Errata Sheet

Rel. 1.7, 2021-11-04

Device **TC33x/TC32x**

Marking/Step **(E)ES-AA, AA**

Package **see Data Sheet**

10300AERRA

This Errata Sheet describes the deviations from the current user documentation.

Table 1 Current Documentation[1)]

AURIX™ TC3xx User's Manual	V1.2.0	2019-04
AURIX™ TC33x/TC32x Appendix to User's Manual	V1.2.0	2019-04
TC33x/TC32x AA-Step Data Sheet	V1.1	2021-03
TriCore TC1.6.2 Core Architecture Manual: - Core Architecture (Vol. 1) - Instruction Set (Vol. 2)	 V1.2.2 V1.2.2	 2020-01-15 2020-01-15
AURIX™ TC3xx Safety Manual	V1.11	10/2020

1) Newer versions replace older versions, unless specifically noted otherwise.

Make sure you always use the corresponding documentation for this device (User's Manual, Data Sheet, Documentation Addendum (if applicable), TriCore Architecture Manual, Errata Sheet) available in category 'Documents' at **www.infineon.com/AURIX** and **www.myInfineon.com**.

Conventions used in this document

Each erratum identifier follows the pattern **Module_Arch.TypeNumber**:

- **Module**: subsystem, peripheral, or function affected by the erratum
- **Arch**: microcontroller architecture where the erratum was initially detected
  - **AI**: Architecture Independent
  - **TC**: TriCore

- **Type**: category of deviation
  - **[none]**: Functional Deviation
  - **P**: Parametric Deviation
  - **H**: Application Hint
  - **D**: Documentation Update
- **Number**: ascending sequential number within the three previous fields. As this sequence is used over several derivatives, including already solved deviations, gaps inside this enumeration can occur.

Notes

1. This Errata Sheet applies to all temperature and frequency versions and to all memory size variants, unless explicitly noted otherwise. For a synopsis of the available variants, see the latest Data Sheet/User's Manual and the addendum "AURIX™ TC3x Variants" of the corresponding TC3x device.
   This Errata Sheet covers several device versions. If an issue is related to a particular module, and this module is not specified for a specific device version, this issue does not apply to this device version.
   E.g. issues with identifier "EBU" do not apply to devices where no EBU is specified, and issues with identifier "RIF" only apply to "ADAS" devices.
2. Devices marked with EES or ES are engineering samples which may not be completely tested in all functional and electrical characteristics, therefore they should be used for evaluation only.
   The specific test conditions for EES and ES are documented in a separate Status Sheet.
3. Some of the errata have workarounds which are possibly supported by the tool vendors. Some corresponding compiler switches need possibly to be set. Please see the respective documentation of your compiler.
   For effects of issues related to the on-chip debug system, see also the documentation of the debug tool vendor.

1 History List / Change Summary

Table 2 History List

Version	Date	Remark
1.0	2020-01-17	First version for TC33x step AA
1.1	2020-03-31	Update: • TC32x included • New/updated text modules see column “Change” in tables 3..5 of errata sheet V1.1 • Removed: – CPU_TC.H016 (List of OS and I/O Privileged Instructions - Documentation Update): updated description in TriCore TC1.6.2 Core Architecture Manual V1.2.1, Vol. 2 Instruction Set, table 14 – GTM_TC.H020 (GTM can cause unintended bus errors after enabling when SPB or GTM frequency is very low): does not apply to this design step
1.2	2020-07-06	Update: • New/updated text modules see column “Change” in tables 3..5 of errata sheet V1.2
1.3	2020-10-23	Update: • New/updated text modules see column “Change” in tables 3..5 of errata sheet V1.3 • Text module SCR_TC.022 (Effect of application or system reset and warm PORST on MC77_ECCD and MC78_ECCD for SCR RAMs) moved from chapter “Application Hints” to chapter “Functional Problems”

Table 2 History List (cont'd)

Version	Date	Remark
1.3	...	... continued: • Removed: – SAFETY_TC.H001 (Features intended for development only – Documentation update to Safety Manual) – SAFETY_TC.H003 (ESM[SW]:EDSADC: VAREF_PLAUSIBILITY and ESM[SW]: EVADC:VAREF_ PLAUSIBILITY – Additional information) – SAFETY_TC.H004 (ESM[HW]:PMS: VEXT_VEVRSB_OVERVOLTAGE – Wording update) >> updated description in TC3xx Safety Manual V1.11
1.4	2021-01-22	Update: • New/updated text modules see column "Change" in tables 3..5 of errata sheet V1.4
1.5	2021-04-22	Update: • New/updated text modules see column "Change" in tables 3..5 of errata sheet V1.5 – Text modules already published in TC3xx Errata Advance Information 2021_02: MCMCAN_AI.022, SMU_TC.H012 – Text modules already published in TC3xx Errata Advance Information 2021_03: FlexRay_TC.H004, SCR_TC.023, SENT_TC.H007 • Removed SCU_TC.032, included description in update of SCU_TC.031 (Bits SCU_STSTAT.HWCFGx (x=1-5) could have an unexpected value in application if pins HWCFGx are left unconnected)

Table 2 History List (cont'd)

Version	Date	Remark
1.6	2021-07-23	Update: • New/updated text modules see column "Change" in tables 3..5 of errata sheet V1.6 – Text modules already published in TC3xx Errata Advance Information 2021_05: GTM_AI.364, GTM_AI.370, GTM_AI.374..376 – Text modules already published in TC3xx Errata Advance Information 2021_06: FLASH_TC.055, MCMCAN_TC.H008, MTU_TC.018, PMS_TC.015
1.7	2021-11-04	Update: • New/updated text modules see column "Change" in tables 3..5 – Text modules already published in TC3xx Errata Advance Information 2021-09: FLASH_TC.056, GTM_AI.358, MCMCAN_AI.023, MEMMAP_TC.001, PADS_TC.H007, SAFETY_TC.023, SAFETY_TC.024 • Table 2 (History List) of errata sheet V1.6: corrected "GTM.AI.*" to "GTM_AI.*"

Note: Changes to the previous errata sheet version are particularly marked in column "Change" in the following tables.

Table 3 Functional Deviations

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BROM_TC.016	Uncorrectable ECC error in Boot Mode Headers		23
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Table 3 Functional Deviations (cont'd)

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FlexRay_AI.101	READY command accepted in READY state		44
FlexRay_AI.102	Slot Status vPOC!SlotMode is reset immediately when entering HALT state		45
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GTM_AI.254	TIM TDU: TDU_STOP=b101 not functional		51
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Table 3 Functional Deviations (cont'd)

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Table 3 Functional Deviations (cont'd)

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Table 3 Functional Deviations (cont'd)

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Table 3 Functional Deviations (cont'd)

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Table 3 Functional Deviations (cont'd)

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Table 5 Application Hints

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2 Functional Deviations

BROM_TC.013 CAN BSL does not send error message if no valid baudrate is detected

If the CAN Bootstrap loader (BSL) is unable to determine the baudrate from the initialization message sent by the host, it does not send the error message as defined in table “Error message (No baudrate detected)” in chapter “AURIX™ TC3xx Platform Firmware”, but enters an endless loop with no activity on external pins.

Workaround

If the external host does not receive Acknowledgment Message 1 from the CAN BSL within the expected time (~5 ms), it should check the integrity of the connection, and then may reset the TC3xx to restart the boot procedure.

BROM_TC.014 Lockstep Comparator Alarm for CPU0 after Warm PORST, System or Application Reset if Lockstep is disabled

Lockstep monitoring may be disabled in the Boot Mode Header structure (BMHD) for each CPUx with lockstep functionality (including CPU0). The startup software (SSW) will initially re-enable lockstep upon the next reset trigger.

If lockstep is disabled for CPU0, and the next reset is a warm PORST, System or Application reset, a lockstep comparator alarm will be raised for CPU0.

Note: This effect does not occur for CPUx, x>0.

Workaround

Do not disable lockstep for CPU0, always keep lockstep on CPU0 enabled.

Non-safety applications may ignore the lockstep comparator alarm for CPU0.

BROM_TC.016 Uncorrectable ECC error in Boot Mode Headers

If one or more boot mode headers UCB_BMHDx_ORIG or UCB_BMHDx_COPY contain an uncorrectable ECC error (4-bit error) in the BMI, BMHDID, STAD, CRCBMHD or CRCBMHD_N fields, firmware will end up in an irrecoverable state resulting in a device not being able to boot anymore.

This may happen in the following scenarios:

- Power-loss during BMHD reprogramming or erase
- Over-programming of complete BMHD contents.

Workaround

- Ensure continuous power-supply during BMHD reprogramming and erase using power monitoring including appropriate configuration.
- Avoid over-programming of BMHD contents.
- Ensure that also in any BMHDx_ORIG or _COPY unused in the application, the above fields are in a defined ECC-error free state (e.g. clear them to 0).

CCU_TC.004 Oscillator supervision – Documentation update for register OSCCON

The formulas for the threshold frequencies f_{LV}, f_{HV} that are documented in the description of bits PLLLV and PLLHV in register OSCCON in the current version of the TC3xx User's Manual are not correctly representing the actual device behavior. The formulas shall be updated as listed below.

In addition, the note listed below on the range of the reference frequency f_{OSC} supervised by the oscillator watchdog shall be added to the description of field OSCVAL.

Table 6 Register OSCCON - Documentation updates[1)]

Field	Bits	Type	Description
PLLLV	1	rh	**Oscillator for PLL Valid Low Status Bit** ... By using the crystal's nominal frequency (f_{oscnom}), the lower threshold frequency f_{LV} calculates as follows: • $f_{LV} = f_{oscnom}$ * **0.75** - 0.31 MHz (typical case for back-up clock after trimming) • $f_{LV} = f_{oscnom}$ * 0.53 - 0.39 MHz (lower boundary for back-up clock before trimming) ...
PLLHV	8	rh	**Oscillator for PLL Valid High Status Bit** ... By using the crystal's nominal frequency (f_{oscnom}), the upper threshold frequency f_{HV} calculates as follows: • $f_{HV} = f_{oscnom}$ * **1.46** + 0.29 MHz (typical case for back-up clock after trimming) • $f_{HV} = f_{oscnom}$ * 1.86 + 0.21 MHz (higher boundary for back-up clock before trimming) ...
OSCVAL	20:16	rw	**OSC Frequency Value** ... The reference frequency calculates as follows: f_{OSC} = (OSCCON.OSCVAL - 1 + 16) MHz **Note**: **Valid range for f_{OSC} is from 16 MHz - 40 MHz. For any other value set outside this range, the status of flags PLLHV and PLLLV is undefined.**

1) Only the direct context of the updated text is shown here, with most significant modifications to present text in bold. For the other parts see the description of register OSCCON in the TC3xx User's Manual.

CPU_TC.130 Data Corruption when ST.B to local DSPR coincides with external access to same address

Under certain conditions, when a CPU accesses it's local DSPR using "store byte" (ST.B) instructions, coincident with stores from another bus master (remote CPU, DMA etc.) to addresses containing the same byte, the result is the corruption of data in the adjacent byte in the same halfword.

All the following conditions must be met for the issue to be triggered:

- CPU A executes a ST.B targeting its local DSPR
- Remote bus master performs a write of 16-bit or greater targeting CPU A DSPR
- Both internal and external accesses target the same byte without synchronization.

Note that although single 8-bit write accesses by the remote bus master do not trigger the problem, 16-bit bus writes from a remote CPU could occur from a sequence of two 8-bit writes merged by the store buffers into one 16-bit access.

When the above conditions occur, the value written by the external master to the adjacent byte (to that written by CPU A) is lost, and the prior value is retained.

Workarounds

Workaround 1

Ensure mutually exclusive accesses to the memory location. A semaphore or mutex can be put in place in order to ensure that Core A and other bus masters have exclusive access to the targeted DSPR location.

Workaround 2

When sharing objects without synchronization between multiple cores, use objects of at least halfword in size.

Workaround 3

When two objects, being shared without synchronization between multiple cores, are of byte granularity, locate these objects in a memory which is not a local DSPR to either of the masters (LMU, PSPR, other DSPR etc.).

CPU_TC.131 Performance issue when MADD/MSUB instruction uses E0/D0 register as accumulator

Under certain conditions, when a Multiply (MULx.y) or Multiply-Accumulate (MAC) instruction is followed by a MAC instruction which uses the result of the first instruction as its accumulator input, a performance reduction may occur if the accumulator uses the E0/D0 register. The accumulator input is that to which the multiplication result is added to / subtracted from in a MAC instruction.

All MAC instructions MADDx.y, MSUBx.y are affected except those that operate on Floating-Point operands (MADD.F, MSUB.F).

The problem occurs where there is a single cycle bubble, or an instruction not writing a result, between these dependent instructions in the Integer Pipeline (IP). When this problem occurs the dependent MAC instruction will take 1 additional cycle to complete execution. If this sequence is in a loop, the additional cycle will be added to every iteration of the loop.

Example:

```
maddm.h e0, e0, d3, d5ul ; MUL/MAC writing E0 as result
ld.d    e8, [a5]    ; Load instruction causing IP bubble
maddm.h e0, e0, d6, d8ul ; MAC using E0 as accumulator.
                    ; Should be delayed by 1 cycle due to
                    ; dependency to result of previous LD.D,
                    ; but is delayed for 2 cycles
```

Note that if there are 2 or more IP instructions, or a single IP instruction writing a result, between the MAC and the previous MUL/MAC, then this issue does not occur.

Workaround

Since the issue only affects D0 / E0, it is recommended that to ensure the best performance of an affected sequence as the above example, D0 / E0 is replaced with another register (D1-D15 / E2-E14).

CPU_TC.132 Unexpected PSW values used upon Fast Interrupt entry

Under certain conditions, unexpected PSW values may be used during the first instructions of an interrupt handler, if the interrupt has been taken as a fast interrupt. For a description of fast interrupts, see the “CPU Implementation-Specific Features” section of the relevant User’s Manual.

When the problem occurs, the first instructions of the interrupt handler may be executed using the PSW state from the end of the previous exception handler, rather than that which is being loaded by the fast interrupt entry sequence. The TC1.6E, TC1.6P and TC1.6.2P processors are all affected by this problem as follows:

- TC1.6E (in TC21x..TC27x): Only the first instruction of the ISR is affected.
- TC1.6P (in TC26x..TC29x), TC1.6.2P (in TC3xx): Up to 4 instructions at the start of the ISR may be affected. However, if the following precondition is not met, then there is no issue for these processor variants:
  – A11 must point to the first instruction of the fast interrupt handler at the end of the previous exception handler, i.e. the return value from the previous exception must be pointing to the very first instruction of the new interrupt handler. Note that this case should not occur normally, unless software updates the A11 register to a value corresponding to the start of an interrupt handler.

Workarounds

Workaround 1

When the PSW fields PSW.PRS, PSW. S, PSW.IO or PSW.GW need to be changed in an exception handler, the change should be wrapped in a function call.

```
_exception_handler:
  CALL _common_handler
  RFE

_common_handler:
  MOV.U d0, #0x0380
  MTCR #(PSW), d0   // PSW.IO updated to User-0 mode
```

```
...
RET
```

Note that this workaround assumes SYSCON.TS == SYSCON.IS such that the workaround functions correctly for both traps and interrupts. If this is not the case it is possible for bus accesses to use an incorrect master Tag ID, potentially resulting in an access to be incorrectly allowed, or an unexpected alarm to be generated. In this case it should be ensured that for all interrupt handlers the potentially affected instructions do not produce bus accesses.

Workaround 2

Do not use any instructions dependent upon PSW settings (e.g. BISR or ENABLE, dependent on PSW.IO) as the first instruction of an ISR in TC1.6E, or as one of the first 4 instructions in an ISR for TC1.6P or TC1.6.2P.

Note: The workarounds need to be applied in TC1.6P and TC1.6.2P only in case software modifies the A11 register in an exception handler, as described in the preconditions above.

CPU_TC.133 Test sequence for DTAG single or double bit errors

The error injection method described in the section “13.5.2.1.4 Error injection and Alarm Triggering” in the MTU chapter of the TC3xx User’s Manual using the ECCMAP method is not sufficient to trigger alarms pertaining to the DTAG RAM of each CPU. In the case of DTAG RAM, an alternate method relying on the Read Data and Bit Flip register (RDBFL) must be used instead.

When using the ECCMAP, the DTAG ECC error detection is disabled when the DTAG memory is mapped in the system address map.

This limitation only affects the testing using ECCMAP for DTAG RAM.

During normal operation, where DTAG is used as part of the CPU data cache operation, the ECC error detection functions as intended.

During SSH test mode (used for MBIST) the ECC error detection also operates as intended.

