbers of STM32L433xx/443xx devices and the device variants as stated in this page. It gives a summary and a description of the device errata, with respect to the device datasheet and reference manual RM0394. Deviation of the real device behavior from the intended device behavior is considered to be a device limitation. Deviation of the description in the reference manual or the datasheet from the intended device behavior is considered to be a documentation erratum. The term “errata” applies both to limitations and documentation errata.

**Table 1. Device summary**

Reference	Part numbers
STM32L433xx	STM32L433CC, STM32L433RC, STM32L433VC, STM32L433CB, STM32L433RB
STM32L443xx	STM32L443CC, STM32L443RC, STM32L443VC

**Table 2. Device variants**

Reference	Silicon revision codes	
	Device marking <sup>(1)</sup>	REV_ID <sup>(2)</sup>
STM32L433xx/443xx	A	0x1000
	Z	0x1001

1. Refer to the device datasheet for how to identify this code on different types of package.
2. REV\_ID[15:0] bitfield of DBGMCU\_IDCODE register.

# 1 Summary of device errata

The following table gives a quick reference to the STM32L433xx/443xx device limitations and their status:

A = limitation present, workaround available

N = limitation present, no workaround available

P = limitation present, partial workaround available

“-” = limitation absent

Applicability of a workaround may depend on specific conditions of target application. Adoption of a workaround may cause restrictions to target application. Workaround for a limitation is deemed partial if it only reduces the rate of occurrence and/or consequences of the limitation, or if it is fully effective for only a subset of instances on the device or in only a subset of operating modes, of the function concerned.

**Table 3. Summary of device limitations**

Function	Section	Limitation	Status
			Rev. A,Z
Core	2.1.1	Interrupted loads to SP can cause erroneous behavior	A
	2.1.2	VDIV or VSQRT instructions might not complete correctly when very short ISRs are used	A
	2.1.3	Store immediate overlapping exception return operation might vector to incorrect interrupt	A
System	2.2.1	MSIRDY flag issue preventing entry in low-power mode	A
	2.2.2	PCPROP area within a single flash memory page becomes unprotected at RDP change from Level 1 to Level 0	A
	2.2.3	MSI frequency overshoot upon Stop mode exit	A
	2.2.4	Internal voltage reference corrupted upon Stop mode entry with temperature sensing enabled	A
	2.2.5	Spurious brown-out reset after short run sequence	A
	2.2.6	Full JTAG configuration without NJTRST pin cannot be used	A
	2.2.7	Current injection from V <sub>DD</sub> to V <sub>DDA</sub> through analog switch voltage booster	A
	2.2.8	Unstable LSI when it clocks RTC or CSS on LSE	P
	2.2.9	HSI48 ready interrupt capability is not supported	A
	2.2.10	FLASH_ECCR corrupted upon reset or power-down occurring during flash memory program or erase operation	A
	2.2.11	HSE oscillator long startup at low voltage	P
	2.2.12	SRAM write error	A
	2.2.13	PC13 signal transitions disturb LSE	N
FW	2.3.1	Code segment unprotected if non-volatile data segment length is zero	A
QUADSPI	2.4.1	First nibble of data not written after dummy phase	A
	2.4.2	Wrong data from memory-mapped read after an indirect mode operation	A
ADC	2.5.1	Writing ADCx_JSQR when JADCSTART and JQDIS are set might lead to incorrect behavior	N
	2.5.2	Wrong ADC result if conversion done late after calibration or previous conversion	A
	2.5.3	Spurious temperature measurement due to spike noise	A
	2.5.4	Selected external ADC inputs unduly clamped to V <sub>DD</sub> when all analog peripherals are disabled	A

Function	Section	Limitation	Status
			Rev. A,Z
COMP	2.6.1	Comparator outputs cannot be configured in open-drain	N
	2.6.2	COMP1 and COMP2 configuration lost with software reset	N
TSC	2.7.2	TSC signal-to-noise concern under specific conditions	A
TIM	2.9.1	HSE/32 is not available for TIM16 input capture if RTC clock is disabled or other than HSE	A
LPTIM	2.10.1	Device may remain stuck in LPTIM interrupt when entering Stop mode	A
	2.10.2	Device may remain stuck in LPTIM interrupt when clearing event flag	P
	2.10.3	LPTIM1 outputs cannot be configured as open-drain	N
RTC and TAMP	2.11.1	RTC calendar registers are not locked properly	A
	2.11.2	RTC interrupt can be masked by another RTC interrupt	A
	2.11.3	Calendar initialization may fail in case of consecutive INIT mode entry	A
	2.11.4	RTC_REFIN and RTC_OUT on PB2 not operating in Stop 2 mode	P
I2C	2.12.1	10-bit master mode: new transfer cannot be launched if first part of the address is not acknowledged by the slave	A
	2.12.3	Wrong data sampling when data setup time ( $t_{SU, DAT}$ ) is shorter than one I2C kernel clock period	P
	2.12.4	Spurious bus error detection in master mode	A
	2.12.5	Last-received byte loss in reload mode	P
	2.12.6	Spurious master transfer upon own slave address match	P
	2.12.7	I2C3 analog filter activation requires that both PC0/PC1 are configured as I2C3 alternate function	A
USART	2.13.1	RTS is active while RE = 0 or UE = 0	A
LPUART	2.14.1	LPUART1 outputs cannot be configured as open-drain	N
SPI	2.15.1	BSY bit may stay high at the end of data transfer in slave mode	A
	2.15.2	Wrong CRC in full-duplex mode handled by DMA with imbalanced setting of data counters	A
	2.15.4	SPI master communication failure at high SYSCLK frequency within the specified voltage range	A
SDMMC	2.16.1	Wrong CCRCFAIL status after a response without CRC is received	A
	2.16.2	MMC stream write of less than seven bytes does not work correctly	A
bxCAN	2.17.1	bxCAN time-triggered communication mode not supported	N

The following table gives a quick reference to the documentation errata.

**Table 4. Summary of device documentation errata**

Function	Section	Documentation erratum
TSC	2.7.1	Inhibited acquisition in short transfer phase configuration
AES	2.8.1	Burst read or write accesses not supported
	2.8.2	TAG computation in GCM encryption mode
	2.8.3	CCM authentication mode not compliant with NIST CMAC
	2.8.4	Datatype initial configuration in GCM mode
	2.8.5	Wait until BUSY is low when suspending GCM encryption

Function	Section	Documentation erratum
RTC and TAMP	2.11.5	Setting GPIO properties of PC13 used as RTC_ALARM open-drain output
I2C	2.12.2	Wrong behavior in Stop mode
SPI	2.15.3	CRC error in SPI slave mode if internal NSS changes before CRC transfer

## 2 Description of device errata

The following sections describe the errata of the applicable devices with Arm® core and provide workarounds if available. They are grouped by device functions.

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



### 2.1 Core

Reference manual and errata notice for the Arm® Cortex®-M4F core revision r0p1 is available from <http://infocenter.arm.com>.

#### 2.1.1 Interrupted loads to SP can cause erroneous behavior

This limitation is registered under Arm ID number 752770 and classified into “Category B”. Its impact to the device is minor.

##### Description

If an interrupt occurs during the data-phase of a single word load to the stack-pointer (SP/R13), erroneous behavior can occur. In all cases, returning from the interrupt will result in the load instruction being executed an additional time. For all instructions performing an update to the base register, the base register will be erroneously updated on each execution, resulting in the stack-pointer being loaded from an incorrect memory location.

The affected instructions that can result in the load transaction being repeated are:

- LDR SP, [Rn],#imm
- LDR SP, [Rn,#imm]!
- LDR SP, [Rn,#imm]
- LDR SP, [Rn]
- LDR SP, [Rn,Rm]

The affected instructions that can result in the stack-pointer being loaded from an incorrect memory address are:

- LDR SP,[Rn],#imm
- LDR SP,[Rn,#imm]!

As compilers do not generate these particular instructions, the limitation is only likely to occur with hand-written assembly code.

##### Workaround

Both issues may be worked around by replacing the direct load to the stack-pointer, with an intermediate load to a general-purpose register followed by a move to the stack-pointer.

#### 2.1.2 VDIV or VSQRT instructions might not complete correctly when very short ISRs are used

This limitation is registered under Arm ID number 776924 and classified into “Category B”. Its impact to the device is limited.

##### Description

The VDIV and VSQRT instructions take 14 cycles to execute. When an interrupt is taken a VDIV or VSQRT instruction is not terminated, and completes its execution while the interrupt stacking occurs. If lazy context save of floating point state is enabled then the automatic stacking of the floating point context does not occur until a floating point instruction is executed inside the interrupt service routine.

Lazy context save is enabled by default. When it is enabled, the minimum time for the first instruction in the interrupt service routine to start executing is 12 cycles. In certain timing conditions, and if there is only one or two instructions inside the interrupt service routine, then the VDIV or VSQRT instruction might not write its result to the register bank or to the FPSCR.

The failure occurs when the following condition is met:

1. The floating point unit is enabled
2. Lazy context saving is not disabled
3. A VDIV or VSQRT is executed
4. The destination register for the VDIV or VSQRT is one of s0 - s15
5. An interrupt occurs and is taken
6. The interrupt service routine being executed does not contain a floating point instruction
7. Within 14 cycles after the VDIV or VSQRT is executed, an interrupt return is executed

A minimum of 12 of these 14 cycles are utilized for the context state stacking, which leaves 2 cycles for instructions inside the interrupt service routine, or 2 wait states applied to the entire stacking sequence (which means that it is not a constant wait state for every access).

In general, this means that if the memory system inserts wait states for stack transactions (that is, external memory is used for stack data), then this erratum cannot be observed.

The effect of this erratum is that the VDIV or VSQRT instruction does not complete correctly and the register bank and FPSCR are not updated, which means that these registers hold incorrect, out of date, data.

### Workaround

A workaround is only required if the floating point unit is enabled. A workaround is not required if the stack is in external memory.

There are two possible workarounds:

- Disable lazy context save of floating point state by clearing LSPEN to 0 (bit 30 of the FPCCR at address 0xE000EF34).
- Ensure that every interrupt service routine contains more than 2 instructions in addition to the exception return instruction.

## 2.1.3 Store immediate overlapping exception return operation might vector to incorrect interrupt

This limitation is registered under Arm ID number 838869 and classified into “Category B (rare)”. Its impact to the device is minor.

### Description

The core includes a write buffer that permits execution to continue while a store is waiting on the bus. Under specific timing conditions, during an exception return while this buffer is still in use by a store instruction, a late change in selection of the next interrupt to be taken might result in there being a mismatch between the interrupt acknowledged by the interrupt controller and the vector fetched by the processor.

The failure occurs when the following condition is met:

1. The handler for interrupt A is being executed.
2. Interrupt B, of the same or lower priority than interrupt A, is pending.
3. A store with immediate offset instruction is executed to a bufferable location.
  - STR/STRH/STRB <Rt>, [<Rn>,#imm]
  - STR/STRH/STRB <Rt>, [<Rn>,#imm]!
  - STR/STRH/STRB <Rt>, [<Rn>],#imm
4. Any number of additional data-processing instructions can be executed.
5. A BX instruction is executed that causes an exception return.
6. The store data has wait states applied to it such that the data is accepted at least two cycles after the BX is executed.
  - Minimally, this is two cycles if the store and the BX instruction have no additional instructions between them.
  - The number of wait states required to observe this erratum needs to be increased by the number of cycles between the store and the interrupt service routine exit instruction.
7. Before the bus accepts the buffered store data, another interrupt C is asserted which has the same or lower priority as A, but a greater priority than B.

Example:

The processor should execute interrupt handler C, and on completion of handler C should execute the handler for B. If the conditions above are met, then this erratum results in the processor erroneously clearing the pending state of interrupt C, and then executing the handler for B twice. The first time the handler for B is executed it will be at interrupt C's priority level. If interrupt C is pending by a level-based interrupt which is cleared by C's handler then interrupt C will be pending again once the handler for B has completed and the handler for C will be executed.

As the STM32 interrupt C is level based, it eventually becomes pending again and is subsequently handled.

### Workaround

For software not using the memory protection unit, this erratum can be worked around by setting DISDEFWBUF in the Auxiliary Control Register.

In all other cases, the erratum can be avoided by ensuring a DSB occurs between the store and the BX instruction. For exception handlers written in C, this can be achieved by inserting the appropriate set of intrinsics or inline assembly just before the end of the interrupt function, for example:

ARMCC:

```
...
__schedule_barrier();
__asm{DSB};
__schedule_barrier();
}
```

GCC:

```
...
__asm volatile ("dsb 0xf" ::: "memory");
}
```

## 2.2 System

### 2.2.1 MSIRDY flag issue preventing entry in low-power mode

#### Description

If the MSI clock is stopped when it is running at high frequency (24 MHz or above), the MSIRDY (MSI ready) flag can stay at value 1 instead of 0.

Once this flag remains set while the MSI clock is off, entry in Stop 0, Stop 1, Stop 2, Standby and Shutdown modes is no longer possible (the product is blocked in the low-power mode entry phase).

The following factors increase the probability to have this issue:

- high MSI frequency
- low VDD external supply
- high temperature

#### Workaround

- The MSI clock can run at any frequency if both conditions below are met:
  - The system clock is MSI or PLL fed by MSI when requesting entry in low-power mode.
  - The wakeup clock is MSI.
- If the system clock is any other clock than MSI, lower the MSI frequency to 16 MHz (or less) and add a short delay loop (200 ns minimum) before stopping MSI by software. This ensures that the MSIRDY flag be really 0 before requesting entry in low-power mode.
- If the system clock is MSI and the wakeup clock is not MSI, lower the MSI frequency to 16 MHz (or less) and add a short delay loop (200 ns minimum) before requesting entry in low-power mode.
- If the system clock is PLL fed by MSI and the wakeup clock is not MSI, the MSI frequency used as PLL input should not exceed 16 MHz. In other words, do not use the PLL fed by MSI as system clock with MSI at high frequency (24 MHz or above) divided by PLLM (ensuring the PLL input is between 4 and 16 MHz).

### 2.2.2 PCROP area within a single flash memory page becomes unprotected at RDP change from Level 1 to Level 0

#### Description

With PCROP\_RDP option bit cleared, the change of RDP from Level 1 to Level 0 normally results in erasure of flash memory banks except the flash memory pages containing the PCROP area. The PCROP area remains read-protected.

This operates as expected if the PCROP area crosses the limits of at least one flash memory page, which is always true if PCROP area size exceeds 2 Kbytes. The limitation occurs if the PCROP area is fully contained within one single flash memory page. Upon the RDP change from Level 1 to Level 0, the flash memory bank with PCROP area is not erased and the read protection of the PCROP area is removed.

#### Workaround

Always define PCROP area such that it crosses limits of at least one flash memory page.

### 2.2.3 MSI frequency overshoot upon Stop mode exit

#### Description

When

- the system is clocked by the MSI clock, and
- MSI is selected as system clock source upon wakeup from Stop mode, and
- a wakeup event occurs only a few system clock cycles before entering Stop mode,

then upon the exit from Stop mode, the MSI frequency can overshoot above its selected range.

The limitation applies to all Stop modes: Stop 0, Stop 1, and Stop 2.

#### Workaround

Apply the following sequence:

1. Select HSI16 as system clock.
2. Shut MSI down.
3. Wait for MSIRDY to go low (after 6 MSI clock cycles).
4. Mask interrupts by setting PRIMASK (in the core).
5. Initiate Stop mode entry, with MSI selected as system clock source upon wakeup. At this point, the systems enters Stop mode (unless an early wakeup event occurs). The following steps are done upon Stop mode exit.
6. Enable MSI.
7. Wait for MSIRDY to go high.
8. Select MSI as system clock.
9. Unmask interrupts by clearing PRIMASK.