Workaround

A correct test sequence for DTAG single and double bit error injection must therefore use the RDBFL register without mapping the RAM to the system address space.

DTAG SRAM test sequence

In order to test the DTAG error injection the following test sequence should be followed:

1. Read an DTAG SRAM location into RDBFL register
   (see section 13.3.5.1.6 “Reading a Single Memory Location”).
2. Flip some bit in RDBFL[0].
3. Writeback the content of the RDBFL into the DTAG SRAM
   (see section 13.3.5.1.7 “Writing a Single Memory Location”).
4. Read the DTAG SRAM location again.

Depending on the number of bits flipped the CE or UCE alarms will be triggered.

Note: Absolute chapter numbers in the text above refer to MTU chapter version V7.4.12 included in the TC3xx User’s Manual V1.6.0. They may change if used in other versions of this document.

DAP_TC.005 DAP client_read: dirty bit feature of Cerberus’ Triggered Transfer Mode

Note: This problem is only relevant for tool development, not for application development.

The DAP telegram client_read reads a certain number of bits from an IOclient (e.g. Cerberus). The parameter k can be selected to be zero, which is supposed to activate reading of 32 bits plus dirty bit.

However, in the current implementation, the dirty bit feature does not work correctly.

It is recommended not to use this dirty bit feature, meaning the number k should not evaluate to “0”.

DAP_TC.007 Incomplete client_blockread telegram in DXCM mode when using the “read CRCup” option

In DXCM (DAP over CAN Messages) mode, the last parcel containing the CRC32 might be skipped in a client_blockread telegram using the “read CRCup” option.

Workaround

Do not use CRCup option with client_blockread telegrams in DXCM mode.

Instead the CRCup can be read by a dedicated getCRCup telegram.

DMA_TC.066 DMA Double Buffering Operations - Update Address Pointer

Software may configure a DMA channel for one of the DMA double buffering operations:

- DMA Double Source Buffering Software Switch Only
  – (DMA channel DMA_ADICRz.SHCT = 1000_B),
- DMA Double Source Buffering Automatic Hardware and Software Switch
  – (DMA channel DMA_ADICRz.SHCT = 1001_B),
- DMA Double Destination Buffering Software Switch Only
  – (DMA channel DMA_ADICRz.SHCT = 1010_B),
- DMA Double Destination Buffering Automatic Hardware and Software Switch
  – (DMA channel DMA_ADICRz.SHCT = 1011_B).

If the software updates a buffer address pointer by BYTE or HALF-WORD writes, the resulting value of the address pointer is corrupted.

Workaround

If the software updates a buffer address pointer, the software should only use a 32-bit WORD access.

DMA_TC.067 DMA Double Buffering Software Switch Buffer Overflow

If a DMA channel is configured for DMA Double Buffering Software Switch Only and the active buffer is emptied or filled, the DMA does not stop. A bug results in the DMA evaluating the state of the FROZEN bit (DMA channel CHCSR.FROZEN). If the FROZEN bit is not set, the DMA continues to service DMA requests in the current buffer. The DMA may perform DMA write moves outside of the address range of the buffer potentially trashing other data.

Workaround

Implement one or more of the following to minimize the impact of the bug:

1. Configure access protection across the whole memory map to prevent the trashing data by the DMA channel configured for DMA double buffering. A DMA resource partition may be used to assign a unique master tag identifier to the DMA channel.

2. The address generation of the DMA channel configured for DMA double buffering should use a circular buffer aligned to the size of the buffer to prevent the DMA from writing outside the address range of the buffer.

DMA_TC.068 DMA Double Buffering Lost DMA Request

If a DMA channel is configured for DMA Double Buffering and a buffer switch is performed, no DMA requests shall be lost by the DMA and there shall be no loss, duplication or split of data across two buffers.

A bug results in a software switch clearing a pending DMA request. As a result a DMA transfer is lost without the recording of a TRL event so violating the aforementioned top-level requirements of DMA double buffering.

Workaround

The system must ensure that a software switch does not collide with a DMA request. A user program must execute the following steps to switch the buffer:

1. Software must disable the servicing of interrupt service requests by the DMA channel by disabling the corresponding Interrupt Router (IR) Service Request Node (SRN).

a) Software shall write IR_SRCi.SRE = 0_B
2. Software must halt the DMA channel configured for DMA double buffering.
   a) Software shall write DMA channel TSRc.HLTREQ = 1_B
   b) Software shall monitor DMA channel TSRc.HLTACK = 1_B
3. Software must monitor the DMA Channel Transaction Request State
   a) Software shall read DMA channel TSRc.CH and store the value in a variable SAVED_CH
4. Software must switch the source or destination buffer
   a) Software shall write DMA channel CHCSRc.SWB = 1_B
   b) Software shall monitor the DMA channel frozen bit CHCSRc.FROZEN
5. When the DMA channel has switched buffers (DMA channel CHCSRc.FROZEN = 1_B)
   a) If (SAVED_CH==1), software shall trigger a DMA software request by writing DMA channel CHCSRc.SCH = 1_B to restore DMA channel TSRc.CH to the state before the buffer switch.
6. Software must unhalt the DMA channel.
   a) Software shall write DMA channel TSRc.HLTCLR = 1_B
7. Software must enable the servicing of interrupt service requests by the DMA channel.
   a) Software shall write IR_SRCi.SRE = 1_B

The software must include an error routine.

1. Software must monitor for interrupt overflows (IR_SRCi.IOV = 1_B) and lost DMA requests (TSRc.TRL = 1_B).
2. If software detects an overflow or lost DMA request, the software must execute an error routine and take the appropriate reaction consistent with the application.

FLASH_TC.053 Erase Size Limit for PFLASH

The device may fail to start up after a primary voltage monitor triggered (cold) PORST if all of the following four conditions are fulfilled at the same time:

- Erase operation is ongoing in PFLASH, AND
- PORST is triggered by one of the primary voltage monitors, AND
- Ambient temperature T_A > 60°C OR junction temperature T_J > 70°C, AND

- Size of logical sectors > 256 Kbyte is specified in “Erase Logical Sector Range” command

Workaround

If it cannot be excluded that all four conditions listed above may occur at the same time:

- Limit the maximum logical sector erase size to 256 Kbyte in the “Erase Logical Sector Range” command.

FLASH_TC.055 Multi-bit errors detected by PFlash are not communicated to SPB masters

Problem

Section “PFLASH ECC” in the NVM chapter of the TC3xx User Manual states in bullet points

- “Multi-bit error and not All-0 error” and
- “Multi-bit error and All-0 error”

that a bus error is returned to the reading master.

The same statement is repeated in section “Program Side Memories” in the CPU chapter under the headline “Local Pflash Bank (LPB)” and in the HSM Target Specification.

Effectively the processing of such errors depends on the type of transaction (burst or single) and the path the read transaction takes through the on-chip connectivity with the result that an SPB master (like HSM) gets no information about the detected error as detailed below:

When a CPU reads its local PFlash bank using direct access through its DPI (also called “Fast Path”) such errors are directly translated into a PIE trap for instruction fetch and a DIE trap for data read. No bus error is generated as no bus communication is involved.

When any master reads PFlash through the SRI (this includes CPUs reading the PFlash located at another CPU or its local bank with disabled Fast Path) a single transfer with multi-bit error returns a bus error but a burst read is reporting this error using a forced “Transaction ID Error” (concept described in “On-Chip

System Connectivity {and Bridges}"). The bus error is always communicated back to the master. The handling of the Transaction ID Error however is master specific.

When a CPU receives the SRI transaction ID error it handles it as bus error and triggers a PSE trap for instruction fetch and a DSE trap for data read.

Also the DMA handles the Transaction ID Error like a bus error, sets the corresponding error flags and triggers the source error interrupt request.

When an SPB master like HSM performs a burst read from a PFlash bank this SRI Transaction ID Error terminates at the SFI_F2S bridge. The SPB master does not receive a bus error and continues operation with wrong data. The SFI_F2S bridge signals the error to the XBar for alarm generation.

The SPB master Cerberus acting on behalf of a debug tool issues only single transfers and is therefore correctly informed by a bus-error.

Workaround

Such multi-bit errors are added to the MBAB error buffer in the PFI (documented in the NVM chapter). Filling the MBAB results in sending an alarm "Safety Mechanism: PFlash ECC; Alarm: Multiple Bit Error Detection Tracking Buffer Full" to the SMU.

As described above also SFI_F2S bridge informs the XBar to generate an alarm "Safety Mechanism: Built-in SRI Error Detection; Alarm: XBAR0 Bus Error Event" to the SMU. With HSM as requesting master the XBAR0 just captures the occurrence of this error but doesn't capture address or other transaction data in its Error Capture registers.

The application has to take care that the SMU alarm handler informs the SPB master.

FLASH_TC.056 Reset value for register HF_ECCC is 0x0000 0000 - Documentation correction

In the register description for register HF_ECCC (DF0 ECC Control Register) in the TC3xx User's Manual, the application reset value is documented as 0xC000 0000.

However, this register is cleared by the startup software SSW, and the user software will read the reset value of 0x0000 0000.

Documentation correction

- The application reset value for register HF_ECCC is 0x0000 0000.

Note: The user must consider that field HF_ECCC.TRAPDIS is 00_B after reset, which means a bus error trap is generated if an uncorrectable ECC error occurs upon read from DF0, or read from DF1 when DF1 is configured as not HSM_exclusive.

FlexRay_AI.087 After reception of a valid sync frame followed by a valid non-sync frame in the same static slot the received sync frame may be ignored

Description:

If in a static slot of an even cycle a valid sync frame followed by a valid non-sync frame is received, and the frame valid detection (prt_frame_decoded_on_X) of the DEC process occurs one sclk after valid frame detection of FSP process (fsp_val_syncfr_chx), the sync frame is not taken into account by the CSP process (devte_xxs_reg).

Scope:

The erratum is limited to the case where more than one valid frame is received in a static slot of an even cycle.

Effects:

In the described case the sync frame is not considered by the CSP process. This may lead to a SyncCalcResult of MISSIMG_TERM (error flag SFS.MRCS set). As a result the POC state may switch to NORMAL_PASSIVE or HALT or the Startup procedure is aborted.

Workaround

Avoid static slot configurations long enough to receive two valid frames.

FlexRay_AI.088 A sequence of received WUS may generate redundant `SIR.WUPA/B` events

Description:

If a sequence of wakeup symbols (WUS) is received, all separated by appropriate idle phases, a valid wakeup pattern (WUP) should be detected after every second WUS.The E-Ray detects a valid wakeup pattern after the second WUS and then after each following WUS.

Scope:

The erratum is limited to the case where the application program frequently resets the appropriate `SIR.WUPA/B` bits.

Effects:

In the described case there are more `SIR.WUPA/B` events seen than expected.

Workaround

Ignore redundant `SIR.WUPA/B` events.

FlexRay_AI.089 Rate correction set to zero in case of SyncCalcResult=MISSING_TERM

Description:

In case a node receives too few sync frames for rate correction calculation and signals a SyncCalcResult of MISSING_TERM, the rate correction value is set to zero instead to the last calculated value.

Scope:

The erratum is limited to the case of receiving too few sync frames for rate correction calculation (SyncCalcResult=MISSING_TERM in an odd cycle).

Effects:

In the described case a rate correction value of zero is applied in NORMAL_ACTIVE / NORMAL_PASSIVE state instead of the last rate correction value calculated in NORMAL_ACTIVE state. This may lead to a desynchronisation of the node although it may stay in NORMAL_ACTIVE state (depending on gMaxWithoutClockCorrectionPassive) and decreases the probability to re-enter NORMAL_ACTIVE state if it has switched to NORMAL_PASSIVE (pAllowHaltDueToclock=false).

Workaround

It is recommended to set gMaxWithoutClockCorrectionPassive to 1. If missing sync frames cause the node to enter NORMAL_PASSIVE state, use higher level application software to leave this state and to initiate a re-integration into the cluster. HALT state can also be used instead of NORMAL_PASSIVE state by setting pAllowHaltDueToClock to true.

FlexRay_AI.090 Flag SFS.MRCS is set erroneously although at least one valid sync frame pair is received

Description:

If in an odd cycle 2c+1 after reception of a sync frame in slot n the total number of different sync frames per double cycle has exceeded gSyncNodeMax and the node receives in slot n+1 a sync frame that matches with a sync frame received in the even cycle 2c, the sync frame pair is not taken into account by CSP process. This may cause the flags SFS.MRCS and EIR.CCF to be set erroneously.

Scope:

The erratum is limited to the case of a faulty cluster configuration where different sets of sync frames are transmitted in even and odd cycles and the total number of different sync frames is greater than gSyncNodeMax.

Effects:

In the described case the error interrupt flag EIR.CCF is set and the node may enter either the POC state NORMAL_PASSIVE or HALT.

Workaround

Correct configuration of gSyncNodeMax.

FlexRay_AI.091 Incorrect rate and/or offset correction value if second Secondary Time Reference Point (STRP) coincides with the action point after detection of a valid frame

Description:

If a valid sync frame is received before the action point and additionally noise or a second frame leads to a STRP coinciding with the action point, an incorrect deviation value of zero is used for further calculations of rate and/or offset correction values.

Scope:

The erratum is limited to configurations with an action point offset greater than static frame length.

Effects:

In the described case a deviation value of zero is used for further calculations of rate and/or offset correction values. This may lead to an incorrect rate and/or offset correction of the node.

Workaround

Configure action point offset smaller than static frame length.

FlexRay_AI.092 Initial rate correction value of an integrating node is zero if pMicroInitialOffsetA,B = 0x00

Description:

The initial rate correction value as calculated in figure 8-8 of protocol spec v2.1 is zero if parameter pMicroInitialOffsetA,B was configured to be zero.

Scope:

The erratum is limited to the case where pMicroInitialOffsetA,B is configured to zero.

Effects:

Starting with an initial rate correction value of zero leads to an adjustment of the rate correction earliest 3 cycles later (see figure 7-10 of protocol spec v2.1). In a worst case scenario, if the whole cluster is drifting away too fast, the integrating node would not be able to follow and therefore abort integration.

Workaround

Avoid configurations with pMicroInitialOffsetA,B equal to zero. If the related configuration constraint of the protocol specification results in pMicroInitialOffsetA,B equal to zero, configure it to one instead. This will lead to a correct initial rate correction value, it will delay the startup of the node by only one microtick.

FlexRay_AI.093 Acceptance of startup frames received after reception of more than gSyncNodeMax sync frames

Description:

If a node receives in an even cycle a startup frame after it has received more than gSyncNodeMax sync frames, this startup frame is added erroneously by process CSP to the number of valid startup frames (zStartupNodes). The faulty number of startup frames is delivered to the process POC. As a consequence this node may integrate erroneously to the running cluster because it assumes that it has received the required number of startup frames.

Scope:

The erratum is limited to the case of more than gSyncNodeMax sync frames.

Effects:

In the described case a node may erroneously integrate successfully into a running cluster.

Workaround

Use frame schedules where all startup frames are placed in the first static slots. gSyncNodeMax should be configured to be greater than or equal to the number of sync frames in the cluster.

FlexRay_AI.094 Sync frame overflow flag `EIR.SFO` may be set if slot counter is greater than 1024

Description:

If in the static segment the number of transmitted and received sync frames reaches gSyncNodeMax and the slot counter in the dynamic segment reaches the value cStaticSlotIDMax + gSyncNodeMax = 1023 + gSyncNodeMax, the sync frame overflow flag `EIR.SFO` is set erroneously.

Scope:

The erratum is limited to configurations where the number of transmitted and received sync frames equals to gSyncNodeMax and the number of static slots plus the number of dynamic slots is greater or equal than 1023 + gSyncNodeMax.

Effects:

In the described case the sync frame overflow flag `EIR.SFO` is set erroneously. This has no effect to the POC state.

Workaround

Configure gSyncNodeMax to number of transmitted and received sync frames plus one or avoid configurations where the total of static and dynamic slots is greater than cStaticSlotIDMax.

FlexRay_AI.095 Register RCV displays wrong value

Description:

If the calculated rate correction value is in the range of [-pClusterDriftDamping .. +pClusterDriftDamping], vRateCorrection of the CSP process is set to zero. In this case register `RCV` should be updated with this value. Erroneously `RCV.RCV[11:0]` holds the calculated value in the range [-pClusterDriftDamping .. +pClusterDriftDamping] instead of zero.

Scope:

The erratum is limited to the case where the calculated rate correction value is in the range of [-pClusterDriftDamping .. +pClusterDriftDamping].

Effects:

The displayed rate correction value `RCV.RCV[11:0]` is in the range of [-pClusterDriftDamping .. +pClusterDriftDamping] instead of zero. The error of the displayed value is limited to the range of [-pClusterDriftDamping .. +pClusterDriftDamping]. For rate correction in the next double cycle always the correct value of zero is used.