The steps 6 through 8 are required to cover the case of the MCU not entering Stop mode after the step 5 (due to an early wakeup event), thus maintaining HSI16 as system clock.

This workaround guarantees the best wakeup time.

### 2.2.4 Internal voltage reference corrupted upon Stop mode entry with temperature sensing enabled

#### Description

When entering Stop mode with the temperature sensor channel and the associated ADC(s) enabled, the internal voltage reference may be corrupted.

The occurrence of the corruption depends on the supply voltage and the temperature.

The corruption of the internal voltage reference may cause:

- an overvoltage in  $V_{CORE}$  domain
- an overshoot / undershoot of internal clock (LSI, HSI, MSI) frequencies
- a spurious brown-out reset



The limitation applies to Stop 1 and Stop 2 modes.

**Workaround**

Before entering Stop mode:

- Disable the ADC(s) using the temperature sensor signal as input, and/or
- Disable the temperature sensor channel, by clearing the CH17SEL bit of the ADCx\_CCR register.

Disabling both the ADC(s) and the temperature sensor channel reduces the power consumption during Stop mode.

**2.2.5 Spurious brown-out reset after short run sequence**

**Description**

When the MCU wakes up from Stop mode and enters the Stop mode again within a short period of time, a spurious brown-out reset may be generated.

This limitation depends on the supply voltage (see the following table).

**Table 5. Minimum run time**

V <sub>DD</sub> supply voltage (V)	Minimum run time (µs)
1.71	15
1.8	13
2.0	11
2.2	9
2.4	8
2.6	6
2.8	5
3.0	3
3.2 and above	2

The minimum run time defined in the previous table corresponds to the firmware execution time on the core. There is no need to add a delay for the wakeup time. Note also that the MCO output length is longer than the firmware execution time.

This limitation applies to Stop 1 and Stop 2 modes.

**Workaround**

Ensure that the run time between exiting Stop mode and entering Stop mode again is long enough not to generate a brown-out reset. This can be done by adding a software loop or using a timer to add a delay; the system clock frequency can be reduced during this waiting loop in order to minimize power consumption.

**2.2.6 Full JTAG configuration without NJTRST pin cannot be used**

**Description**

When using the JTAG debug port in Debug mode, the connection with the debugger is lost if the NJTRST pin (PB4) is used as a GPIO or for an alternate function other than NJTRST. Only the 4-wire JTAG port configuration is impacted.

**Workaround**

Use the SWD debug port instead of the full 4-wire JTAG port.

## 2.2.7 Current injection from $V_{DD}$ to $V_{DDA}$ through analog switch voltage booster

### Description

With  $V_{DDA}$  below 2.4 V and  $V_{DD}$  above 3 V, a small current injected from VDD line to VDDA line may cause  $V_{DDA}$  to exceed its nominal value.

This current injection only occurs when the I/O analog switch voltage booster is disabled (the BOOSTEN bit of the SYSCFG\_CFGR1 register is cleared) and at least one of the analog peripherals (ADC, COMP, DAC, or OPAMP) is enabled.

### Workaround

Enable the I/O analog switch voltage booster, by setting the BOOSTEN bit of the SYSCFG\_CFGR1 register when  $V_{DDA}$  is below 2.4 V and  $V_{DD}$  is above 3 V.

## 2.2.8 Unstable LSI when it clocks RTC or CSS on LSE

### Description

The LSI clock can become unstable (duty cycle different from 50 %) and its maximum frequency can become significantly higher than 32 kHz, when:

- LSI clocks the RTC, or it clocks the clock security system (CSS) on LSE (which holds when the LSECSSON bit set), and
- the  $V_{DD}$  power domain is reset while the backup domain is not reset, which happens:
  - upon exiting Shutdown mode
  - if  $V_{BAT}$  is separate from  $V_{DD}$  and  $V_{DD}$  goes off then on
  - if  $V_{BAT}$  is tied to  $V_{DD}$  (internally in the package for products not featuring the VBAT pin, or externally) and a short (< 1 ms)  $V_{DD}$  drop under  $V_{DD}(\min)$  occurs

### Workaround

Apply one of the following measures:

- Clock the RTC with LSE or HSE/32, without using the CSS on LSE
- If LSI clocks the RTC or when the LSECSSON bit is set, reset the backup domain upon each  $V_{DD}$  power up (when the BORRSTF flag is set). If  $V_{BAT}$  is separate from  $V_{DD}$ , also restore the RTC configuration, backup registers and anti-tampering configuration.

## 2.2.9 HSI48 ready interrupt capability is not supported

### Description

HSI48 ready interrupt feature described in the reference manual is not supported. The bit HSI48RDYIE in the register RCC\_CIER is stuck at 0. It is not possible to set it to interrupt the CPU when the oscillator is ready.

### Workaround

After switching the HSI48 internal oscillator on by setting the bit HSI48ON of the RCC\_CRRCR register, poll the HSI48RDY flag of the RCC\_CRRCR register until it goes high, which indicates that the HSI48 oscillator is ready to provide the clock to peripherals.

## 2.2.10 FLASH\_ECCR corrupted upon reset or power-down occurring during flash memory program or erase operation

### Description

Reset or power-down occurring during a flash memory location program or erase operation, followed by a read of the same memory location, may lead to a corruption of the FLASH\_ECCR register content.

### Workaround

Under such condition, erase the page(s) corresponding to the flash memory location.

## 2.2.11 HSE oscillator long startup at low voltage

### Description

When  $V_{DD}$  is below 2.7 V, the HSE oscillator may take longer than specified to start up. Several hundred milliseconds might elapse before the HSERDY flag in the RCC\_CR register is set.

### Workaround

The following sequence is recommended:

1. Configure PH0 and PH1 as standard GPIOs in output mode and low-level state.
2. Enable the HSE oscillator.

## 2.2.12 SRAM write error

### Description

In rare cases, system reset occurring in a critical instant may upset the SRAM state machine. The first SRAM read or write access after the system reset then restores the normal operation of the SRAM for any subsequent accesses. However, if it is a write access, it fails to write data.

### Workaround

Upon system reset, make a dummy read access to each 16-Kbyte SRAM instance used by the application, through one of the following methods:

1. Place a dummy variable initialization, which allows the compiler to create the assembly code.
2. Use this initialization assembly code:

```
MOV32 R0, #0x20000000 //SRAM address
LDR R1, [R0, #+0] //read access
MOV32 R0, #0x20004000 //next SRAM instance
LDR R1, [R0, #+0] //dummy read, no consequence on R1 value
MOV32 R0, #0x20008000
LDR R1, [R0, #+0]
...
```

Follow the first method for SRAM instances with the parity check enabled. Follow the first or the second method for SRAM instances with the parity check disabled.

## 2.2.13 PC13 signal transitions disturb LSE

### Description

The PC13 port toggling disturbs the LSE clock.

### Workaround

None.

## 2.3 FW

### 2.3.1 Code segment unprotected if non-volatile data segment length is zero

#### Description

If during FW configuration the length of firewall-protected non-volatile data segment is set to zero through the LENG[21:8] bitfield of the FW\_NVDSL register, the firewall protection of code segment does not operate.

### Workaround

Always set the LENG[21:8] bitfield of the FW\_NVDSL register to a non-zero value, even if no firewall protection of data in the non-volatile data segment is required.

## 2.4 QUADSPI

### 2.4.1 First nibble of data not written after dummy phase

#### Description

The first nibble of data to be written to the external flash memory is lost when the following condition is met:

- QUADSPI is used in indirect write mode.
- At least one dummy cycle is used.

#### Workaround

Use alternate bytes instead of dummy phase to add latency between the address phase and the data phase. This works only if the number of dummy cycles to substitute corresponds to a multiple of eight bits of data.

Example:

- To substitute one dummy cycle, send one alternate byte (only possible in DDR mode with four data lines).
- To substitute two dummy cycles, send one alternate byte in SDR mode with four data lines.
- To substitute four dummy cycles, send two alternate bytes in SDR mode with four data lines, or one alternate byte in SDR mode with two data lines.
- To substitute eight dummy cycles, send one alternate byte in SDR mode with one data line.

### 2.4.2 Wrong data from memory-mapped read after an indirect mode operation

#### Description

The first memory-mapped read in indirect mode can yield wrong data if the QUADSPI peripheral enters memory-mapped mode with bits ADDRESS[1:0] of the QUADSPI\_AR register both set.

#### Workaround

Before entering memory-mapped mode, apply the following measure, depending on access mode:

- Indirect read mode: clear the QUADSPI\_AR register then issue an abort request to stop reading and to clear the BUSY bit.
- Indirect write mode: clear the QUADSPI\_AR register.

**Caution:** The QUADSPI\_DR register must not be written after clearing the QUADSPI\_AR register.

## 2.5 ADC

### 2.5.1 Writing ADCx\_JSQR when JADCSTART and JQDIS are set might lead to incorrect behavior

#### Description

Writing the ADCx\_JSQR register when there is an on-going injected conversion (JADCSTART = 1) might lead to unpredictable ADC behavior if the queues of context are not enabled (JQDIS = 1).

#### Workaround

None.

## 2.5.2 Wrong ADC result if conversion done late after calibration or previous conversion

### Description

The result of an ADC conversion done more than 1 ms later than the previous ADC conversion or ADC calibration might be incorrect.

### Workaround

Perform two consecutive ADC conversions in single, scan or continuous mode. Reject the result of the first conversion and only keep the result of the second.

## 2.5.3 Spurious temperature measurement due to spike noise

### Description

Depending on the MCU activity, internal interference may cause temperature-dependent spike noise on the temperature sensor output to the ADC, resulting in occasional spurious (outlying) temperature measurement.

### Workaround

Perform a series of measurements and process the acquired data samples such as to obtain a mean value not affected by the outlying samples.

For this, it is recommended to use interquartile mean (IQM) algorithm with at least 64 samples. IQM is based on rejecting the quarters (quartiles) of sample population with the lowest and highest values and on computing the mean value only using the remaining (interquartile) samples.

The acquired sample values are first sorted from lowest to highest, then the sample sequence is truncated by removing the lowest and highest sample quartiles.

Example:

**Table 6. Measurement result after IQM post-processing**

Data	Sample												Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
Acquired	17.2	10.92	9.56	2.12	9.82	10.72	10.6	3.5	9.46	9.78	9.5	1.1	8.69
Sorted	1.1	2.12	3.5	9.46	9.5	9.56	9.78	9.82	10.6	10.72	10.92	17.2	8.69
Truncated	-	-	-	9.46	9.5	9.56	9.78	9.82	10.6	-	-	-	9.79

The measurement result after the IQM post-processing in the example is 9.79. For consistent results, use a minimum of 64 samples. It is recommended to optimize the code performing the sort task such as to minimize its processing power requirements.

## 2.5.4 Selected external ADC inputs unduly clamped to $V_{DD}$ when all analog peripherals are disabled

### Description

When all analog peripherals (other than VREFBUF) are disabled, the GPIO(s) selected as ADC input(s) are unduly clamped (through a parasitic diode) to  $V_{DD}$  instead to  $V_{DDA}$ . As a consequence, the input voltage is limited to  $V_{DD} + 0.3$  V even if  $V_{DDA}$  is higher than  $V_{DD} + 0.3$  V.

*Note:* The selection of GPIOs as ADC inputs is done with the SQy and JSQy bitfields of the ADC\_SQRx and ADC\_JSQR registers, respectively.

*VREFBUF enable/disable has no impact to the issue described.*

### Workaround

Apply one of the following measures:

- Use  $V_{DDA}$  lower than  $V_{DD} + 0.3$  V.

- Keep at least one analog peripheral (other than VREFBUF) enabled if GPIOs are selected as ADC inputs.
- Deselect GPIOs as ADC inputs (by clearing ADC\_SQRx or/and ADC\_JSQR registers) when no analog peripheral (other than VREFBUF) is enabled.

## 2.6 COMP

### 2.6.1 Comparator outputs cannot be configured in open-drain

#### Description

Comparator outputs are always forced in push-pull mode whatever the GPIO output type configuration bit value.

#### Workaround

None.

### 2.6.2 COMP1 and COMP2 configuration lost with software reset

#### Description

The control and status registers of the comparators COMP1 and COMP2 (COMP1\_CSR and COMP2\_CSR) should be protected against software changes when the LOCK bit is set. Therefore, these registers should be reset only by a system reset. However, it is possible to reset these registers by setting the SYSCFGRST bit of the RCC\_APB2RSTR register.

#### Workaround

None.

## 2.7 TSC

### 2.7.1 Inhibited acquisition in short transfer phase configuration

#### Description

Some revisions of the reference manual may omit the information that the following configurations of the TSC\_CR register are forbidden:

- The PGPSC[2:0] bitfield set to 000 and the CTPL[3:0] bitfield to 0000 or 0001
- The PGPSC[2:0] bitfield set to 001 and the CTPL[3:0] bitfield to 0000

Failure to respect this restriction leads to an inhibition of the acquisition.

This is a documentation inaccuracy issue rather than a product limitation.

#### Workaround

No application workaround is required.

### 2.7.2 TSC signal-to-noise concern under specific conditions

#### Description

$V_{DD}$  equal to or greater than  $V_{DDA}$  may lead (depending on part) to some degradation of the signal-to-noise ratio on the TSC analog I/O group 2.

The lower are the sampling capacitor ( $C_S$ ) and the sensing electrode ( $C_X$ ) capacitances, the worse is the signal-to-noise ratio degradation.

### Workaround

Apply one of the following measures:

- Maximize C<sub>S</sub> capacitance.
- Use the analog I/O group 2 as active shield.

## 2.8 AES

### 2.8.1 Burst read or write accesses not supported

#### Description

Some revisions of the reference manual may omit the information that the AES peripheral does not support LDM, STM, LDRD and STRD instructions for successive multiple-data (burst) read and write accesses to a contiguous address block.

This is a documentation issue rather than a product limitation.

#### Workaround

No application workaround is required, provided that the multiple-data instructions are not used to access the AES peripheral.

*Note: To prevent compilers from generating LDM, STM, LDRD and STRD instructions to access the AES peripheral, organize the source code such as to avoid consecutive read or write accesses to neighboring addresses in lower-to-higher order. In case where consecutive read or write accesses to neighboring addresses cannot be avoided, order the source code such as to access higher address first.*

### 2.8.2 TAG computation in GCM encryption mode

#### Description

Some revisions of the reference manual may omit the following application guidelines for the device to correctly compute GCM encryption authentication tags when the input data in the last block is inferior to 128 bits.

During GCM encryption payload phase and before inserting a last plaintext block smaller than 128 bits, apply the following steps:

1. Disable the AES peripheral by clearing the EN bit of the AES\_CR register.
2. Change the mode to CTR by writing 010 to the CHMOD[2:0] bitfield of the AES\_CR register.
3. Pad the last block (smaller than 128 bits) with zeros to have a complete block of 128 bits, then write it into AES\_DINR register.
4. Upon encryption completion, read the 128-bit ciphertext from the AES\_DOUTR register and store it as intermediate data.
5. Change again the mode to GCM by writing 011 to the CHMOD[2:0] bitfield of the AES\_CR register.
6. Select Final phase by writing 11 to the GCMPH[1:0] bitfield of the AES\_CR register.
7. In the intermediate data, set to zero the bits corresponding to the padded bits of the last block of payload, then insert the resulting data into AES\_DINR register.
8. Wait for operation completion, and read data on AES\_DOUTR. This data is to be discarded.
9. Apply the normal Final phase as described in the datasheet

This is a documentation issue rather than a product limitation.

#### Workaround

No further application workaround is required, provided that these guidelines are respected.