Workaround

A value of `RCV.RCV[11:0]` in the range of [-pClusterDriftDamping .. +pClusterDriftDamping] has to be interpreted as zero.

FlexRay_AI.096 Noise following a dynamic frame that delays idle detection may fail to stop slot

Description:

If (in case of noise) the time between ’potential idle start on X’ and ’CHIRP on X’ (see Protocol Spec. v2.1, Figure 5-21) is greater than gdDynamicSlotIdlePhase, the E-Ray will not remain for the remainder of the current dynamic segment in the state ’wait for the end of dynamic slot rx’. Instead, the E-Ray continues slot counting. This may enable the node to further transmissions in the current dynamic segment.

Scope:

The erratum is limited to noise that is seen only locally and that is detected in the time window between the end of a dynamic frame's DTS and idle detection ('CHIRP on X').

Effects:

In the described case the faulty node may not stop slot counting and may continue to transmit dynamic frames. This may lead to a frame collision in the current dynamic segment.

Workaround

None.

FlexRay_AI.097 Loop back mode operates only at 10 MBit/s

Description:

The looped back data is falsified at the two lower baud rates of 5 and 2.5 MBit/s.

Scope:

The erratum is limited to test cases where loop back is used with the baud rate prescaler (`PRTC1.BRP[1:0]`) configured to 5 or 2.5 MBit/s.

Effects:

The loop back self test is only possible at the highest baud rate.

Workaround

Run loop back tests with 10 MBit/s (`PRTC1.BRP[1:0]` = 00_B).

FlexRay_AI.099 Erroneous cycle offset during startup after abort of start-up or normal operation

Description:

An abort of startup or normal operation by a READY command near the macotick border may lead to the effect that the state INITIALIZE_SCHEDULE is one macrotick too short during the first following integration attempt. This leads to an early cycle start in state INTEGRATION_COLDSTART_CHECK or INTEGRATION_CONSISTENCY_CHECK.

As a result the integrating node calculates a cycle offset of one macrotick at the end of the first even/odd cycle pair in the states INTEGRATION_COLDSTART_CHECK or INTEGRATION_CONSISTENCY_CHECK and tries to correct this offset.

If the node is able to correct the offset of one macrotick (pOffsetCorrectionOut >> gdMacrotick), the node enters NORMAL_ACTIVE with the first startup attempt.

If the node is not able to correct the offset error because pOffsetCorrectionOut is too small (pOffsetCorrectionOut ≤ gdMacrotick), the node enters ABORT_STARTUP and is ready to try startup again. The next (second) startup attempt is not effected by this erratum.

Scope:

The erratum is limited to applications where READY command is used to leave STARTUP, NORMAL_ACTIVE, or NORMAL_PASSIVE state.

Effects:

In the described case the integrating node tries to correct an erroneous cycle offset of one macrotick during startup.

Workaround

With a configuration of pOffsetCorrectionOut >> gdMacrotick • (1+cClockDeviationMax) the node will be able to correct the offset and therefore also be able to successfully integrate.

FlexRay_AI.100 First WUS following received valid WUP may be ignored

Description:

When the protocol engine is in state WAKEUP_LISTEN and receives a valid wakeup pattern (WUP), it transfers into state READY and updates the wakeup status vector `CCSV.WSV[2:0]` as well as the status interrupt flags `SIR.WST` and `SIR.WUPA/B`. If the received wakeup pattern continues, the protocol engine may ignore the first wakeup symbol (WUS) following the state transition and signals the next `SIR.WUPA/B` at the third instead of the second WUS.

Scope:

The erratum is limited to the reception of redundant wakeup patterns.

Effects:

Delayed setting of status interrupt flags `SIR.WUPA/B` for redundant wakeup patterns.

Workaround

None.

FlexRay_AI.101 READY command accepted in READY state

Description:

The E-Ray module does not ignore a READY command while in READY state.

Scope:

The erratum is limited to the READY state.

Effects:

Flag `CCSV.CSI` is set. Cold starting needs to be enabled by POC command ALLOW_COLDSTART (`SUCC1.CMD` = 1001_B).

Workaround

None.

FlexRay_AI.102 Slot Status vPOC!SlotMode is reset immediately when entering HALT state

Description:

When the protocol engine is in the states NORMAL_ACTIVE or NORMAL_PASSIVE, a HALT or FREEZE command issued by the Host resets vPOC!SlotMode immediately to SINGLE slot mode (`CCSV.SLM[1:0]` = 00_B). According to the FlexRay protocol specification, the slot mode should not be reset to SINGLE slot mode before the following state transition from HALT to DEFAULT_CONFIG state.

Scope:

The erratum is limited to the HALT state.

Effects:

The slot status vPOC!SlotMode is reset to SINGLE when entering HALT state.

Workaround

None.

FlexRay_AI.103 Received messages not stored in Message RAM when in Loop Back Mode

After a FREEZE or HALT command has been asserted in NORMAL_ACTIVE state, and if state LOOP_BACK is then entered by transition from HALT state via DEF_CONFIG and CONFIG, it may happen that acceptance filtering for received messages is not started, and therefore these messages are not stored in the respective receive buffer in the Message RAM.

Scope:

The erratum is limited to the case where Loop Back Mode is entered after NORMAL_ACTIVE state was left by FREEZE or HALT command.

Effects:

Received messages are not stored in Message RAM because acceptance filtering is not started.

Workaround

Leave HALT state by hardware reset.

FlexRay_AI.104 Missing startup frame in cycle 0 at coldstart after FREEZE or READY command

When the E-Ray is restarted as leading coldstarter after it has been stopped by FREEZE or READY command, it may happen, depending on the internal state of the module, that the E-Ray does not transmit its startup frame in cycle 0. Only E-Ray configurations with startup frames configured for slots 1 to 7 are affected by this behaviour.

Scope:

The erratum is limited to the case when a coldstart is initialized after the E-Ray has been stopped by FREEZE or READY command. Coldstart after hardware reset is not affected.

Effects:

During coldstart it may happen that no startup frame is sent in cycle 0 after entering COLDSTART_COLLISION_RESOLUTION state from COLDSTART_LISTEN state.

Severity:

Low, as the next coldstart attempt is no longer affected. Coldstart sequence is lengthened but coldstart of FlexRay system is not prohibited by this behaviour.

Workaround

Use a static slot greater or equal 8 for the startup / sync message.

FlexRay_AI.105 RAM select signals of IBF1/IBF2 and OBF1/OBF2 in RAM test mode

When accessing Input Buffer RAM 1,2 (IBF1,2) or Output Buffer RAM 1,2 (OBF1,2) in RAM test mode, the following behaviour can be observed when entering RAM test mode after hardware reset.

- Read or write access to IBF2:
  - In this case also IBF1 RAM select **eray_ibf1_cen** is activated initiating a read access of the addressed IBF1 RAM word. The data read from IBF1 is evaluated by the respective parity checker.
- Read or write access to OBF1:
  - In this case also OBF2 RAM select **eray_obf2_cen** is activated initiating a read access of the addressed OBF2 RAM word. The data read from OBF2 is evaluated by the respective parity checker.

If the parity logic of the erroneously selected IBF1 resp. OBF2 detects a parity error, bit **MHDS.PIBF** resp. **MHDS.POBF** in the E-Ray Message Handler Status register is set although the addressed IBF2 resp. OBF1 had not error. The logic for setting **MHDS.PIBF** / **MHDS.POBF** does not distinguish between set conditions from IBF1 or IBF2 resp. OBF1 or OBF2.

Due to the IBF / OBF swap mechanism as described in section 5.11.2 in the E-Ray Specification, the inverted behaviour with respect to IBF1,2 and OBF1,2 can be observed depending on the IBF / OBF access history.

Scope:

The erratum is limited to the case when IBF1,2 or OBF1,2 are accessed in RAM test mode. The problem does not occur when the E-Ray is in normal operation mode.

Effects:

When reading or writing IBF1,2 / OBF1,2 in RAM test mode, it may happen, that the parity logic of IBF1,2 / OBF1,2 signals a parity error.

Severity:

Low, workaround available.

Workaround

For RAM testing after hardware reset, the Input / Output Buffer RAMs have to be first written and then read in the following order: IBF1 before IBF2 and OBF2 before OBF1

FlexRay_AI.106 Data transfer overrun for message transfers Message RAM to Output Buffer (OBF) or from Input Buffer (IBF) to Message RAM

The problem occurs under the following conditions:

1) A received message is transferred from the Transient Buffer RAM (TBF) to the message buffer that has its data pointer pointing to the first word of the Message RAM's Data Partition located directly after the last header word of the Header Partition of the Last Configured Buffer as defined by **MRC.LCB**.

2) The Host triggers a transfer from / to the Last Configured Buffer in the Message RAM with a specific time relation to the start of the TBF transfer described under 1).

Under these conditions the following transfers triggered by the Host may be affected:

a) Message buffer transfer from Message RAM to OBF

When the message buffer has its payload configured to maximum length (**PLC** = 127), the OBF word on address 00h (payload data bytes 0 to 3) is overwritten with unexpected data at the end of the transfer.

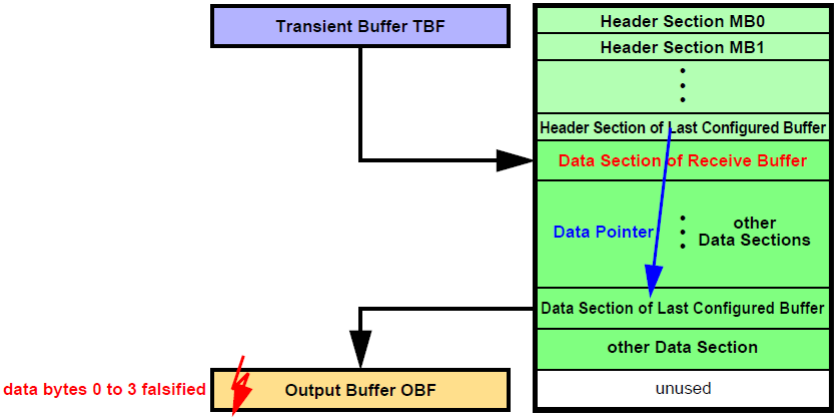

Figure 1 Message buffer transfer from Message RAM to OBF

b) Message buffer transfer from IBF to Message RAM

After the Data Section of the selected message buffer in the Message RAM has been written, one additional write access overwrites the following word in the Message RAM which might be the first word of the next Data Section.

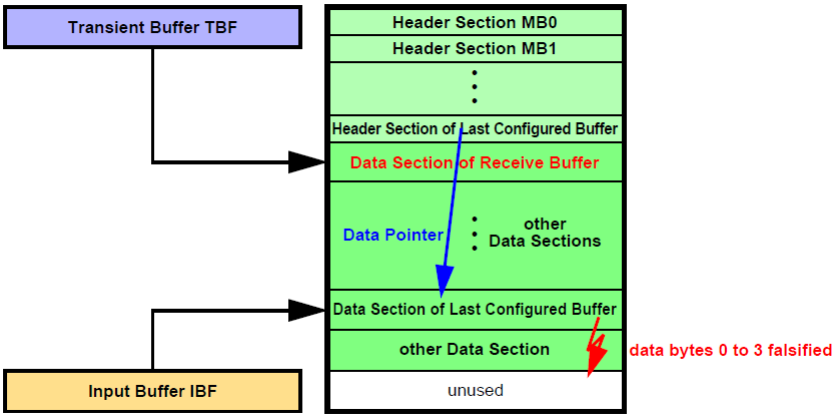

Figure 2 Message buffer transfer from IBF to Message RAM

Scope:

The erratum is limited to the case when (see **Figure 3** “Bad Case”):

1) The first Data Section in the Data Partition is assigned to a receive buffer (incl. FIFO buffers)

AND

2) The Data Partition in the Message RAM starts directly after the Header Partition (no unused Message RAM word in between)

Effects:

a) When a message is transferred from the Last Configured Buffer in the Message RAM to the OBF and **PLC** = 127 it may happen, that at the end of the transfer the OBF word on address 00h (payload data bytes 0 to 3) is overwritten with unexpected data (see **Figure 1**).

b) When a message is transferred from IBF to the Last Configured Buffer in the Message RAM, it may happen, that at the end of the transfer of the Data Section one additional write access overwrites the following word, which may be the first word of another message's Data Section in the Message RAM (see **Figure 2**).

Severity:

Medium, workaround available, check of configuration necessary.

Workaround

1) Leave at least one unused word in the Message RAM between Header Section and Data Section.

OR

2) Ensure that the Data Section directly following the Header Partition is assigned to a transmit buffer.

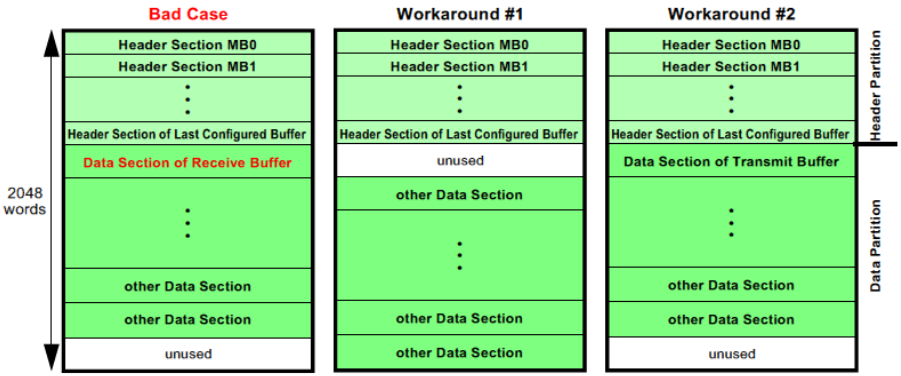

Figure 3 Message RAM Configurations

GTM_AI.254 TIM TDU: TDU_STOP=b101 not functional

Stop counting of register TO_CNT on an tdu_word_event or stop counting of TO_CNT1 on a tdu_frame_event is not possible.

Scope

TIM

Effects

TO_CNT1, TO_CNT can not be stopped counting.

Workaround

No workaround available.

GTM_AI.308 TIM, ARU: Limitation that back-to-back TIM data transfers at full ARU clock rate cannot be transferred correctly with ARU dynamic routing feature

If TIM input signals with signal changes faster or equal than ARU clock rate are processed with the TIM and the results are routed via ARU in dynamic routing

mode, it is likely that there is a data loss and only each second data can be transferred.

Scope

ARU Routing, DEBUG signal interface

Effects

- a) If the ARU CADDR is kept stable and data is transferred back-to-back for 2 or more consecutive aru clock cycles while operating in ARU dynamic routing mode, then every second data provided by the TIM module gets lost.
- b) Debugging of an ARU data transfer not completely correct. Every second GTM_DBG_ARU_DATAi_val signal missing.

Workaround

Do not use the dynamic routing feature of ARU in the manner that the same ARU caddr is served for multiple cycles with back-to-back data transfers.

Ensure that every ARU clock cycle the CADDR address will change.

GTM_AI.335 TOM output signal to SPE not functional if up/down counter mode is configured

TOM output signal TOM[i]_CH[x]_SOUR to SPE not functional if up/down counter mode is configured by setting of TOM[i]_CH[x]_CTRL.UDMODE > 0.

Scope

TOM - SPE interface

Effects

TOM output signal TOM[i]_CH[x]_SOUR to SPE not functional.

Workaround

No workaround available.

Don't use up/down counter mode together with SPE interface.

GTM_AI.340 TOM/ATOM: Generation of TRIG_CCU0/TRIG_CCU1 trigger signals skipped in initial phase of A/TOM SOMP one-shot mode

Configuration in use:

- A/TOM[i]_CH[x]_CTRL.OSM=1
- A/TOM[i]_CH[x]_CTRL.OSM_TRIG=0
- A/TOM[i]_CH[x]_CTRL.UDMODE=00
- ATOM[i]_CH[x]_CTRL.MODE=10

Expected behavior:

The generation of one-shot pulses in A/TOM can be initiated by a write to CN0. In this case the pulse generation comprises of an initial phase where the signal level at A/TOM output is inactive followed by a pulse. The duration of the initial phase can be controlled by the written value of CN0, where the duration is defined by CM0-CN0. After the counter CN0 reaches the value of CM0-1, the pulse starts with its active edge, CN0 is reset, and starts counting again. When CN0 reaches CM1-1, the inactive edge of the pulse occurs. Due to the fact, that the capture compare units CCU0 and CCU1 compare also in the initial phase of the pulse generation, the trigger conditions for these comparators apply also in this initial phase. Thus, the TRIG_CCU0 and TRIG_CCU1 signals also occur in the initial phase of the one-shot pulse. When these trigger signals are enabled in the A/TOM[i]_CH[x]_IRQ_EN, an interrupt signal is generated by A/TOM on the CCU0TC and CCU1TC trigger conditions and the corresponding A/TOM[i]_CH[x]_IRQ_NOTIFY bits are set.