### 2.8.3 CCM authentication mode not compliant with NIST CMAC

#### Description

Some revisions of the reference manual may omit the information that setting the CHMOD[2:0] bitfield to 100 selects the CCM authentication mode. It is not compliant with NIST CMAC, as defined in Special Publication 800-38B. In order to fully implement the CCM chaining as specified in NIST Special Publication 800-38C, the payload must first be encrypted or decrypted with the AES peripheral set in CTR mode (CHMOD[2:0] = 010), then the message associated data and payload authenticated with the AES peripheral set in CCM mode (CHMOD[2:0] = 100).

This is a documentation issue rather than a product limitation.

#### Workaround

No further application workaround is required, provided that these guidelines are respected.

### 2.8.4 Datatype initial configuration in GCM mode

#### Description

Some revisions of the reference manual may omit the information that GCM generated TAG is not correct if data swapping is not disabled in GCM init phase (GCMPLH[1:0] = 00) by setting the DATATYPE[1:0] bitfield of the AES\_CR register to zero.

This is a documentation issue rather than a product limitation.

#### Workaround

No further application workaround is required, provided that these guidelines are respected.

### 2.8.5 Wait until BUSY is low when suspending GCM encryption

#### Description

Some revisions of the reference manual may omit the information that when suspending the GCM encryption of a message, in the payload phase the BUSY flag of the AES\_SR register must be low before saving the AES\_SUSPxR registers in the memory.

This is a documentation issue rather than a product limitation.

#### Workaround

No further application workaround is required, provided that these guidelines are respected.

## 2.9 TIM

### 2.9.1 HSE/32 is not available for TIM16 input capture if RTC clock is disabled or other than HSE

#### Description

If the RTC clock is either disabled or other than HSE, the HSE/32 clock is not available for TIM16 input capture even if selected (bitfield TI1\_RMP[2:0] = 101 in the TIM16\_OR1 register).

#### Workaround

Apply the following procedure:

1. Enable the power controller clock (bit PWREN = 1 in the RCC\_APB1ENR1 register).
2. Disable the backup domain write protection (bit DBP = 0 in the PWR\_CR1 register).
3. Enable RTC clock and select HSE as clock source for RTC (bits RTCSEL[1:0] = 11 and bit RTCEN = 1 in the RCC\_BDCR register).
4. Select the HSE/32 as input capture source for TIM16 (bitfield TI1\_RMP[2:0] = 101 in the TIM16\_OR1 register).



Alternatively, use TIM17 that implements the same features as TIM16, and is not affected by the limitation described.

## 2.10 LPTIM

### 2.10.1 Device may remain stuck in LPTIM interrupt when entering Stop mode

#### Description

This limitation occurs when disabling the low-power timer (LPTIM).

When the user application clears the ENABLE bit in the LPTIM\_CR register within a small time window around one LPTIM interrupt occurrence, then the LPTIM interrupt signal used to wake up the device from Stop mode may be frozen in active state. Consequently, when trying to enter Stop mode, this limitation prevents the device from entering low-power mode and the firmware remains stuck in the LPTIM interrupt routine.

This limitation applies to all Stop modes and to all instances of the LPTIM. Note that the occurrence of this issue is very low.

#### Workaround

In order to disable a low power timer (LPTIMx) peripheral, do not clear its ENABLE bit in its respective LPTIM\_CR register. Instead, reset the whole LPTIMx peripheral via the RCC controller by setting and resetting its respective LPTIMxRST bit in RCC\_APBxRSTRz register.

### 2.10.2 Device may remain stuck in LPTIM interrupt when clearing event flag

#### Description

This limitation occurs when the LPTIM is configured in interrupt mode (at least one interrupt is enabled) and the software clears any flag in LPTIM\_ISR register by writing its corresponding bit in LPTIM\_ICR register. If the interrupt status flag corresponding to a disabled interrupt is cleared simultaneously with a new event detection, the set and clear commands might reach the APB domain at the same time, leading to an asynchronous interrupt signal permanently stuck high.

This issue can occur either during an interrupt subroutine execution (where the flag clearing is usually done), or outside an interrupt subroutine.

Consequently, the firmware remains stuck in the LPTIM interrupt routine, and the device cannot enter Stop mode.

#### Workaround

To avoid this issue, it is strongly advised to follow the recommendations listed below:

- Clear the flag only when its corresponding interrupt is enabled in the interrupt enable register.
- If for specific reasons, it is required to clear some flags that have corresponding interrupt lines disabled in the interrupt enable register, it is recommended to clear them during the current subroutine prior to those which have corresponding interrupt line enabled in the interrupt enable register.
- Flags must not be cleared outside the interrupt subroutine.

*Note:* The standard clear sequence implemented in the HAL\_LPTIM\_IRQHandler in the STM32Cube is considered as the proper clear sequence.

### 2.10.3 LPTIM1 outputs cannot be configured as open-drain

#### Description

LPTIM1 outputs are set in push-pull mode regardless of the configuration of corresponding GPIO outputs.

#### Workaround

None.

## 2.11 RTC and TAMP

### 2.11.1 RTC calendar registers are not locked properly

#### Description

When reading the calendar registers with BYPSHAD = 0, the RTC\_TR and RTC\_DR registers may not be locked after reading the RTC\_SSR register. This happens if the read operation is initiated one APB clock period before the shadow registers are updated. This can result in a non-consistency of the three registers. Similarly, the RTC\_DR register can be updated after reading the RTC\_TR register instead of being locked.

#### Workaround

Apply one of the following measures:

- Use BYPSHAD = 1 mode (bypass shadow registers), or
- If BYPSHAD = 0, read SSR again after reading SSR/TR/DR to confirm that SSR is still the same, otherwise read the values again.

### 2.11.2 RTC interrupt can be masked by another RTC interrupt

#### Description

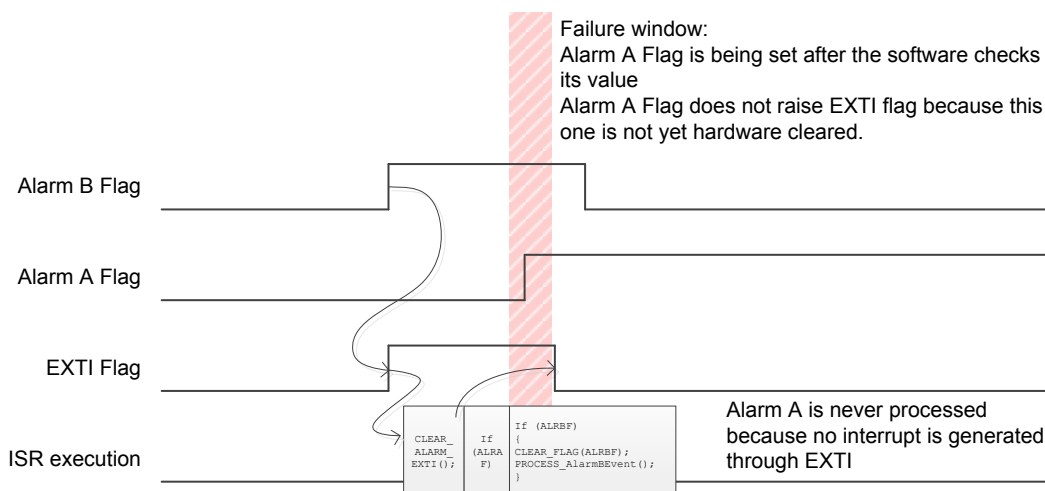
One RTC interrupt request can mask another RTC interrupt request if they share the same EXTI configurable line. For example, interrupt requests from Alarm A and Alarm B or those from tamper and timestamp events are OR-ed to the same EXTI line (refer to the *EXTI line connections* table in the *Extended interrupt and event controller (EXTI)* section of the reference manual).

The following code example and figure illustrate the failure mechanism: The Alarm A event is lost (fails to generate interrupt) as it occurs in the failure window, that is, after checking the Alarm A event flag but before the effective clear of the EXTI interrupt flag by hardware. The effective clear of the EXTI interrupt flag is delayed with respect to the software instruction to clear it.

Alarm interrupt service routine:

```
void RTC_Alarm_IRQHandler(void)
{
    CLEAR_ALARM_EXTI(); /* Clear the EXTI line flag for RTC alarms*/
    If(ALRAF) /* Check if Alarm A triggered ISR */
    {
        CLEAR_FLAG(ALRAF); /* Clear the Alarm A interrupt pending bit */
        PROCESS_AlarmAEvent(); /* Process Alarm A event */
    }
    If(ALRBF) /* Check if Alarm B triggered ISR */
    {
        CLEAR_FLAG(ALRBF); /* Clear the Alarm B interrupt pending bit */
        PROCESS_AlarmBEvent(); /* Process Alarm B event */
    }
}
```

Figure 1. Masked RTC interrupt



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### Workaround

In the interrupt service routine, apply three consecutive event flag checks - source one, source two, and source one again, as in the following code example:

```
void RTC_Alarm_IRQHandler(void)
{
    CLEAR_ALARM_EXTI(); /* Clear the EXTI's line Flag for RTC Alarm */
    If(ALRAF) /* Check if AlarmA triggered ISR */
    {
        CLEAR_FLAG(ALRAF); /* Clear the AlarmA interrupt pending bit */
        PROCESS_AlarmAEvent(); /* Process AlarmA Event */
    }
    If(ALRBF) /* Check if AlarmB triggered ISR */
    {
        CLEAR_FLAG(ALRBF); /* Clear the AlarmB interrupt pending bit */
        PROCESS_AlarmBEvent(); /* Process AlarmB Event */
    }
    If(ALRAF) /* Check if AlarmA triggered ISR */
    {
        CLEAR_FLAG(ALRAF); /* Clear the AlarmA interrupt pending bit */
        PROCESS_AlarmAEvent(); /* Process AlarmA Event */
    }
}
```

### 2.11.3 Calendar initialization may fail in case of consecutive INIT mode entry

#### Description

If the INIT bit of the RTC\_ISR register is set between one and two RTCCLK cycles after being cleared, the INITF flag is set immediately instead of waiting for synchronization delay (which should be between one and two RTCCLK cycles), and the initialization of registers may fail.

Depending on the INIT bit clearing and setting instants versus the RTCCLK edges, it can happen that, after being immediately set, the INITF flag is cleared during one RTCCLK period then set again. As writes to calendar registers are ignored when INITF is low, a write during this critical period might result in the corruption of one or more calendar registers.

#### Workaround

After exiting the initialization mode, clear the BYPSHAD bit (if set) then wait for RSF to rise, before entering the initialization mode again.

*Note:* It is recommended to write all registers in a single initialization session to avoid accumulating synchronization delays.

#### 2.11.4 RTC\_REFIN and RTC\_OUT on PB2 not operating in Stop 2 mode

##### Description

In Stop 2 low-power mode, the RTC\_REFIN function does not operate and the RTC\_OUT function does not operate if mapped on the PB2 pin.

##### Workaround

Apply one of the following measures:

- Use Stop 1 mode instead of Stop 2. This ensures the operation of both functions.
- Map RTC\_OUT to the PC13 pin. This ensures the operation of the RTC\_OUT function in either low-power mode. However, it has no effect to the RTC\_REFIN function.

#### 2.11.5 Setting GPIO properties of PC13 used as RTC\_ALARM open-drain output

##### Description

Some reference manual revisions may omit the information that the PC13 GPIO must be set as input when the RTC\_OR register configures PC13 as open-drain output of the RTC\_ALARM signal.

*Note:* Enabling the internal pull-up function through the PC13 GPIO settings allows sparing an external pull-up resistor. This is a documentation issue rather than a product limitation.

##### Workaround

No application workaround is required provided that the described GPIO setting is respected.

## 2.12 I2C

#### 2.12.1 10-bit master mode: new transfer cannot be launched if first part of the address is not acknowledged by the slave

##### Description

An I<sup>2</sup>C-bus master generates STOP condition upon non-acknowledge of I<sup>2</sup>C address that it sends. This applies to 7-bit address as well as to each byte of 10-bit address.

When the MCU set as I<sup>2</sup>C-bus master transmits a 10-bit address of which the first byte (5-bit header + 2 MSBs of the address + direction bit) is not acknowledged, the MCU duly generates STOP condition but it then cannot start any new I<sup>2</sup>C-bus transfer. In this spurious state, the NACKF flag of the I2C\_ISR register and the START bit of the I2C\_CR2 register are both set, while the START bit should normally be cleared.

##### Workaround

In 10-bit-address master mode, if both NACKF flag and START bit get simultaneously set, proceed as follows:

1. Wait for the STOP condition detection (STOPF = 1 in I2C\_ISR register).
2. Disable the I2C peripheral.
3. Wait for a minimum of three APB cycles.
4. Enable the I2C peripheral again.

#### 2.12.2 Wrong behavior in Stop mode

##### Description

The correct use of the I2C peripheral is to disable it (PE = 0) before entering Stop mode, and re-enable it when back in Run mode.

Some reference manual revisions may omit this information.

Failure to respect the above while the MCU operating as slave or as master in multi-master topology enters Stop mode during a transfer ongoing on the I<sup>2</sup>C-bus may lead to the following:

1. BUSY flag is wrongly set when the MCU exits Stop mode. This prevents from initiating a transfer in master mode, as the START condition cannot be sent when BUSY is set.
2. If clock stretching is enabled (NOSTRETCH = 0), the SCL line is pulled low by I2C and the transfer stalled as long as the MCU remains in Stop mode.  
The occurrence of such condition depends on the timing configuration, peripheral clock frequency, and I<sup>2</sup>C-bus frequency.

This is a description inaccuracy issue rather than a product limitation.

#### Workaround

No application workaround is required.

### 2.12.3 Wrong data sampling when data setup time ( $t_{\text{SU, DAT}}$ ) is shorter than one I2C kernel clock period

#### Description

The I<sup>2</sup>C-bus specification and user manual specify a minimum data setup time ( $t_{\text{SU, DAT}}$ ) as:

- 250 ns in Standard mode
- 100 ns in Fast mode
- 50 ns in Fast mode Plus

The device does not correctly sample the I<sup>2</sup>C-bus SDA line when  $t_{\text{SU, DAT}}$  is smaller than one I2C kernel clock (I<sup>2</sup>C-bus peripheral clock) period: the previous SDA value is sampled instead of the current one. This can result in a wrong receipt of slave address, data byte, or acknowledge bit.

#### Workaround

Increase the I2C kernel clock frequency to get I2C kernel clock period within the transmitter minimum data setup time. Alternatively, increase transmitter's minimum data setup time. If the transmitter setup time minimum value corresponds to the minimum value provided in the I<sup>2</sup>C-bus standard, the minimum I2CCLK frequencies are as follows:

- In Standard mode, if the transmitter minimum setup time is 250 ns, the I2CCLK frequency must be at least 4 MHz.
- In Fast mode, if the transmitter minimum setup time is 100 ns, the I2CCLK frequency must be at least 10 MHz.
- In Fast-mode Plus, if the transmitter minimum setup time is 50 ns, the I2CCLK frequency must be at least 20 MHz.

### 2.12.4 Spurious bus error detection in master mode

#### Description

In master mode, a bus error can be detected spuriously, with the consequence of setting the BERR flag of the I2C\_SR register and generating bus error interrupt if such interrupt is enabled. Detection of bus error has no effect on the I<sup>2</sup>C-bus transfer in master mode and any such transfer continues normally.

#### Workaround

If a bus error interrupt is generated in master mode, the BERR flag must be cleared by software. No other action is required and the ongoing transfer can be handled normally.

### 2.12.5 Last-received byte loss in reload mode

#### Description

If in master receiver mode or slave receive mode with SBC = 1 the following conditions are all met:

- I<sup>2</sup>C-bus stretching is enabled (NOSTRETCH = 0)
- RELOAD bit of the I2C\_CR2 register is set
- NBYTES bitfield of the I2C\_CR2 register is set to N greater than 1
- byte N is received on the I<sup>2</sup>C-bus, raising the TCR flag
- N - 1 byte is not yet read out from the data register at the instant TCR is raised,

then the SCL line is pulled low (I<sup>2</sup>C-bus clock stretching) and the transfer of the byte N from the shift register to the data register inhibited until the byte N-1 is read and NBYTES bitfield reloaded with a new value, the latter of which also clears the TCR flag. As a consequence, the software cannot get the byte N and use its content before setting the new value into the NBYTES field.