Observed behavior:

For certain start values of CN0 and dependent on the history of pulse generation, the trigger signals TRIG_CCU0 and TRIG_CCU1 are skipped. As a consequence, this can led to missing interrupts CCU0TC and CCU1TC on behalf of their missing trigger signals TRIG_CCU0 and TRIG_CCU1.

For the first pulse generation after enabling the channel, all trigger signals TRIG_CCU0 and TRIG_CCU1 appear as expected and described in the section expected behavior. If the channel stays enabled and a new value CN0 is written to trigger a subsequent one-shot pulse, the TRIG_CCU0/TRIG_CCU1

triggers in the initial phases of subsequent one-shot pulses are skipped under the following conditions:

- For TRIG_CCU0 trigger: if the one-shot pulse is started by writing a value to CN0 greater or equal to CM0-1.
- For TRIG_CCU1 trigger: if the one-shot pulse is started by writing a value to CN0 greater or equal to CM1-1.

Scope

TOM/ATOM

Effects

Missing TRIG_CCU0 and TRIG_CCU1 trigger signals in initial phase of subsequent pulses in A/TOM one-shot mode, when one shot-mode is started with writing to CN0 values greater equal CM0-1 or CM1-1.

Workaround 1

Disabling, resetting (channel reset), re-enabling and initializing of the channel between each one-shot pulse will ensure the correct behavior of CCU0TC and CCU1TC interrupt source.

Workaround 2

Starting a new one-shot pulse by writing twice the counter CN0 whereas the first value, which is written to CN0 should be zero followed by the value which defines the length of the initial phase.

Be aware that in this case, the total length of the initial phase until the pulse is started, is influenced by the time between the two write accesses to CN0.

GTM_AI.341 TOM/ATOM: False generation of TRIG_CCU1 trigger signal in SOMP one-shot mode with OSM_TRIG=1 when CM1 is set to value 1

Configuration in use:

- A/TOM[i]_CH[x]_CTRL.OSM=1
- A/TOM[i]_CH[x]_CTRL.OSM_TRIG=1

- A/TOM[i]_CH[x]_CTRL.UDMODE=00
- ATOM[i]_CH[x]_CTRL.MODE=10

Expected behavior:

The generation of one-shot pulses in A/TOM can be initiated by the trigger event TRIG_[x-1] from trigger chain or by TIM_EXT_CAPTURE(x) trigger event from TIM, whereas the counter CN0 is reset to zero and starts counting. In this case the pulse generation comprises of an initial phase where the signal level at A/TOM output is inactive followed by a pulse. The duration of the initial phase is always as long until the counter CN0 reaches CM0-1.

After the counter CN0 reaches the value of CM0-1, the pulse starts with its active edge, CN0 is reset, and starts counting again. When CN0 reaches CM1-1, the inactive edge of the pulse occurs. Due to the fact, that the capture compare units CCU0 and CCU1 compare also in the initial phase of the pulse generation, the trigger conditions for these comparators apply also in this initial phase. Thus, the TRIG_CCU0 and TRIG_CCU1 signals also occur in the initial phase of the one-shot pulse. When these trigger signals are enabled in the A/TOM[i]_CH[x]_IRQ_EN, an interrupt signal is generated by A/TOM on the CCU0TC and CCU1TC trigger conditions and the corresponding A/TOM[i]_CH[x]_IRQ_NOTIFY bits are set.

Observed behavior:

If the compare register CM1 is set to 1 and a new one-shot pulse is triggered, two effects can be observed:

- The first observed behavior is that the capture compare unit doesn't generate the TRIG_CCU1 trigger signal in the initial phase of the one-shot cycle.
- The second observed behavior is that at the end of the operation phase of the one-shot cycle, where CN0 reaches CM0-1 a second time, the capture compare unit generates a TRIG_CCU1 trigger signal which is not expected at this point in time.

Scope

TOM/ATOM

Effects

Missing TRIG_CCU1 trigger signal in initial phase of the one-shot cycle and unexpected TRIG_CCU1 trigger signal at the end of the operation phase of the one-shot cycle.

Workaround

Instead of using value 1 for CM1 it could be possible to generate the same pulse length by using a higher CMU_FXCLK/CMU_CLK frequency. Then, to get the same pulse length, the value of CM1 has to be multiplied by the difference of the two CMU_FXCLK/CMU_CLK frequencies.

Be aware that this workaround is only possible, if you are not already using the CMU_FXCLK(0) because there is no higher CMU_FXCLK frequency to select.

Example for TOM: Instead of using CMU_FXCLK(1), which has the divider value 2**4, use CMU_FXCLK(0), which has the divider value 2**0. In this case, CM1 has to be configured with value 2**4 minus 2**0 which is equal to 2**4=16.

Hint: To get the same length of period, which defines the length of the initial phase, the value for the period in CM0 has to be multiplied by the same value.

A second limitation is that the maximum length of the period, which is configured in CM0, is limited. Using a higher CMU_FXCLK/CMU_CLK frequency reduces the maximum possible period.

GTM_AI.345 SPE: Incorrect behaviour of direction change control via SPE_CMD.SPE_CTRL_CMD bits

A direction change (“00” <-> “01”) via SPE_CTRL_CMD disturbs the increment/decrement of the pat_ptr resulting in incorrect output patterns not corresponding to the input pattern position. Changing the direction bit in SPE_CTRL_CMD can also generate invalid IRQs.

Scope

SPE, TOM

Effects

Modifying the direction bit (“00” <-> “01”) in SPE_CTRL_CMD does not provide the correct output pattern to the BLDC motor. Due to a wrong pat_ptr position incorrect output patterns will be sent to the motor, which are not correlated to the sensor position.

In addition the SPE logic can generate unpredictable IRQs (perr_irq, dchg_irq, bis_irq).

Workaround

Do not use SPE_CTRL_CMD.

Instead reprogram the SPE_OUT_PAT register to change the direction.

GTM_AI.346 ATOM SOMS mode: Shift cycle is not executed correctly in case the reload condition is deactivated with ATOM[i]_AGC_GLB_CTRL.UPEN = 0

ATOM is configured to SOMS continuous mode by setting the following configuration bitfields:

- ATOM[i]_CH[x]_CTRL.MODE=11
- ATOM[i]_CH[x]_CTRL.OSM=0
- ATOM[i]_CH[x]_CTRL.ARU_EN=0
- ATOM[i]_AGC_GLB_CTRL.UPEN[x]=0b00

Expected behaviour:

After the counter CN0 reaches CM0, no reload cycle is executed due to the configuration of UPEN=0b00.

Instead of a reload cycle a shift cycle has to be executed to ensure an continuous shifting.

Observed behaviour:

Neither a reload cycle nor a shift cycle is executed when the counter CN0 reaches CM0. The shifting stops and the shift register CM1 as well as the output

ATOM[i]_CH[x]_OUT stays unexpectedly stable for two shift clock cycles whereas the counter CN0 continuously counting further on.

Scope

ATOM

Effects

After the counter CN0 reaches CM0 the output stays stable for two shift clock cycles before the next shift will be executed.

Workaround

Increase the number of bits that have to be shifted out inside CM0 register to the maximum value of 23 to ensure an continuous shifting of all bits of the shift register CM1.

GTM_AI.347 TOM/ATOM: Reset of (A)TOM[i]_CH[x]_CN0 with TIM_EXT_CAPTURE are not correctly synchronized to selected CMU_CLK/CMU_FXCLK

To reset the counter (A)TOM[i]_CH[x]_CN0 (SOMP mode in ATOM), the input signal TIM_EXT_CAPTURE can be used by configuration of (A)TOM[i]_CH[x]_CTRL.EXT_TRIG=1 and (A)TOM[i]_CH[x]_CTRL.RST_CCU0=1.

The reset of the counter (A)TOM[i]_CH[x]_CN0 should happen synchronously to the internal selected CMU clock CMU_CLK/CMU_FXCLK. Therefore a synchronisation stage is implemented to synchronize the input signal TIM_EXT_CAPTURE to the internal selected CMU clock CMU_CLK/CMU_FXCLK.

It can be observed, that the reset of the counter is done immediately with the occurrence of the input signal TIM_EXT_CAPTURE and not as expected synchronously to the selected CMU clock enable CMU_CLK/CMU_FXCLK.

As a consequence of this, the output signal for the compare values 0 and 1 of (A)TOM[i]_CH[x]_CM1.CM1 and (A)TOM[i]_CH[x]_CM0.CM0 will not be set correctly.

Scope

ATOM, TOM

Effects

The output signal (A)TOM[i]_CH[x]_OUT is not set correctly for the compare values 0 and 1 of the operation register bitfields (A)TOM[i]_CH[x]_CM1.CM1 and (A)TOM[i]_CH[x]_CM0.CM0.

Workaround 1

Select a CMU clock enable signal CMU_CLK/CMU_FXCLK by appropriate setting of (A)TOM[i]_CH[x]_CTRL.CLK_SRC which is setup inside the CMU module in that way, that each system clock is enabled. In other words this means that the selected clock enable signal CMU_CLK/CMU_FXCLK should be always active high.

Note: No frequency divider should be used for CMU_CLKz (only CMU_CLK_z_CTRL.B.CNT = 0) and CMU_FXCLKx (only CMU_FXCLK0).

Workaround 2

Avoid the compare values 0 and 1 for the operation register bitfields (A)TOM[i]_CH[x]_CM1.CM1 and (A)TOM[i]_CH[x]_CM0.CM0.

GTM_AI.349 TOM-SPE: OSM-Pulse width triggered by SPE_NIPD for selected CMU_FXCLK not correct

The SPE_NIPD signal is used to reset TOM_CH_CN0 and to generate a one-shot pulse. When the CMU_FXCLK of the corresponding TOM_CH is set to a value unequal to 0, there are two effects observed:

1. the first pulse triggered by SPE_NIPD is generated with the CMU_FXCLK(0), while any subsequent pulses are generated with the configured CMU_FXCLK;
2. the pulses generated with the correct CMU_FXCLK show no determinism. Some pulses end with CCU_TRIG1, some with CCU_TRIG0.

Scope

TOM, SPE

Effects

The OSM-Pulse width triggered by SPE_NIPD are not correct.

Workaround

Use SYS_CLK by selecting CMU_FXCLK(0) instead of a value unequal to zero for CMU_FXCLK.

To reach the same pulse width on the output signal, the value for the period (TOM[i]_CH[x]_CM0.CM0) and duty cycle (TOM[i]_CH[x]_CM1.CM1) has to be scaled due to the relationship between SYS_CLK and the needed CMU_FXCLK.

GTM_AI.350 TOM-SPE: Update of SPE[i]_OUT_CTRL triggered by SPE_NIPD not working for a delay value 1 in TOM[i]_CH[x]_CM1

When configured in one-shot mode some TOM channels can initiate a delayed change of register SPE_OUT_CTRL. The delay can be configured in TOM[i]_CH[x]_CM1 register of the corresponding TOM channel.

Expected behaviour:

The SPE_OUT_CTRL register changed its content after a delay of CMU_FXCLK cycles which are configured in the TOM channel. For CM1=0, no update is expected, for CM1=1, the update is expected with the next CMU_FXCLK, for CM1=2, a delay of two CMU_FXCLK clock cycles is expected.

Observed behaviour:

For CM1=1, there is no change of SPE_OUT_CTRL at all, independent of CMU_FXCLK.

Scope

TOM, SPE

Effects

The update of SPE_OUT_CTRL register is not executed.

Workaround

Use SYS_CLK by selecting CMU_FXCLK(0) instead of a value unequal to zero for CMU_FXCLK.

To get the trigger signal from TOM for the delayed update at the same time, the value for the period (TOM[i]_CH[x]_CM0.CM0) and duty cycle (TOM[i]_CH[x]_CM1.CM1) has to be scaled due to the relationship between SYS_CLK and the needed CMU_FXCLK.

GTM_AI.352 ATOM: No reload of data from ARU in SOMS and SOMP mode if TIM_EXT_CAPTURE(x) or TRIGIN(x) is selected as clock source

ATOM configuration:

- SOMP or SOMS mode (ATOM[i]_CH[x]_CTRL.MODE=0b10/0b11)
- ARU input stream enabled (ATOM[i]_CH[x]_CTRL.ARU_EN=1)
- TRIGIN(x) or TIM_EXT_CAPTURE(x) as selected clock source (ATOM[i]_CH[x]_CTRL.CLK_SRC=0b1101/0b1110)

Expected behaviour in SOMS mode:

ATOM Channel in SOMS mode shifts all data provided by ARU.

Observed behaviour in SOMS mode:

ATOM channel stops after data is shifted out which was stored in shift register ATOM[i]_CH[x]_CM1.CM1 by the CPU. Data which was transferred via ARU stays in shadow register ATOM[i]_CH[x]_SR1.SR1 and will not be reloaded into the shift register; instead the channel stops.

Expected behaviour in SOMP continuous mode:

Synchronized to the beginning of a new period ATOM Channel requests new data from ARU. The received values from ARU are stored into the shadow registers. If the actual period is ended the stored values are copied from the shadow registers into the operation registers for the new period. At the same time, a new read request to the ARU is started.

Observed behaviour in SOMP continuous mode:

ATOM Channel requests new data from ARU without synchronization to the beginning of a new period. The received values are stored into the shadow registers and then copied directly into the operation registers. The next ARU read request is started immediately without synchronization to the actual period.

SOMP one-shot mode together with the reloading of values via the ARU is not supported and is therefore not affected by this ERRATUM.

Scope

ATOM

Effects

The reloading and update of new values for the shadow registers from ARU doesn't happen. The channel stops.

Workaround

If TIM_EXT_CAPTURE(x) is to be used as clock source, this can be configured within the CCM as clock source for one of the CMU clock sources. This clock source must then be selected in the ATOM itself.

If TRIGIN(x) is to be used as clock source, the output signal of the ATOM channel, which delivers the trigger signal TRIGIN(x), can be routed to TIM input as AUX_IN signal. Now the TIM_EXT_CAPTURE(x) signal from this TIM module can be used with the same workaround as described before for TIM_EXT_CAPTURE(x) clock source. An additional clock delay of 3 cluster clocks would need to be considered for the generation of the TRIGIN(x) source.

GTM_AI.353 SPEC-ATOM: Specification of the smallest possible PWM Period in SOMP mode wrong, when ARU_EN=1

Configuration in use:

- ATOM[i]_CH[x]_CTRL.MODE=0b10 (SOMP),
- ATOM[i]_CH[x]_CTRL.ARU_EN=1,
- ATOM[i]_AGC_GLB_CTRL.UPEN_CTRLx=1

Functionality:

When ATOM[i]_CH[x]_CTRL.ARU_EN=1 and ATOM[i]_AGC_GLB_CTRL.UPEN_CTRLx=1 the PWM period and duty cycle (PWM characteristic) can be reloaded via ARU in SOMP mode. The ATOM generates a PWM on the operation registers ATOM[i]_CH[x]_CM0.CM0 and ATOM[i]_CH[x]_CM1.CM1 while the new values received via ARU are stored in the shadow registers ATOM[i]_CH[x]_SR0.SR0 and ATOM[i]_CH[x]_SR1.SR1.

Reloading of the ATOM[i]_CH[x]_CM0.CM0 and ATOM[i]_CH[x]_CM1.CM1 registers with the values from ATOM[i]_CH[x]_SR0.SR0 and ATOM[i]_CH[x]_SR1.SR1 takes place, when the old PWM period expires (ATOM[i]_CH[x]_CN0.CN0 reaches ATOM[i]_CH[x]_CM0.CM0 in up counter mode or ATOM[i]_CH[x]_CN0.CN0 reaches 0 in up/down counter mode).

Therefore, it is important, that the new PWM characteristic is available in the shadow registers ATOM[i]_CH[x]_SR0.SR0 and ATOM[i]_CH[x]_SR1.SR1 before ATOM[i]_CH[x]_CN0.CN0 reaches ATOM[i]_CH[x]_CM0.CM0 (up counter mode) or 0 (up/down counter mode).

Problem description:

The GTM-IP specification defines as minimal possible PWM period, where the PWM characteristic can be reloaded in a predictable manner so that new data is always available in time at the ATOM channel, to be the ARU round trip time of the specific microcontroller device. This is not correct, because the data needs two additional ARU clock cycles to flow through the ARU from a source to the ATOM channel plus one clock cycle for loading the value from the shadow registers ATOM[i]_CH[x]_SR0.SR0 and ATOM[i]_CH[x]_SR1.SR1 to the registers ATOM[i]_CH[x]_CM0.CM0 and ATOM[i]_CH[x]_CM1.CM1.

When the PWM period is smaller than the ARU round trip time plus three ARU clock cycles, the PWM output is not correct.

Scope

SPEC-ATOM

Effects

When the ATOM channel operates in SOMP mode and receives updates of PWM period and/or duty cycle via ARU, new PWM period and/or duty cycle values get lost, when the PWM Period is smaller than the ARU round trip time plus one or two ARU clock cycles for the given microcontroller device the PWM Period runs on.

Workaround

The PWM period has to be larger than ARU round trip time + 3 ARU clock cycles. Alternatively use ARU dynamic routing, or reduce the value of ARU_CADDR_END to a value, which fits the PWM period. So, PWM period greater than ARU_CADDR_END + 1 + 3 ARU clock cycles.

GTM_AI.358 TOM/ATOM: Synchronous update of working register for RST_CCU0=1 and UDMODE=0b01 not correct

TOM/ATOM is configured in SOMP mode with ATOM[i]_CH[x]_CTRL.MODE=”10” (only for ATOM) and up-down counter mode is enabled by setting of (A)TOM[i]_CH[x]_CTRL.UDMODE=0b01. With the additional configuration of (A)TOM[i]_CH[x]_CTRL.RST_CCU0=1, the counter direction from up to down is changed with the trigger signal from a preceding channel TRIGIN[x] or with the TIM_EXT_CAPTURE signal from TIM module.

Expected behaviour:

The synchronous update of the working registers (A)TOM[i]_CH[x]_CM0 and (A)TOM[i]_CH[x]_CM1 in this configuration shall be done only when the channel counter (A)TOM[i]_CH[x]_CN0 reaches zero.

Observed behaviour:

Additionally to the update of the working registers (A)TOM[i]_CH[x]_CM0 and (A)TOM[i]_CH[x]_CM1 when the channel counter (A)TOM[i]_CH[x]_CN0 reaches zero, the update is executed with the selected trigger signal TRIGIN[x] or TIM_EXT_CAPTURE(x). This is not expected in this configuration with (A)TOM[i]_CH[x]_CTRL.UDMODE=0b01.

Scope

TOM, ATOM

Effects

The synchronous update of the working register (A)TOM[i]_CH[x]_CM0 and (A)TOM[i]_CH[x]_CM1 is done unintendedly with the selected trigger signal TRIGIN[x] or TIM_EXT_CAPTURE.

Workaround

For settings where the PWM phases are longer than the register access times on target system: Ensure to deliver new data to the associated shadow registers (A)TOM[i]_CH[x]_SR0 and (A)TOM[i]_CH[x]_SR1 only when the channel counter ATOM[i]_CH[x]_CN0 is in down counting phase. The down counting phase is reported by the according interrupt.

The described workaround is only possible for ATOM as long as the ARU interface is disabled and the new shadow register values are delivered by configuration interface and not by ARU interface.

GTM_AI.359 TOM: Both edges on TOM_OUT_T at unexpected times for RST_CCU0=1 and UDMODE>0

TOM channel is configured in up-down counter mode by setting of TOM[i]_CH[x]_CTRL.UDMODE>0 and the channel is triggered by a preceding channel or by TIM_EXT_CAPTURE with configuration of TOM[i]_CH[x]_CTRL.RST_CCU0=1.

Expected behaviour:

In up-counting phase, the output signal TOM_OUT is set to SL when CN0 >= CM1 and the second output signal TOM_OUT_T has to be set to SL when CN0 >= CM0.

In down-counting phase the output signals has to be set to !SL when CN0 < CM1/CM0.

Observed behaviour:

The second output signal TOM_OUT_T is set to SL in upcounting phase when CN0 >= CM0 - 1, which is one CMU clock cycle to early.

When the counter is counting down, the output signal TOM_OUT_T is set to !SL when CN0 < CM0 - 1, which is one CMU clock cycle too late.

Scope

TOM

Effects

The second output signal TOM_OUT_T is set one CMU clock cycle too early in up-counting phase and one CMU clock cycle to late in down-counting phase.

Workaround

The compare value TOM[i]_CH[x]_CM0 for the second output signal TOM_OUT_T has to be configured with a value which is greater by one (CM0+1).

GTM_AI.360 SPEC-(A)TOM: PCM mode (BITREV=1) is only available for UDMODE=0

If TOM/ATOM channel is configured in PCM mode with (A)TOM[i]_CH[x]_CTRL.BITREV=1, the channel may be configured in up-counting mode only with (A)TOM[i]_CH[x]_CTRL.UDMODE=0.

Up-down counting mode ((A)TOM[i]_CH[x]_CTRL.UDMODE>0) is not supported for PCM mode.

Scope

TOM, ATOM

Effects

The user is not aware that the combination of PCM mode together with up-down counting mode is not supported and may not be used.

Workaround

Do not use the combination of PCM mode together with up-down counting mode.

GTM_AI.361 IRQ: Missing pulse in single-pulse interrupt mode on simultaneous interrupt and clear event

In single-pulse interrupt mode ([MODULE]_IRQ_MODE = 0b11) only the first interrupt event of the interrupt bits of the interrupt notify register inside this module generates a pulse on the output signal IRQ_line, if the associated interrupt is enabled ([MODULE]_IRQ_EN=1). All further interrupt events have no effect on the output signal IRQ_line until all enabled interrupts are cleared, except when an interrupt and a clear event (HW_clear or a SW_clear) occur at the same time.

Expected behaviour:

On simultaneous occurrence of an interrupt and clear event, a pulse on the output signal IRQ_line is generated.

Observed behaviour:

If the associated notify register bit of the interrupt event is not set and another bit of the same notify register is set and this interrupt is enabled, no pulse on the output signal IRQ_line is generated.

All modules ([MODULE]) are affected by this ERRATUM, which are able to generate interrupts and which have multiple interrupt sources which are ORed to the output. Not affected are the modules DPLL and ARU.

Scope

IRQ

Effects

Missing pulse on interrupt signal IRQ_line.

All modules, which deliver an interrupt signal and have more than one internal interrupt source which are ORed are affected. The only exceptions are the modules ARU and DPLL.

Workaround

On a SW clear prevent HW clear events and read the interrupt notify register to check on new interrupts without a received interrupt pulse on IRQ_line. In this case repeat the SW clear step to enable interrupt generation again.

When disabling the HW clear is not an option refrain from using the single-pulse interrupt mode.

GTM_AI.364 ATOM: ARU read request does not start at expected time-point in UDMODE=1 and UDMODE=3

ATOM is configured in SOMP continuous up-down counter mode with UDMODE=1,3 and ARU interface is enabled by setting of ARU_EN=1.

Expected behaviour:

A new ARU read request has to be started always after the operation registers are updated from their shadow registers. This depends on the UDMODE configuration:

- UDMODE=1: New ARU read request after CN0 changes the count direction from down to up.
- UDMODE=2: New ARU read request after CN0 changes the count direction from up to down.
- UDMODE=3: New ARU read request in both cases.

Observed behaviour:

A new ARU read request is always started when the counter CN0 changes the count direction from up to down, independently from UDMODE configuration.

- UDMODE=1: New ARU read request after CN0 changes the count direction from up to down.
- UDMODE=2: Works as expected.
- UDMODE=3: New ARU read request after CN0 changes the count direction from up to down.

Scope

ATOM

Effects

The effect depends on the UDMODE configuration:

- UDMODE=1: The remaining time, from starting a ARU read request until new data from ARU should be received is only half of the defined PWM period instead of the full PWM period.
- UDMODE=3: No new ARU read request is started when the counter CN0 changes the count direction from down to up and therefore no new data can be delivered in this case.

Workaround

Workaround for UDMODE=1:

The PWM period length in up-down counter mode has to be double the length as the ARU round trip cycle (plus 3 ARU clock cycles).

Workaround for UDMODE=3:

Use AEI interface for reloading new shadow register values instead of ARU.

GTM_AI.370 TOM/ATOM: Unexpected reset of CN0 in up-down counter mode and CM0=2

TOM/ATOM is configured in SOMP mode with ATOM[i]_CH[x]_CTRL.MODE=0b10 (only for ATOM) and up-down counter mode is enabled by setting of (A)TOM[i]_CH[x]_CTRL.UDMODE != 0b00.

Expected behaviour:

In this case, the counter CN0 changes its count direction from up to down either until CN0 reaches CM0-1 for RST_CCU0=0 or with the selected trigger signal TRIGIN (EXT_TRIG=0) or EXT_TRIGIN (EXT_TRIG=1) for RST_CCU0=1.

Observed behaviour:

There are three different configuration scenarios, where the counter CN0 is unexpectedly reset.

- 1. In case of RST_CCU0=0:
  - The period value inside CM0 is configured to 2 and then reconfigured to a value greater than 2. After the counter CN0 starts incrementing and reaches value 1, CN0 is once reset to 0 unexpectedly, before it starts incrementing again.
- 2. In case of RST_CCU0=1 and EXT_TRIG=0:
  - The TRIGIN signal from a preceding channel is used to reset the count direction of CN0.
  - After the period value CM0 of the preceding channel is reconfigured from value 2 to a greater value, CN0 of this channel, which is triggered by the preceding channel, is once reset to 0 similar to the first scenario, which happens in the preceding channel.
- 3. In case of RST_CCU0=1 and EXT_TRIG=1:
  - The EXT_TRIGIN signal from TIM module is used to reset the count direction of CN0.
  - If the EXT_TRIGIN signal occurs while the counter CN0 is incrementing and reaches the value 1, CN0 is once reset unexpectedly. However, there is already no deterministic dependency between the EXT_TRIGIN signal and the reset of CN0.

Scope

TOM, ATOM

Effects

Unexpected reset of the counter CN0.

Workaround

No workaround available. The following limitations have to be considered:

- For scenario 1 and 2:
  - Do not use value 2 for the period, which is configured inside CM0.
- For scenario 3:
  - Do not use EXT_TRIGIN as trigger signal to change the count direction in up-down counter mode.

GTM_AI.374 SPEC-ATOM: Statement on timing of duty cycle output level change not correct for SOMP up/down-counter mode

The duty cycle output level is determined by ATOM[i]_CH[x]_CTRL.SL bit. The specification describes in section 15.3.3 “ATOM Signal output mode PWM (SOMP)” of the GTM chapter in the AURIX™ TC3xx User’s Manual, that “the duty cycle output level can be changed during runtime by writing the new duty cycle level into SL bit of the channels configuration register” (section 15.3.3.4). Further, it is mentioned: “the new signal level becomes active for the next trigger CCU_TRIGx (since bit SL is written)”.

However, the timing specification in the second part of the statement is only valid for the SOMP in up-counter mode. When the ATOM is configured in SOMP up/down-counter mode, the new signal level becomes immediately active, when the ATOM[i]_CH[x]_CTRL.SL bit is written.

Scope

ATOM

Effects

When the ATOM channel is configured in SOMP up/down-counter mode, a change of bit ATOM[i]_CH[x]_CTRL.SL will be visible immediately after the value is written by software and not, as described in the specification, with the next compare match event of one of the CCUx compare units.

Workaround

No workaround for SOMP up/down-counter mode. Use SOMP up-counter mode, if update of SL-Bit needed during runtime.

GTM_AI.375 ATOM: Data from ARU are read only once in SOMC mode even though ARU blocking mode is disabled while FREEZE=1 and EN-DIS=0

ATOM is configured in SOMC mode and ARU input stream is enabled and ARU blocking mode is disabled.

Configuration register setting:

ATOM[i]_CH[x]_CTRL.MODE==0b01 (SOMC mode)

ATOM[i]_CH[x]_CTRL.ARU_EN==0b1 (ARU input stream enabled)

ATOM[i]_CH[x]_CTRL.ABM==0b0 (ARU blocking mode disabled)

Expected behaviour:

If the channel gets disabled while ATOM[i]_CH[x]_CTRL.FREEZE is set, a pending ARU read request will still be held active, even if the current request is served from ARU with valid data. This is the expected non-blocking behavior.

Observed behaviour:

If the channel gets disabled while ATOM[i]_CH[x]_CTRL.FREEZE is set and afterwards the ARU read request is served by an ARU read valid, the ARU read request is reset and no more data is requested from ARU interface. This corresponds to a blocking behavior.

Scope

ATOM

Effects

In SOMC mode and activated FREEZE mode, reading new compare values stops after the first received data instead of continuing data reads.

Workaround

Instead of using the ARU interface for reloading new compare values while the channel is in FREEZE mode, the configuration interface can be used to deliver the new compare values.

If DPLL is used as data source for the ATOM compare values, an MCS channel has to be used to first read the data from DPLL by ARU interface and afterwards to write the data via MCS master interface to ATOM. The used MCS module has to be in the same cluster as the ATOM module.

GTM_AI.376 TOM/ATOM: Interrupt trigger signals CCU0TC_IRQ and CCU1TC_IRQ are delayed by one CMU_CLK period related to the output signals

Interrupt trigger signals CCU0TC_IRQ and CCU1TC_IRQ are delayed by one CMU_CLK period if the following configurations are used:

1. Both CCU0TC_IRQ and CCU1TC_IRQ are affected (ATOM: in SOMP mode) when the channel is configured in up-down counter mode ((A)TOM[i]_CH[x]_CTRL.UDMODE>0)
2. CCU1TC_IRQ only is affected (ATOM: in SOMP mode) when the channel is configured in up-counter mode ((A)TOM[i]_CH[x]_CTRL.UDMODE==0) and (A)TOM[i]_CH[x]_CTRL.SR0_TRIG is enabled

Scope

ATOM, TOM

Effects

Interrupt signals CCU0TC_IRQ and CCU1TC_IRQ are raised with a delay of one CMU_CLK period.

Depending on the CMU_CLK period related to system frequency outside of the GTM this can be an issue or none at all.

Workaround

No workaround available.

GTM_TC.020 Debug/Normal read access control via bit field ODA.DRAC

A few GTM registers have a different read behavior when accessing them with debug read accesses (see section “GTM Software Debugger Support” in the GTM chapter of the User’s Manual for further details).

Depending on the reading master and the configuration of bit field DRAC in register GTM_ODA (OCDS Debug Access Register), the read can be performed in a specific way for debug related read operation.

According to the User’s Manual the read is performed as a debug read operation

- for all masters when ODA.DRAC = 10_B or 11_B,
- for the Cerberus (OCDS) FPI master when ODA.DRAC = 00_B

Problem Description

In the current implementation the read is performed as debug read operation

- for all masters when ODA.DRAC = 10 or 11_B,
- for the CPU2 FPI master when ODA.DRAC = 00_B

Workaround

The problem described above has 2 aspects:

1. For CPU2 Access to GTM

When the CPU2 FPI master is used to perform a normal read of the GTM registers mentioned above, setting ODA.DRAC = 01_B is required to avoid an unintended debug read access that would be caused by this issue.

2. For Cerberus (OCDS) Access to GTM

When ODA.DRAC = 00_B, due to this problem any read access of the Cerberus (OCDS) FPI master to the registers that by default have a different behavior between normal and debug read will cause the normal read behavior. To get the intended debug read behavior, ODA.DRAC needs to be set to 10_B or 11_B before each access of the Cerberus and set back to 00_B afterwards to not affect the access of other FPI masters on the registers mentioned above.

GTM_TC.021 Registers CANOUTSEL0, CANOUTSEL1 - Documentation update for fields SELx (x = 0, 1)

The description in the current version of the product specific TC3xx Appendix regarding fields SELx (x = 0, 1) in registers CANOUTSEL0 and CANOUTSEL1 is partly incorrect and will be updated as shown in the following tables.

Note: The changes only affect settings $8_H..F_H$ in fields SEL0 and SEL1 of registers CANOUTSEL0 and CANOUTSEL1, respectively.