#### Workaround

- In master mode or in slave mode with SBC = 1, use the reload mode with NBYTES = 1.
- In master receiver mode, if the number of bytes to transfer is greater than 255, do not use the reload mode. Instead, split the transfer into sections not exceeding 255 bytes and separate them with repeated START conditions.
- Make sure, for example through the use of DMA, that the byte N - 1 is always read before the TCR flag is raised.

The last workaround in the list must be evaluated carefully for each application as the timing depends on factors such as the bus speed, interrupt management, software processing latencies, and DMA channel priority.

### 2.12.6 Spurious master transfer upon own slave address match

#### Description

When the device is configured to operate at the same time as master and slave (in a multi-master I<sup>2</sup>C-bus application), a spurious master transfer may occur under the following condition:

- Another master on the bus is in process of sending the slave address of the device (the bus is busy).
- The device initiates a master transfer by bit set before the slave address match event (the ADDR flag set in the I2C\_ISR register) occurs.
- After the ADDR flag is set:
  - the device does not write I2C\_CR2 before clearing the ADDR flag, or
  - the device writes I2C\_CR2 earlier than three I2C kernel clock cycles before clearing the ADDR flag

In these circumstances, even though the START bit is automatically cleared by the circuitry handling the ADDR flag, the device spuriously proceeds to the master transfer as soon as the bus becomes free. The transfer configuration depends on the content of the I2C\_CR2 register when the master transfer starts. Moreover, if the I2C\_CR2 is written less than three kernel clocks before the ADDR flag is cleared, the I2C peripheral may fall into an unpredictable state.

#### Workaround

Upon the address match event (ADDR flag set), apply the following sequence.

Normal mode (SBC = 0):

1. Set the ADDRCONF bit.
2. Before Stop condition occurs on the bus, write I2C\_CR2 with the START bit low.

Slave byte control mode (SBC = 1):

1. Write I2C\_CR2 with the slave transfer configuration and the START bit low.
2. Wait for longer than three I2C kernel clock cycles.
3. Set the ADDRCONF bit.
4. Before Stop condition occurs on the bus, write I2C\_CR2 again with its current value.

The time for the software application to write the I2C\_CR2 register before the Stop condition is limited, as the clock stretching (if enabled), is aborted when clearing the ADDR flag.

Polling the BUSY flag before requesting the master transfer is not a reliable workaround as the bus may become busy between the BUSY flag check and the write into the I2C\_CR2 register with the START bit set.

### 2.12.7 I2C3 analog filter activation requires that both PC0/PC1 are configured as I2C3 alternate function

#### Description

I2C3 analog filters can be enabled for PC0 and/or PC1 only if both IOs are configured in I2C3 alternate function mode. For example, for using PC0 as clock and PB4 as data, PC0 filter can be enabled only if PC1 is configured in I2C3 alternate function mode, too.

#### Workaround

Use both PC0/PC1 as I2C3 alternate functions if the analog filter is needed.

## 2.13 USART

### 2.13.1 RTS is active while RE = 0 or UE = 0

#### Description

The RTS line is driven low as soon as RTSE bit is set, even if the USART is disabled (UE = 0) or the receiver is disabled (RE = 0), that is, not ready to receive data.

#### Workaround

Upon setting the UE and RE bits, configure the I/O used for RTS into alternate function.

## 2.14 LPUART

### 2.14.1 LPUART1 outputs cannot be configured as open-drain

#### Description

LPUART1 outputs are set in push-pull mode regardless of the configuration of corresponding GPIO outputs.

#### Workaround

None.

## 2.15 SPI

### 2.15.1 BSY bit may stay high at the end of data transfer in slave mode

#### Description

BSY flag may sporadically remain high at the end of a data transfer in slave mode. This occurs upon coincidence of internal CPU clock and external SCK clock provided by master.

In such an event, if the software only relies on BSY flag to detect the end of SPI slave data transaction (for example to enter low-power mode or to change data line direction in half-duplex bidirectional mode), the detection fails.

As a conclusion, the BSY flag is unreliable for detecting the end of data transactions.

#### Workaround

Depending on SPI operating mode, use the following means for detecting the end of transaction:

- When NSS hardware management is applied and NSS signal is provided by master, use NSS flag.

- In SPI receiving mode, use the corresponding RXNE event flag.
- In SPI transmit-only mode, use the BSY flag in conjunction with a timeout expiry event. Set the timeout such as to exceed the expected duration of the last data frame and start it upon TXE event that occurs with the second bit of the last data frame. The end of the transaction corresponds to either the BSY flag becoming low or the timeout expiry, whichever happens first.

Prefer one of the first two measures to the third as they are simpler and less constraining.

Alternatively, apply the following sequence to ensure reliable operation of the BSY flag in SPI transmit mode:

1. Write last data to data register.
2. Poll the TXE flag until it becomes high, which occurs with the second bit of the data frame transfer.
3. Disable SPI by clearing the SPE bit mandatorily before the end of the frame transfer.
4. Poll the BSY bit until it becomes low, which signals the end of transfer.

*Note:* The alternative method can only be used with relatively fast CPU speeds versus relatively slow SPI clocks or/and long last data frames. The faster is the software execution, the shorter can be the duration of the last data frame.

### 2.15.2 Wrong CRC in full-duplex mode handled by DMA with imbalanced setting of data counters

#### Description

When SPI is handled by DMA in full-duplex master or slave mode with CRC enabled, the CRC computation may temporarily freeze for the ongoing frame, which results in corrupted CRC.

This happens when the receive counter reaches zero upon the receipt of the CRC pattern (as the receive counter was set to a value greater, by CRC length, than the transmit counter). An internal signal dedicated to receive-only mode is left unduly pending. Consequently, the signal can cause the CRC computation to freeze during a next transaction in which DMA TXE event service is accidentally delayed (for example, due to DMA servicing a request from another channel).

#### Workaround

Apply one of the following measures prior to each full-duplex SPI transaction:

- Set the DMA transmission and reception data counters to equal values. Upon the transaction completion, read the CRC pattern out from RxFIFO separately by software.
- Reset the SPI peripheral via peripheral reset register.

### 2.15.3 CRC error in SPI slave mode if internal NSS changes before CRC transfer

#### Description

Some reference manual revisions may omit the information that the device operating as SPI slave must be configured in software NSS control if the SPI master pulses the NSS (for example in NSS pulse mode).

Otherwise, the transition of the internal NSS signal after the CRCNEXT flag is set might result in wrong CRC value computed by the device and, as a consequence, in a CRC error. As a consequence, the NSS pulse mode cannot be used along with the CRC function.

This is a documentation error rather than a product limitation.

#### Workaround

No application workaround is required as long as the device operating as SPI slave is duly configured in software NSS control.



## 2.15.4 SPI master communication failure at high SYSCLK frequency within the specified voltage range

### Description

The SPI peripheral configured as master may spuriously generate an extra clock pulse when:

- the CPHA bit of the SPIx\_CR1 register is set, and
- the BR[2:0] bitfield of the SPIx\_CR1 register is at 001 ( $f_{PCLK}$  divided by four), and
- the SPI clock is about to be suspended or stopped (which occurs at the end of a data frame), and
- the SYSCLK frequency exceeds the values as per the following table

This leads to a de-synchronization of the SPI data flow.

**Table 7. Maximum  $f_{SYSCLK}$  for safe SPI operation**

SPI instance	$f_{SYSCLK(max)}$ [MHz]	
	Range 1	Range 2
SPI1	65.1	>26 (OK)
SPI2	70.2	>26 (OK)
SPI3	60.2	>26 (OK)

### Workaround

Depending on the application constraints, apply one of the following measures:

- Set the SYSCLK frequency to within the limits in the table.
- Choose a combination of AHB and APB prescaler settings that allows setting the BR[2:0] bitfield to a value other than 001 ( $f_{PCLK}/4$ ).
- Use another SPI instance on another APB if this can avoid setting BR[2:0] to 001. If the other instance is available on the same pins through the GPIO alternate function, the same application hardware can be used.

## 2.16 SDMMC

### 2.16.1 Wrong CCRCFAIL status after a response without CRC is received

#### Description

The CRC is calculated even if the response to a command does not contain any CRC field. As a consequence, after the SDIO command IO\_SEND\_OP\_COND (CMD5) is sent, the CCRCFAIL bit of the SDMMC\_STA register is set.

#### Workaround

The CCRCFAIL bit in the SDMMC\_STA register shall be ignored by the software. CCRCFAIL must be cleared by setting CCRCFAILC bit of the SDMMC\_ICR register after reception of the response to the CMD5 command.

### 2.16.2 MMC stream write of less than seven bytes does not work correctly

#### Description

Stream write initiated with WRITE\_DAT\_UNTIL\_STOP command (CMD20) does not define the amount of data bytes to store. The card keeps storing data coming in from the SDMMC host until it gets a valid STOP\_TRANSMISSION (CMD12) command. The commands are streamed on a line separate from data line, with common clock line.

As the STOP\_TRANSMISSION command is 48-bit long and due to the bus protocol, the STOP\_TRANSMISSION command start bit must be advanced by 50 clocks with respect to the stop bit of the data bitstream.

Therefore, for small data chunks of up to six bytes, SDMMC hosts should normally operate such that, the start of the STOP\_TRANSMISSION (CMD12) command streaming precedes the start of the data streaming.

The device duly anticipates the STOP\_TRANSMISSION command streaming start, with respect to the data bitstream end. WAITPEND (bit 9 of SDMMC\_CMD register) must be set for this mechanism to operate.

However, a failure occurs in case of small data chunks of up to six bytes. Instead of starting the STOP\_TRANSMISSION command 50 clocks ahead of the data bitstream stop bit, the SDMMC peripheral on the device starts the command along with the first bit of the data bitstream. As the command is longer than the data, it ends a number of clocks behind the data that the software intended to store onto the card by setting the DATALENGTH register. During the clocks in excess, the SDMMC peripheral keeps the data line in logical-one level.

As a consequence, the card intercepts more data and updates more memory locations than the number set in DATALENGTH. The spuriously updated locations of memory receive 0xFF values.

#### Workaround

Do not use stream write WRITE\_DAT\_UNTIL\_STOP command (CMD20) with DATALENGTH set to less than seven. Instead, use SET\_BLOCKLEN command (CMD16) followed with single-block write command WRITE\_BLOCK (CMD24), with a desired block length.

## 2.17 bxCAN

### 2.17.1 bxCAN time-triggered communication mode not supported

#### Description

The time-triggered communication mode described in the reference manual is not supported. As a result, timestamp values are not available. The TTCM bit of the CAN\_MCR register must be kept cleared (time-triggered communication mode disabled).

#### Workaround

None.

## Important security notice

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## Revision history

**Table 8. Document revision history**

Date	Version	Changes
18-Apr-2016	1	Initial release.
05-Sep-2016	2	<b>Added:</b> <ul style="list-style-type: none"> <li>PCPROP area within a single flash memory page becomes unprotected at RDP change from level1 to level0</li> <li>Spurious bus error detection in master mode</li> <li>Inhibited acquisition in short transfer phase configuration</li> </ul>
03-Dec-2016	3	<b>Added:</b> <ul style="list-style-type: none"> <li>Silicon revision Z</li> <li>MSI frequency overshoot upon Stop mode exit</li> <li>Internal voltage reference corrupted upon Stop mode entry with temperature sensing enabled</li> <li>Wrong data can be read in memory-mapped after an indirect mode operation</li> <li>First nibble of data is not written after dummy phase</li> <li>10-bit master mode: new transfer cannot be launched if first part of the address has not been acknowledged by the slave</li> </ul> <b>Modified:</b> <ul style="list-style-type: none"> <li>Document structure: cover page, titles, legend, removal of the list of tables, Table 3: Summary of device limitations</li> <li>The order of functions aligned with the reference manual</li> <li>JTAG function replaced with more general DBG</li> <li>BSY bit may stay high at the end of a data transfer in slave mode</li> </ul>
27-Nov-2018	4	<b>Added:</b> <ul style="list-style-type: none"> <li>Table of documentation errata</li> <li>VDIV or VSQRT instructions might not complete correctly when very short ISRs are used</li> <li>Store immediate overlapping exception return operation might vector to incorrect interrupt</li> <li>Unstable LSI when it clocks RTC or CSS on LSE</li> <li>First double-word of flash memory corrupted upon reset or power down while eprogramming</li> <li>Code segment unprotected if nonvolatile data segment length is zero</li> <li>Writing ADCx_JSQR when JADCSTART and JQDIS are set might lead to incorrect behavior</li> <li>CCM authentication mode not compliant with NIST CMAC to Wait until BUSY is low when suspending GCM encryption</li> <li>Spurious temperature measurement due to spike noise</li> <li>MCU may remain stuck in LPTIM interrupt when entering Stop mode</li> <li>RTC and TAMP with four limitations and one documentation erratum</li> <li>Last-received byte loss in reload mode</li> </ul> <b>Added:</b> <ul style="list-style-type: none"> <li>Spurious master transfer upon own slave address match</li> <li>nRTS is active while RE = 0 or UE = 0</li> <li>Wrong CRC in full-duplex mode handled by DMA with imbalanced setting of data counters</li> <li>CRC error in SPI slave mode if internal NSS changes before CRC transfer</li> </ul>

Date	Version	Changes
		<b>Modified:</b> <ul style="list-style-type: none"> <li>• HSI48 ready interrupt capability is not supported and Full JTAG configuration without NJTRST pin cannot be used moved to <a href="#">System</a></li> <li>• Wrong data from memory-mapped read after an indirect mode operation</li> <li>• Wrong ADC result if conversion done late after calibration or previous conversion</li> <li>• Burst read or write accesses not supported and TAG computation in GCM encryption mode moved to documentation errata table</li> <li>• Wrong behavior in Stop mode when wakeup from Stop mode is disabled in I2C and Inhibited acquisition in short transfer phase configuration modified and moved to documentation errata table</li> </ul>
31-Jul-2019	5	<b>Added:</b> <ul style="list-style-type: none"> <li>• <a href="#">Spurious brown-out reset after short run sequence</a></li> <li>• <a href="#">SPI master communication failure at high SYSCLK frequency within the specified voltage range</a></li> </ul> <b>Modified:</b> <ul style="list-style-type: none"> <li>• <a href="#">reference to Unstable LSI when it clocks RTC or CSS on LSE added to Table 3</a></li> </ul>
28-May-2021	6	<b>Added:</b> <ul style="list-style-type: none"> <li>• <a href="#">FLASH_ECCR corrupted upon reset or power-down occurring during flash memory program or erase operation</a></li> <li>• <a href="#">HSE oscillator long startup at low voltage</a></li> <li>• <a href="#">TSC signal-to-noise concern under specific conditions</a></li> </ul> <b>Removed:</b> <i>First double-word of flash memory corrupted upon reset or power-down while programming</i>
10-May-2022	7	Added erratum <a href="#">SRAM write error</a> . Updated status from P to A for erratum <a href="#">Wrong CCRCFAIL status after a response without CRC is received</a> . Added Section Important security notice.
20-Feb-2023	8	Added erratum <a href="#">PC13 signal transitions disturb LSE</a> . Modified errata: <ul style="list-style-type: none"> <li>• <a href="#">SRAM write error</a></li> <li>• <a href="#">SPI master communication failure at high SYSCLK frequency within the specified voltage range</a> - now applicable to high <math>f_{SYSCLK}</math> condition not only to the specific case of high <math>f_{PCLK} = f_{SYSCLK}</math>. Re-qualified to A and a workaround described.</li> </ul>

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