Table 7 GTM_CANOUTSEL0 - CAN0/CAN1 Output Select Register - Documentation update for fields SELx (x = 0, 1)

Field	Description	
SELx (x = 0)	**Output Selection for GTM to CAN connection x** This bit field defines which TOM/ATOM channel output is used as CAN0/CAN1 node trigger x.	
	$0_H..7_H$	- No change: see description in TC3xx Appendix-
	8_H	**CDTM0_DTM1_2, TOM0_6**, Dead-time output of TOM0, channel 6
	9_H	**CDTM0_DTM1_3, TOM0_7**, Dead-time output of TOM0, channel 7

Table 7 GTM_CANOUTSEL0 - CAN0/CAN1 Output Select Register - Documentation update for fields SELx (x = 0, 1) (cont'd)

Field	Description	
	A_H	**TOM0_13**, Output of TOM0, channel 13
	B_H	**TOM0_14**, Output of TOM0, channel 14
	C_H	**CDTM0_DTM5_0, ATOM0_4**, Dead-time output of ATOM0, channel 4
	D_H	**CDTM0_DTM5_1, ATOM0_5**, Dead-time output of ATOM0, channel 5
	E_H	**CDTM0_DTM5_2, ATOM0_6**, Dead-time output of ATOM0, channel 6
	F_H	**CDTM0_DTM5_3, ATOM0_7**, Dead-time output of ATOM0, channel 7
SELx (x = 1)	**Output Selection for GTM to CAN connection x** This bit field defines which TOM/ATOM channel output is used as CAN0/CAN1 node trigger x.	
	$0_H..7_H$	- No change: see description in TC3xx Appendix-
	8_H	**CDTM1_DTM1_2, TOM1_6**, Dead-time output of TOM1, channel 6
	9_H	**CDTM1_DTM1_3, TOM1_7**, Dead-time output of TOM1, channel 7
	A_H	**TOM1_13**, Output of TOM1, channel 13
	B_H	**TOM1_14**, Output of TOM1, channel 14
	C_H	**CDTM1_DTM5_0, ATOM1_4**, Dead-time output of ATOM1, channel 4
	D_H	**CDTM1_DTM5_1, ATOM1_5**, Dead-time output of ATOM1, channel 5
	E_H	**CDTM1_DTM5_2, ATOM1_6**, Dead-time output of ATOM1, channel 6
	F_H	**CDTM1_DTM5_3, ATOM1_7**, Dead-time output of ATOM1, channel 7

Table 8 GTM_CANOUTSEL1 - CAN2 Output Select Register - Documentation update for fields SELx (x = 0, 1)

Field	Description	
SELx (x = 0)	**Output Selection for GTM to CAN connection x** This bit field defines which TOM/ATOM channel output is used as CAN2 node trigger x.	
	$0_H..7_H$	- No change: see description in TC3xx Appendix-
	8_H	**CDTM0_DTM1_2, TOM0_6**, Dead-time output of TOM0, channel 6
	9_H	**CDTM0_DTM1_3, TOM0_7**, Dead-time output of TOM0, channel 7
	A_H	**TOM0_13**, Output of TOM0, channel 13
	B_H	**TOM0_14**, Output of TOM0, channel 14
	C_H	**CDTM0_DTM5_0, ATOM0_4**, Dead-time output of ATOM0, channel 4
	D_H	**CDTM0_DTM5_1, ATOM0_5**, Dead-time output of ATOM0, channel 5
	E_H	**CDTM0_DTM5_2, ATOM0_6**, Dead-time output of ATOM0, channel 6
	F_H	**CDTM0_DTM5_3, ATOM0_7**, Dead-time output of ATOM0, channel 7
SELx (x = 1)	**Output Selection for GTM to CAN connection x** This bit field defines which TOM/ATOM channel output is used as CAN0/CAN1 node trigger x.	
	$0_H..7_H$	- No change: see description in TC3xx Appendix-
	8_H	**CDTM1_DTM1_2, TOM1_6**, Dead-time output of TOM1, channel 6
	9_H	**CDTM1_DTM1_3, TOM1_7**, Dead-time output of TOM1, channel 7
	A_H	**TOM1_13**, Output of TOM1, channel 13
	B_H	**TOM1_14**, Output of TOM1, channel 14

Table 8 GTM_CANOUTSEL1 - CAN2 Output Select Register - Documentation update for fields SELx (x = 0, 1) (cont'd)

Field	Description	
	C_H	**CDTM1_DTM5_0, ATOM1_4**, Dead-time output of ATOM1, channel 4
	D_H	**CDTM1_DTM5_1, ATOM1_5**, Dead-time output of ATOM1, channel 5
	E_H	**CDTM1_DTM5_2, ATOM1_6**, Dead-time output of ATOM1, channel 6
	F_H	**CDTM1_DTM5_3, ATOM1_7**, Dead-time output of ATOM1, channel 7

GTM_TC.022 Register ATOMi_AGC_ENDIS_STAT - Documentation Update

Note: This erratum might affect the SFR C Header Definitions. In such cases, SFR usage in the software shall be analyzed within the applications for their correct handling.

In the description of register ATOMi_AGC_ENDIS_STAT (i=0-11) in the GTM chapter of the current version of the TC3xx User's Manual,

- the symbolic bit names in the register image and in column "Field" shall be changed from ENDIS_CTRLx to ENDIS_**STATx** (x=0-7);
- in column "Description", the description shall be extended with the behavior on a read access as shown below:
  - Write access:
    0b00 Don't care, bits will not be changed
    0b01 Disable channel
    0b10 Enable channel
    0b11 Don't care, bits will not be changed
  - **Read access:**
    0b00 Channel disabled
    0b01 Unused
    0b10 Unused
    0b11 Channel enabled

MCMCAN_AI.015 Edge filtering causes mis-synchronization when falling edge at Rx input pin coincides with end of integration phase

When edge filtering is enabled (CCCRi.EFBI = ’1’) and when the end of the integration phase coincides with a falling edge at the Rx input pin it may happen, that the MCMCAN synchronizes itself wrongly and does not correctly receive the first bit of the frame. In this case the CRC will detect that the first bit was received incorrectly, it will rate the received FD frame as faulty and an error frame will be send.

The issue only occurs, when there is a falling edge at the Rx input pin within the last time quantum (tq) before the end of the integration phase. The last time quantum of the integration phase is at the sample point of the 11th recessive bit of the integration phase. When the edge filtering is enabled, the bit timing logic of the MCMCAN sees the Rx input signal delayed by the edge filtering. When the integration phase ends, the edge filtering is automatically disabled. This affects the reset of the FD CRC control unit at the beginning of the frame. The Classical CRC control unit is not affected, so this issue does not affect the reception of Classical frames.

In CAN communication, the MCMCAN may enter integrating state (either by resetting CCCRi.INIT or by protocol exception event) while a frame is active on the bus. In this case the 11 recessive bits are counted between the acknowledge bit and the following start of frame. All nodes have synchronized at the beginning of the dominant acknowledge bit. This means that the edge of the following start of frame bit cannot fall on the sample point, so the issue does not occur. The issue occurs only when the MCMCAN is, by local errors, mis-synchronized with regard to the other nodes, or not synchronized at all.

Glitch filtering as specified in ISO 11898-1:2015 is fully functional.

Edge filtering was introduced for applications where the data bit time is at least two tq (of the nominal bit time) long. In that case, edge filtering requires at least two consecutive dominant time quanta before the counter counting the 11 recessive bits for idle detection is restarted. This means edge filtering covers the theoretical case of occasional 1-tq-long dominant spikes on the CAN bus that would delay idle detection. Repeated dominant spikes on the CAN bus would disturb all CAN communication, so the filtering to speed up idle detection would not help network performance.

When this rare event occurs, the MCMCAN sends an error frame and the sender of the affected frame retransmits the frame. When the retransmitted frame is received, the MCMCAN has left integration phase and the frame will be received correctly. Edge filtering is only applied during integration phase, it is never used during normal operation. As integration phase is very short with respect to “active communication time”, the impact on total error frame rate is negligible. The issue has no impact on data integrity.

The MCMCAN enters integration phase under the following conditions:

- when CCCRi.INIT is set to ’0’ after start-up
- after a protocol exception event (only when CCCRi.PXHD = ’0’).

Scope

The erratum is limited to FD frame reception when edge filtering is active (CCCRi.EFBI = ’1’) and when the end of the integration phase coincides with a falling edge at the Rx input pin.

Effects

The calculated CRC value does not match the CRC value of the received FD frame and the MCMCAN sends an error frame. After retransmission the frame is received correctly.

Workaround

Disable edge filtering or wait on retransmission in case this rare event happens.

MCMCAN_AI.017 Retransmission in DAR mode due to lost arbitration at the first two identifier bits

When the MCMCAN CAN Node is configured in DAR mode (CANx.CCCRi.DAR = ’1’) the Automatic Retransmission for transmitted messages that have been disturbed by an error or have lost arbitration is disabled. When the transmission attempt is not successful, the Tx Buffer’s transmission request bit (CANx.TXBRPi.TRPz) shall be cleared and its cancellation finished bit (CANx.TXBCFi.CFz) shall be set.

When the transmitted message loses arbitration at one of the first two identifier bits, it may happen, that instead of the bits of the actually transmitted Tx Buffer, the CANx.TXBRPi.TRPz and CANx.TXBCFi.CFz bits of the previously started Tx Buffer (or Tx Buffer 0 if there is no previous transmission attempt) are written (CANx.TXBRPi.TRPz = ’0’, CANx.TXBCFi.CFz = ’1’).

If in this case the CANx.TXBRPi.TRPz bit of the Tx Buffer that lost arbitration at the first two identifier bits has not been cleared, retransmission is attempted.

When the CAN Node loses arbitration again at the immediately following retransmission, then actually and previously transmitted Tx Buffer are the same and this Tx Buffer’s CANx.TXBRPi.TRPz bit is cleared and its CANx.TXBCFi.CFz bit is set.

Scope

The erratum is limited to the case when the MCMCAN CAN Node loses arbitration at one of the first two transmitted identifier bits while in DAR mode.

The problem does not occur when the transmitted message has been disturbed by an error.

Effects

In this case it may happen, that the CANx.TXBRPi.TRPz bit is cleared after the second transmission attempt instead of the first.

Additionally it may happen that the CANx.TXBRPi.TRPz bit of the previously started Tx Buffer is cleared, if it has been set again. As in this case the previously started Tx Buffer has lost MCMCAN internal arbitration against the active Tx Buffer, its message has a lower identifier priority. It would also have lost arbitration on the CAN bus at the same position.

Workaround

None.

MCMCAN_AI.018 Tx FIFO Message Sequence Inversion

Assume the case that there are two Tx FIFO messages in the output pipeline of the Tx Message Handler (TxMH) and transmission of Tx FIFO message 1 is started:

- Position 1: Tx FIFO message 1 (transmission ongoing)
- Position 2: Tx FIFO message 2
- Position 3: --

Now a non-Tx FIFO message with a higher CAN priority is requested. Due to its priority it will be inserted into the output pipeline. The TxMH performs so called “message-scans” to keep the output pipeline up to date with the highest priority messages from the Message RAM. After the following two message-scans the output pipeline has the following content:

- Position 1: Tx FIFO message 1 (transmission ongoing)
- Position 2: non Tx FIFO message with higher CAN priority
- Position 3: Tx FIFO message 2

If the transmission of Tx FIFO message 1 is not successful (lost arbitration or CAN bus error) it is pushed from the output pipeline by the non-Tx FIFO message with higher CAN priority. The following scan re-inserts Tx FIFO message 1 into the output pipeline at position 3:

- Position 1: non Tx FIFO message with higher CAN priority (transmission ongoing)
- Position 2: Tx FIFO message 2
- Position 3: Tx FIFO message 1

Now Tx FIFO message 2 is in the output pipeline in front of Tx FIFO message 1 and they are transmitted in that order, resulting in a message sequence inversion.

Note: Within the scope of the scenario described above, in case of more than two Tx FIFO messages, the Tx FIFO message that has lost arbitration will be inserted after the next pending Tx FIFO message.

Scope:

The erratum describes the case when the MCMCAN uses both, dedicated Tx Buffers and a Tx FIFO (CAN_TXBCi.TFQM = ’0’) and the messages in the Tx

FIFO do not have the highest internal CAN priority. The described sequence inversion may also happen between two non-Tx FIFO messages (Tx Queue or dedicated Tx Buffers) that have the same CAN identifier and that should be transmitted in the order of their buffer numbers (not the intended use).

Effects:

In the described case it may happen that two consecutive messages from the Tx FIFO exchange their positions in the transmit sequence.

Workaround

When transmitting messages from a dedicated Tx Buffer with higher priority than the messages in the Tx FIFO, choose one of the following workarounds:

First Workaround:

Use two dedicated Tx Buffers, e.g. use Tx Buffers 4 and 5 instead of the Tx FIFO.

The pseudo-code below replaces the function that fills the Tx FIFO.

- Write message to Tx Buffer 4
- Transmit Loop:
  - Request Tx Buffer 4 - write TXBAR.A4
  - Write message to Tx Buffer 5
  - Wait until transmission of Tx Buffer 4 completed – CAN_IRi.TC, read CAN_TXBTOi.TO4
  - Request Tx Buffer 5 - write CAN_TXBARi.AR5
  - Write message to Tx Buffer 4
  - Wait until transmission of Tx Buffer 5 completed – CAN_IRi.TC, read CAN_TXBTOi.TO5

Second Workaround:

Assure that only one Tx FIFO element is pending for transmission at any time. The Tx FIFO elements may be filled at any time with messages to be transmitted, but their transmission requests are handled separately. Each time a Tx FIFO transmission has completed and the Tx FIFO gets empty (CAN_IRi.TFE = ’1’) the next Tx FIFO element is requested.

Third Workaround:

Use only a Tx FIFO. Send the message with the higher priority also from Tx FIFO.

Drawback: The higher priority message has to wait until the preceding messages in the Tx FIFO have been sent.

MCMCAN_AI.019 Unexpected High Priority Message (HPM) interrupt

There are two configurations where the issue occurs:

Configuration A:

- At least one Standard Message ID Filter Element is configured with priority flag set (S0.SFEC = “100”/”101”/”110”)
- No Extended Message ID Filter Element configured
- Non-matching extended frames are accepted (GFC.ANFE = “00”/”01”)

The HPM interrupt flag IR.HPM is set erroneously on reception of a non-high-priority extended message under the following conditions:

1. A standard HPM frame is received, and accepted by a filter with priority flag set
   --> Interrupt flag IR.HPM is set as expected
2. Next an extended frame is received and accepted because of GFC.ANFE configuration
   --> Interrupt flag IR.HPM is set erroneously

Configuration B:

- At least one Extended Message ID Filter Element is configured with priority flag set (F0.EFEC = “100”/”101”/”110”)
- No Standard Message ID Filter Element configured
- Non-matching standard frames are accepted (GFC.ANFS = “00”/”01”)

The HPM interrupt flag IR.HPM is set erroneously on reception of a non-high-priority standard message under the following conditions:

1. An extended HPM frame is received, and accepted by a filter with priority flag set
   --> Interrupt flag IR.HPM is set as expected
2. Next a standard frame is received and accepted because of GFC.ANFS configuration
   --> Interrupt flag IR.HPM is set erroneously

Scope

The erratum is limited to:

- Configuration A:
  – No Extended Message ID Filter Element configured and non-matching extended frames are accepted due to Global Filter Configuration (GFC.ANFE = “00”/”01”).
- Configuration B:
  – No Standard Message ID Filter Element configured and non-matching standard frames are accepted due to Global Filter Configuration (GFC.ANFS = “00”/”01”).

Effects

Interrupt flag IR.HPM is set erroneously at the reception of a frame with:

- Configuration A: extended message ID
- Configuration B: standard message ID

Workaround

Configuration A:

Setup an Extended Message ID Filter Element with the following configuration:

- F0.EFEC = “001”/”010” - select Rx FIFO for storage of extended frames
- F0.EFID1 = any value - value not relevant as all ID bits are masked out by F1.EFID2
- F1.EFT = “10” - classic filter, F0.EFID1 = filter, F1.EFID2 = mask
- F1.EFID2 = zero - all bits of the received extended ID are masked out

Now all extended frames are stored in Rx FIFO 0 respectively Rx FIFO 1 depending on the configuration of F0.EFEC.

Configuration B:

Setup a Standard Message ID Filter Element with the following configuration:

- S0.SFEC = “001”/”010” - select Rx FIFO for storage of standard frames
- S0.SFID1 = any value - value not relevant as all ID bits are masked out by S0.SFID2
- S0.SFT = “10” - classic filter, S0.SFID1 = filter, S0.SFID2 = mask
- S0.SFID2 = zero - all bits of the received standard ID are masked out

Now all standard frames are stored in Rx FIFO 0 respectively Rx FIFO 1 depending on the configuration of S0.SFEC.

MCMCAN_AI.022 Message order inversion when transmitting from dedicated Tx Buffers configured with same Message ID

Configuration

Several Tx Buffers are configured with the same Message ID. Transmission of these Tx Buffers is requested sequentially with a delay between the individual Tx requests.

Expected behaviour

When multiple Tx Buffers that are configured with the same Message ID have pending Tx requests, they shall be transmitted in ascending order of their Tx Buffer numbers. The Tx Buffer with lowest buffer number and pending Tx request is transmitted first.

Observed behaviour

It may happen, depending on the delay between the individual Tx requests, that in the case where multiple Tx Buffers are configured with the same Message ID the Tx Buffers are not transmitted in order of the Tx Buffer number (lowest number first).

Scope

The erratum is limited to the case when multiple Tx Buffers are configured with the same Message ID.

Effects

In the case described it may happen that Tx Buffers configured with the same Message ID and pending Tx request are not transmitted with lowest Tx Buffer number first (message order inversion).

Workaround

First write the group of Tx messages with same Message ID to the Message RAM and then afterwards request transmission of all these messages concurrently by a single write access to **TXBARi**. Before requesting a group of Tx messages with this Message ID ensure that no message with this Message ID has a pending Tx request.

MCMCAN_AI.023 Incomplete description in section *.5.2 “Dedicated Tx Buffers” and *.5.4 “Tx Queue” of the M_CAN documentation in the User’s Manual related to transmission from multiple buffers configured with the same Message ID

*Note: The absolute chapter number * depends on the version of the User’s Manual.*

Section *.5.2 Dedicated Tx Buffers

Wording User’s Manual

In case that multiple dedicated Tx Buffers are configured with the same Message ID, the Tx Buffer with the lowest buffer number is transmitted first.

Enhancement - additional text

These Tx buffers shall be requested in ascending order with lowest buffer number first.

Alternatively all Tx buffers configured with the same Message ID can be requested simultaneously by a single write access to **TXBARi**.

Section *.5.4 Tx Queue

Wording User's Manual - to be deleted

In case that multiple Queue Buffers are configured with the same Message ID, the Queue Buffer with the lowest buffer number is transmitted first.

Replacement

In case that multiple Tx Queue buffers are configured with the same Message ID, the transmission order depends on numbers of the buffers where the messages were stored for transmission. As these buffer numbers depend on the then current states of the PUT index, a prediction of the transmission order is not possible.

Wording User's Manual - to be deleted

An Add Request cyclically increments the Put Index to the next free Tx Buffer.

Replacement

The Put Index always points to that free buffer of the Tx Queue with the lowest buffer number.

Scope

Use of multiple dedicated Tx Buffers or Tx Queue buffers configured with same Message ID.

Effects

In case the dedicated Tx buffers with the same Message ID are not requested in ascending order or at the same time or in case of multiple Tx Queue buffers with the same Message ID, it cannot be guaranteed, that these messages are transmitted in ascending order with lowest buffer number first.

Workaround

In case a defined order of transmission is required the Tx FIFO shall be used for transmission of messages with the same Message ID. Alternatively dedicated Tx buffers with same Message ID shall be requested in ascending

order with lowest buffer number first or by a single write access to **TXBARi**. Alternatively a single Tx Buffer can be used to transmit those messages one after the other.

MEMMAP_TC.001 Size of PFLASH and DFLASH - Correction to TC33xEXT and TC33x/TC32x Appendix

Note: This issue only affects V1.6.0 and V2.0.0 of the TC33xEXT and the TC33x/TC32x Appendix.

Versions V1.6.0 and V2.0.0 include incorrect sizes and address ranges for PFLASH (3 Mbyte instead of 2 Mbyte) and DFLASH DF0 (1 Mbyte instead of 128 Kbyte) in table “Address Map as seen by Bus Masters on Bus SRI” in the MEMMAP chapter of the TC33xEXT and TC33x/TC32x Appendix.

Earlier versions (V1.2.0 .. V1.5.0) of the TC33xEXT and TC33x/TC32x Appendix correctly specify the sizes and address ranges for PFLASH (2 Mbyte) and DFLASH DF0 (128 Kbyte).

Documentation correction

The sizes and address ranges for PFLASH and DFLASH DF0 in table “Address Map as seen by Bus Masters on Bus SRI” in the MEMMAP chapter of the TC33xEXT and TC33x/TC32x Appendix V1.6.0 and V2.0.0 shall be corrected as shown in the following table.

Table 9 Address Map as seen by Bus Masters on Bus SRI - Corrections

Address Range		Size	Unit
from	**to**		
80000000_H	$801FFFFF_H$	2 Mbyte	Program Flash (PFI0)
80200000_H	$8FDFFFFF_H$	-	Reserved
$A0000000_H$	$A01FFFFF_H$	2 Mbyte	Program Flash (PFI0_NC)
$A0200000_H$	$A7FFFFFF_H$	-	Reserved

Table 9 Address Map as seen by Bus Masters on Bus SRI - Corrections (cont'd)

Address Range		Size	Unit
from	**to**		
$AF000000_H$	$AF01FFFF_H$	128 Kbyte	Data Flash 0 EEPROM (DF0) and Host Command
$AF020000_H$	$AF3FFFFF_H$	-	Reserved

MTU_TC.012 Security of CPU Cache Memories During Runtime is Limited

MTU chapter "Security Applications" in the User's Manual describes that selected memories with potentially security relevant content are initialized under certain conditions to prevent reading of their data or supplying manipulated data.

The description is correct, but the initialization of CPU cache and cache tag memories triggered by MBIST enable/disable and when mapping/un-mapping these memories to/from system address space using MEMMAP register is of limited value:

- These memories stay functional as cache in the address mapped state. Therefore software can enable address mapping and afterwards watch cache usage of the application (this is a debug feature). Even manipulation of the cache content is feasible.
- It is possible to abort an ongoing memory initialization.

The security of memory initialization during startup is not affected. Also protection of FSI0 and HSM memories is not limited.

Workaround

Handle security relevant data exclusively inside HSM. Protect the application code by locking external access (e.g. lock debug interface, prevent boot via serial interface). Consider validation of application code by HSM secure boot.

MTU_TC.017 Unexpected alarms after application reset

As described in the MTU chapter “Alarms after startup” section, in case of an application reset, there are no SSH alarms or status bits expected to be triggered.

However, this device deviates from this expected behavior, and status flags AG0.SF10 and AG1.SF10 (DMEM Uncorrectable critical error) are set also after an application reset. Correspondingly, the OPERR[0] bits of the following SSHs are also set in the corresponding MCi_FAULTSTS registers after an application reset:

- MC0 (CPU0_DMEM),
- MC34 (CPU0_DMEM1), and
- MC35 (CPU1_DMEM1)

Note: In contrast to alarms resulting from real errors, for these unexpected alarms after application reset MCi_ERRINFO = 0x0 (i = 0, 34, 35).

Workaround

The application software may clear the above mentioned alarms and errors after an application reset if MCi_ERRINFO = 0x0 (i = 0, 34, 35), and proceed.

In case these errors occur during normal application run, this shall be considered as a real error.

MTU_TC.018 Gated SRAM alarms

Due to a corner case, SRAM alarms to the SMU for SRAM errors are not correctly generated for the following modules.

- GTM: ALM6[10], ALM6[11];
- DMA, SCR: ALM6[19], ALM6[20];
- CPUx: ALMx[4], ALMx[7], ALMx[10]
  (x = 0..n; n depends on number of CPUs available in product).

Background:

From the SRAMs, the following errors are triggered to the SMU:

- ECC-correctable error: Triggered on a read access to SRAM.

- ECC-uncorrectable error: Triggered on a read access to SRAM.
- Address error: Triggered on read or write access to SRAM.

In case of an error, normally these alarms are triggered appropriately on each read or write access.

However, due to this corner case, for certain SRAMs mentioned above, the alarm is not triggered on the read or write access on which the error is generated, rather, it is generated only on the **next** access to the SRAM or to an SSH register (e.g. MCx_ECCD register).

Note: Only the SMU alarm generation is affected by this issue and not the error triggering to the module. E.g. error notification to GTM MCS still works as expected and the MCS may be stopped on an uncorrectable ECC error.

Additionally, only the alarm propagation is gated in this corner case, i.e. the error status is still correctly stored in the MCx_ECCD, MCx_FAULTSTS registers.

Workaround

For GTM & SCR SRAMs

Read the MCx_ECCD register periodically, depending on application safety considerations, for example within each diagnostic test interval.

- Corresponding SSH instances:
  - GTM: MC53..MC60;
  - SCR: MC77, MC78.

For DMA & CPU SRAMs (except DLMUx_STBY)

No workaround is recommended, because here the issue affects only the address error generation on a write access. In this case, the next read access (when the data would be used) will trigger the error.

For DLMU_STBY

The issue occurs in a corner case just before entering standby mode. Therefore, if standby mode is used and Standby RAM is enabled (PMSWCR0.STBYRAMSEL $\neq 000_B$) - then just before entering standby, perform an additional dummy read to DLMU_STBY location 0x9000 0000 or

0xB000 0000 (when using CPU0 dLMU RAM) and 0x9001 0000 or 0xB001 0000 (when using CPU1 dLMU RAM). This dummy read triggers the alarm propagation and ensures that no alarms are lost due to standby entry.

MTU_TC.019 Type properties for reserved bits MCONTROL.R8, R12..R14 - Documentation update

In the description of register MCi_MCONTROL in the MTU chapter of the current version of the TC3xx User's Manual, the type properties of the reserved bits R8, R12, R13, R14 are indicated as read-only ("r").

- Actually, these bits are writable, i.e. the type of the reserved bits MCi_MCONTROL.R8, R12, R13, R14 is read/write ("**rw**").

Note:

As documented in the register description for MCi_MCONTROL,

- Bit R14 shall always be written with 1,
- Bits R8, R12, R13 shall always be written with 0.

PADS_TC.011 Pull-ups activate on specific analog inputs upon PORST

If HWCFG[6] = 1 or PMSWCR5.TRISTREQ = 0, respectively, the following analog inputs in the V_{DDM} domain:

- analog inputs overlaid with general purpose inputs (class S pads) on all pins of P40 and P41[1)],
- analog inputs (class D pads) of channels with multiplexer diagnostics[2)],

will activate internal pull-ups during cold or warm PORST.

When PORST is deasserted and the internal circuitry is reset, the inputs mentioned above will be released to tri-state mode.

1) Availability depends on TC3xy device version, see the product specific Data Sheet.
2) These channels are explicitly marked with (MD) in table "Analog Input Connections for Product TC3yx" in the EVADC chapter of the product specific appendix (file TC3yX_um_appx_V1.*.*.pdf) to the AURIX™ TC3XX User's Manual.

Note: This behavior differs from the description in the "Ports" chapter of the User's Manual (P40/P41 always in tri-state mode during PORST) and the Data Sheet (corresponding pins marked with symbol "HighZ" in columns for buffer/pad type of the pin definition tables).

PMS_TC.005 Voltage rise at P33 and P34 up to V_{EVRSB} during start-up and up to $V_{LVDRSTSB}$ during power-down

The HWCFG pins (located in the V_{EXT} domain) information is evaluated when basic supply and clock infrastructure components are available as the supplies V_{EVRSB} and V_{EXT} ramp up. Tristate control information based on HWCFG[6] latched with V_{EXT} supply ramp can't be used within the V_{EVRSB} supply domain until both supplies (V_{EXT} and V_{EVRSB}) have reached the minimum threshold value of $V_{LVDRST5}$ and $V_{LVDRSTSB}$, respectively.

Therefore, the pad behavior at P33 and P34 pins is "pull-up", even if pin HWCFG[6] =0, with the following characteristics:

- the pad voltage level rises to V_{EVRSB} until the $V_{LVDRSTSB}$ and $V_{LVDRST5}$ thresholds of V_{EVRSB} and V_{EXT} are reached during the ramp-up phase,
- the pad voltage level is below $V_{LVDRSTSB}$ for the ramp-down phase of the V_{EVRSB} supply.

Workaround

If an application requires to ensure the state of P33 and P34 pins within the logical "low" level, then an external pull-down must be used which can overdrive the internal pull-up.

In order to quantify the strength of such an external pull-down, parameter "Pull-up current" (I_{PUH}, CC) for the respective pin may be used as the reference. There, the values for the internal pull-up resistor (for TTL and AL) can be found via parameter R_{MDU} in table "VADC 5V" (see footnotes on parameter "Pull-up current" in the Data Sheet).

PMS_TC.006 PORST not released during Cold Power-on Reset until VDDM is available

Upon a cold power-on reset, the PORST pin is kept asserted by the PMS until the ADC Analog Supply voltage (VDDM) is above 500 mV. This might lead to an additional start-up delay dependent on when VDDM is available from the external regulator relative to the VEXT, VDDP3 and VDD supplies.

During operation, if VDDM drops below the secondary monitor undervoltage threshold, an SMU alarm is generated. If VDDM further drops below 500 mV, the dedicated ADC of the secondary voltage monitor stops converting and the Secondary Monitor Activity Counter (EVRMONSTAT1.ACTVCNT) freezes at the last value.

Workaround

The ADC Analog Supply voltage (VDDM) has to be available and needs to be above 500 mV to ensure proper release of PORST during start-up and proper functioning of secondary monitors.

PMS_TC.007 VDDP3 or VDD Overvoltage during start-up may not be detected by PBIST

In AURIX™ TC3xx devices, Power Built in Self Test (PBIST) is introduced to ensure that the supply voltages do not exceed absolute maximum limits during the start-up phase.

However, for a VDDP3 or VDD overvoltage event during start-up beyond operational upper limits, the PBIST is not able to detect this overvoltage event.

Workaround

Check the VDDP3 overvoltage condition in registers EVRSTAT (flag OV33) and EVRMONSTAT1 (field ADC33V) in software additionally during the start-up phase before enabling the corresponding SMU alarm.

Check the VDD overvoltage condition in registers EVRSTAT (flag OVC) and EVRMONSTAT1 (field ADCCV) in software additionally during the start-up phase before enabling the corresponding SMU alarm.

PMS_TC.011 VEXT supplied PU2 and PD2 pads always in tristate after standby entry - Documentation correction

Tristate mode is enabled for VEXT supplied PU2 and PD2 pads (marked PU2 / VEXT and PD2 / VEXT in column “Buffer Type” in the Data Sheet) at the moment of and after entry to standby mode, regardless of the PMSWCR5.TRISTREQ bit setting and the HWCFG[6] pin setting (reflected in the PMSWSTAT register).

For a definition of the buffer types see also chapter “Legend” in the Data Sheet.

Recommendation

If the application requires the pull-up state of VEXT supplied PU2 pads (or pull-down state of PD2 pads), then it shall ensure it by means of external pull-up devices (or pull-down devices for PD2 pads) in the event of:

- Standby entry while the VEXT supply ramps down,
- Standby entry with the VEXT supply available.

Documentation correction for TC3xx User’s Manual V1.5.0 and following

In TC3xx User’s Manual V1.5.0 and following versions, the description of this behavior has been included in the PMS and PMSLE chapters. Erroneously, the term “PU1” was used instead of “PU2 and PD2”.

In the following sections and sentences in chapter PMS (*=11) and PMSLE (*=12), the term “PU1” shall be replaced by “**PU2 and PD2**”:

- Section *.2.1.1 Supply Mode Selection:
  - „Regardless of the HWCFG[6] setting, the VEXT-buffered PU1 pads (see the PU1 buffer type in the data sheet) are set into tristate ..“
    shall be replaced by
  - “Regardless of the HWCFG[6] setting, the VEXT-buffered **PU2 and PD2** pads (see the **PU2 and PD2** buffer type in the data sheet) are set into tristate ..”.
- Section *.2.3.4.8 Entering Standby Mode (only VEVRSB domain supplied):
  - “Regardless of the PMSWCR5.TRISTREQ setting, the VEXT-buffered PU1 pads (see the PU1 buffer type in the data sheet) are set into tristate ..”
    shall be replaced by

  - "Regardless of the PMSWCR5.TRISTREQ setting, the VEXT-buffered **PU2 and PD2** pads (see the **PU2 and PD2** buffer type in the data sheet) are set into tristate ..".
- Section *.2.3.4.9 Entering Standby Mode (both VEVRSB and VEXT domain supplied):
  - "Regardless of the PMSWCR5.TRISTREQ setting, the VEXT-buffered PU1 pads (see the PU1 buffer type in the data sheet) are set into tristate .."
    shall be replaced by
  - "Regardless of the PMSWCR5.TRISTREQ setting, the VEXT-buffered **PU2 and PD2** pads (see the **PU2 and PD2** buffer type in the data sheet) are set into tristate ..".
- Section *.2.3.4.10 State during Standby Mode:
  - "Regardless of the PMSWCR5.TRISTREQ setting, the VEXT-buffered PU1 pads (see the PU1 buffer type in the data sheet) are set into tristate .."
    shall be replaced by
  - "Regardless of the PMSWCR5.TRISTREQ setting, the VEXT-buffered **PU2 and PD2** pads (see the **PU2 and PD2** buffer type in the data sheet) are set into tristate ..".

See also the corresponding entries in the revision history for PMS chapter V2.2.31 and PMSLE chapter V1.0.4 at the end of each chapter.

PMS_TC.012 Short to Supply and Ground Detection – Documentation update

In the first sentence of the paragraph above Figure "Short to Supply and Ground Detection" in the PMSLE and PMS chapters of the TC3xx User's Manual, starting with "A short detection scheme may be activated for EVR33..", the reference to the register bits to control this detection is incorrect.

Correction

The correct sentence should read as follows:

- A short detection scheme may be activated for EVR33 via **EVR33CON**. SHLVEN / SHHVEN bits.

Note: For details on EVR33CON see the register description in the PMSLE chapter in TC3xx User's Manual V1.3.0 and following.

Note: In V1.5.0 of the TC3xx User's Manual, the PMSLE chapter contains the correct sentence. Update in the PMS chapter will follow in the next revision.

PMS_TC.014 Parasitic coupling on shared ADC pins depending on supply voltages

Bulk diodes exist from the V_{EXT} supply rail to the V_{DDM} supply rail through respective shared analog pins of EVADC Group 9 (P00.1 - P0.12).

If $V_{EXT} > V_{DDM}$ and any of the shared pin voltages (V_{INPIN}) is higher than V_{DDM} by a diode voltage (V_{Diode} ~ 0.6V), i.e.

- $V_{INPIN} > (V_{DDM} + V_{Diode})$ OR V_{INPIN} pulled up to V_{EXT} by internal/external pull-ups > $(V_{DDM} + V_{Diode})$

then during start-up and operation, sink currents will flow from the pin to the V_{DDM} supply. The currents shall be limited by an internal/external pull-up resistor in order to stay within the overload conditions.

Behavior during start-up:

Only during the start-up phase, when the V_{DDM} supply voltage is less than the V_{DDPPA} (~1.3V) subthreshold limit, then the shared analog pins within an ADC multiplexer group of EVADC group G9 are internally connected together. The internal connection is high ohmic in nature (current < 100 µA). Consequently an external pull-up on one pin may be visible on the other pins in the same EVADC multiplexer group until the V_{DDM} supply is above the V_{DDPPA} limit and LVD reset limits on V_{EXT} and V_{EVRSB} have been reached.

Workaround

To avoid any current flow from V_{INPIN}/V_{EXT} to V_{DDM} and to prevent parasitic coupling on shared ADC pins:

- It needs to be ensured that the shared pin voltages (V_{INPIN}) are within the $(V_{DDM} + V_{Diode})$ supply range. Alternatively, V_{DDM} and V_{EXT} may be supplied

together from the same supply source if the pull-ups on the pins are to the V_{EXT} rail.
- When both V_{EXT} and V_{EVRSB} are kept supplied during Standby mode, V_{DDM} should also be kept supplied if shared analog pins are pulled high.

Note: Related to this text module, in TC3xx User's Manual versions after V1.6, the row for V_{DDM} in table "5 V Nominal Supply: Voltage variations at independent supply rails during system modes" will be updated accordingly, and a diagram "Parasitic Diode Connectivity between supply rails" will be added.

PMS_TC.015 EVRC synchronization – Documentation update for register EVRSDCTRL11 (PMS) and EVRSDCTRL2 (PMSLE)

The formulas for d f_{MAXDEV} (Maximum Deviation of the Synchronization Input Frequency) and SYNCHYST (Lock Unlock Hysteresis Window) that are documented in the description of fields SYNCMAXDEV and SYNCHYST in register EVRSDCTRL11 (chapter PMS) and EVRSDCTRL2 (chapter PMSLE) of the TC3xx User's Manual shall be corrected/updated as listed below.

SYNCMAXDEV in TC3xx User's Manual V2.0 (and earlier versions):

- d f_{MAXDEV} =
  100 MHz *(2*SYNCMAXDEV) / (SDFREQ^2+SYNCMAXDEV^2)
- SYNCMAXDEV =
  round [(100 MHz / d f_{MAXDEV}) - sqrt{ (100 MHz / d f_{MAXDEV})^2 - SDFREQ^2}]

Correction to SYNCMAXDEV in register EVRSDCTRL11 (PMS) and EVRSDCTRL2 (PMSLE):

- d f_{MAXDEV} =
  100 MHz *(2*SYNCMAXDEV) / (SDFREQ^2-SYNCMAXDEV^2)
- SYNCMAXDEV =
  round [sqrt{ (100 MHz / d f_{MAXDEV})^2 + SDFREQ^2} - (100 MHz / d f_{MAXDEV})]

SYNCHYST in TC3xx User's Manual V2.0 (and earlier versions):

- SYNCHYST =
  round [d f_{HYST} * (SDFREQ ± SYNCMAXDEV)^2] / [d f_{HYST} * (SDFREQ ± SYNCMAXDEV) + 100 MHz]

Correction/Update to SYNCHYST in register EVRSDCTRL11 (PMS) and EVRSDCTRL2 (PMSLE):

- SYNCHYST =
  round [d f_{HYST} * (SDFREQ ± SYNCMAXDEV)^2 / (100 MHz ± d f_{HYST} * (SDFREQ ± SYNCMAXDEV))]
- First hysteresis band:
  – d f_{HYST} = 100 MHz / (SDFREQ + SYNCMAXDEV - SYNCHYST) - 100 MHz / (SDFREQ + SYNCMAXDEV)
- Second hysteresis band:
  – d f_{HYST} = 100 MHz / (SDFREQ - SYNCMAXDEV) - 100 MHz / (SDFREQ - SYNCMAXDEV + SYNCHYST)

QSPI_TC.006 Baud rate error detection in slave mode (error indication in current frame)

According to the specification, a baud rate error is detected if the incoming shift clock supplied by the master has less than half or more than double the expected baud rate (determined by bit field GLOBALCON.TQ).

However, in this design step, a baud rate error is detected not only if the incoming shift clock has less than half the expected baud rate (as specified), but also already when the incoming shift clock is somewhat (i.e. less than double) higher than the expected baud rate.

In this case, the baud rate error is indicated in the current frame.

Workaround

It is recommended not to rely on the baud rate error detection feature, and not to use the corresponding automatic reset enable feature (i.e. keep GLOBALCON.AREN=0_B).

The baud rate error detection feature in slave mode is of conceptually limited use and is not related to data integrity. Data integrity can be ensured e.g. by parity, CRC, etc., while clocking problems of an AURIX™ master are detected by mechanisms implemented in the master.

Protection against the effects of high frequency glitches is provided by the spike detection feature in slave mode.

QSPI_TC.009 USR Events for PT1=2 (SOF: Start of Frame)

In master mode, when the interrupt on USR event is associated with Start of Frame (i.e. USREN=1_B, PT1=2 in register GLOBALCON1, BACON.UINT=1_B), then flag STATUS.USRF is not set and the interrupt is not triggered for the first frame.

Workaround

In the configuration where the interrupt on USR event is associated with Start of Frame (i.e. USREN=1_B, PT1=2 in GLOBALCON1, BACON.UINT=1_B), first transmit a “dummy” frame with this configuration. Then, for all subsequent frames, flag USRF will be set and the interrupt on USR event will be generated as expected.

QSPI_TC.010 Move Counter Mode - USR Events for PT1=4 (RBF: Receive Buffer Filled)

When a master operates in Move Counter Mode (MCCON.MCEN=1_B), and the interrupt on USR event is associated with Receive Buffer Filled (i.e. USREN=1_B, PT1=4 in register GLOBALCON1), the enable signal in BACON.UINT is only evaluated at the start of frame event.

This means in an ongoing frame the status of UINT in the first BACON control word involved determines whether flag STATUS.USRF is set and a user interrupt is generated or not. The status of UINT in following BACON control words in this frames’ transmission is not considered.

Workaround

In case the Receive Buffer Filled event shall only be used as interrupt on USR event for parts of a frame, initialize e.g. BACON.UINT=1_B and GLOBALCON.PT1=4 before start of frame, and use GLOBALCON1.USREN to selectively disable/enable the user interrupt during frame transmission.

QSPI_TC.013 Slave: No RxFIFO write after transmission upon change of BACON.MSB

While a slave transmission is in progress, and if the BACON.MSB configuration is changed for the subsequent frame, then the RxFIFO write of the currently received frame may not occur.

Also in case of a TxFIFO underflow, the RxFIFO write of the currently received frame may not occur.

Workaround

As a general recommendation, in slave mode the configuration should be done before any transmission starts.

In particular to avoid the problem described above, the re-configuration of the BACON has to be done after the RxFIFO write has occurred. This implies the need for a gap between frames if a BACON update occurs.

QSPI_TC.014 Slave: Incorrect parity bit upon TxFIFO underflow

When a slave TxFIFO underflow occurs, the slave transmits only “ones” in response to a request of the master.

If parity is enabled, also the parity bit transmitted by the slave is always set to “1”. This may be incorrect, depending on data length and parity type.

Workaround

If parity is enabled, select even parity if data length is odd, and select odd parity if data length is even.

QSPI_TC.016 Master: Move Counter Mode - Counter underflows when data is present in the TXFIFO while in the last TRAIL state of the previous transaction

When a master operates in move counter mode (MCCON.MCEN = 1_B) and is configured for adjacent move counter transactions, the MC.CURRENT counter value underflows when the move counter transaction is in the last TRAIL state of the previous transaction and the TXFIFO is already filled with data for the next move counter transaction. Due to this there is a possibility that the next move counter transaction enters an EXPECT state expecting more frames and stays there until intervened by the software.

Therefore, TXFIFO shall not be filled with the next move counter transaction data before the current transaction is over.

Workaround

The End of Frame (EOF) phase transition interrupt (i.e. GLOBALCON1.PT1 = 101_B or GLOBALCON1.PT2 = 101_B) shall only be used to trigger the CPU/DMA to fill the TXFIFO with the next move counter transaction data.

QSPI_TC.017 Slave: Reset when receiving an unexpected number of bits

A deactivation of the slave select input (SLSI) by a master is expected to automatically reset the bit counter of the QSPI module when configured as a slave.

This reset should help slaves to recover from messages where faults in the master or glitches on SCLK lead to an incorrect number of clocks on SCLK (= incorrect number of bits per SPI frame).

However, in this design step, the reset of the bit counter is unreliable.

Workaround

The slave should enable the Phase Transition interrupt (PT2EN = 1_B in register GLOBALCON1) to be triggered after the PT2 event “SLSI deselection” (PT2 = 101_B).

In the interrupt service routine, after ensuring that the receive data has been copied, the software should issue a reset of the bit counter and the state machine via GLOBALCON.RESETS = 01_B.

SAFETY_TC.002 SM[HW]:NVM.PFLASH:FLASHCON_MONITOR – Safe setting - Documentation update

Section 6.325 “SM[HW]:NVM.PFLASH:FLASHCON_MONITOR” of chapter “Safety Mechanisms” in the current version of the AURIX™ TC3xx Safety Manual contains the following paragraph:

- “The NVM configuration register CPUx_FLASHCON2 possess redundant configuration bits to be set by the application software to configure the PFlash NVM. The FLASHCON_MONITOR detects illegal values from incorrect software or random hardware faults from this register to the PFlash NVM and correct unwanted illegal values (00_B,11_B becomes 01_B, considered as “safe setting”).”

The sentence related to “safe setting” is incorrect/misleading.

Note: The corresponding description of register FLASHCON2 in the TC3xx User’s Manual is correct.

Documentation update:

The paragraph in “SM[HW]:NVM.PFLASH:FLASHCON_MONITOR” in the Safety Manual shall be corrected as follows:

- The NVM configuration register CPUx_FLASHCON2 possesses redundant configuration bits to be set by the application software to configure the PFlash NVM. The FLASHCON_MONITOR detects illegal values from incorrect software or random hardware faults from this register to the PFlash NVM. If an illegal value (00_B or 11_B) is detected an alarm will be generated and the system will behave as specified for the “safe setting” 10_B

Note: Absolute section numbers in the text above apply to V1.06 of the AURIX™ TC3xx Safety Manual.

SAFETY_TC.006 SM[HW]:SMU:CCF_MONITOR - Documentation update to Safety Manual

Table “Fault identification interfaces” of SM[HW]:SMU:CCF_MONITOR in the AURIX™ TC3xx Safety Manual is wrongly mentioning alarms that are reserved in the AURIX™ TC3xx devices.

Documentation Update

The “Fault identification interfaces” for the SM[HW]:SMU:CCF_MONITOR have to be considered as shown in the following table:

Table 10 Fault identification interfaces of SM[HW]:SMU:CCF_MONITOR

Alarm Interface	SM Flag
SMU Alarm	ALM20[x] - SMU_Stdby Alarms (x=4..15)
SMU Alarm	ALM21[x] - SMU_Stdby Alarms (x=0..5, 7..16)

SAFETY_TC.007 SM[HW]:PMS:VDDM_MONITOR - Documentation correction

Section “Description” of SM[HW]:PMS:VDDM_MONITOR in the current version of the AURIX™ TC3xx Safety Manual recommends to perform cyclic software checks of EVRSTAT.UVC and EVRSTAT.OVC to monitor the VDDM supply.

This statement is wrong with respect to the mentioned EVRSTAT flags.

Documentation correction

Instead, the dedicated VDDM monitoring flags EVRSTAT.**UVDDM** and EVRSTAT.**OVDDM** must be used.

Note: For users of AURIX™ TC3xx Safety Manual v1.05 or previous versions, the same correction has to be considered for ESM[HW]:SYS:ES_ERROR_PIN_MONITOR and ESM[HW]:SYS:SW_ERROR_PIN_MONITOR.

Note: For users of AURIX™ TC3xx Safety Manual v1.03 or previous versions, the same correction has to be considered for ESM[HW]:SYS:FSP_ERROR_PIN_MONITOR.

SAFETY_TC.023 MCU infrastructure Safety Related Function - Documentation Update

Note: This issue applies to AURIX™ TC3xx Safety Manual version v2.0.

Section 4.3.1 (Introduction) of chapter “Safety Related Functions” in the AURIX™ TC3xx Safety Manual v2.0 mentions in the last bullet point below the table that Safety Related Functions 10, 11 and 12 shall always be correctly implemented in order to reach the ASIL level of the listed Safety Related Functions.

The listed absolute numbers 10, 11, 12 are not correct in this context.

Documentation Update

The MCU infrastructure Safety Related functions **12, 13 and 14** are assumed to be always correctly implemented.

SAFETY_TC.024 Clock alive monitor for f_{SPB} - Documentation update

The AURIX™ TC3xx Safety Manual states in section 6.37 SM[HW]:CLOCK:ALIVE_MONITOR that the clock alive monitor for f_{SPB} is only visible to HSM.

This statement is not correct.

Documentation update

The clock alive monitor for f_{SPB} is visible to all interfaces in the SMU.

SCR_TC.015 Bit SCU_PMCON1.WCAN_DIS does not disable WCAN PCLK input

Setting bit SCU_PMCON1.WCAN_DIS to 1_B has no effect – the WCAN clock input (PCLK) is not disabled. Power consumption of the WCAN module will not decrease as expected.

Workaround

In order to keep power consumption at a minimum, the WCAN module must not be enabled (WCAN_CFG.WCAN_EN = 0_B).

SCR_TC.016 DUT response to first telegram has incorrect C_START value

Note: This problem is only relevant for tool development, not for application development.

The C_START value returned by the SCR OCDS of the DUT (device under test) in response to a first telegram is wrong.

Each monitor processed command starts with sending a telegram containing the CMD (e.g. READ_BYTE). The response to this telegram should be a telegram containing the C_START value of 0x1.

Instead, the value sent by the DUT is a random value.

Workaround

Do not
poll for TRF==1 on the first telegram of the monitor processed commands, and do not
evaluate the return value of the first telegram from the DUT. Even though the returned C_START is wrong, the returned checksum is correct, and should be checked with the theoretical C_START value of 0x01.

SCR_TC.018 SSC Receive FIFO not working

The receive FIFO of the SSC module is not working properly. An unexpected receive FIFO full indication can be set.

Workaround

Do not use the receive FIFO.

Read the received data from the receive buffer register SSC_RBL each time a receive interrupt event is signaled (flag IRCON1.RIR).

The received data must be read before the next data is received.

SCR_TC.019 Accessing the XRAM while SCR is in reset state

When accessing the XRAM while the SCR is executing a reset, the following erroneous behavior will occur:

- A read access returns 0 instead of the actual XRAM contents.
- A write access has no effect, the data will not be written to the XRAM.

Workaround

One of the following methods will avoid this problem:

1. Check the SCR reset status bit PMSWSTAT.SCRST before and after any read/write transaction to the XRAM:
   a) If the bit is set before the transaction, clear bit PMSWSTAT.SCRST and perform the desired XRAM access.
   b) If the bit is set after the transaction, clear bit PMSWSTAT.SCRST and repeat the XRAM read/write access. OR
2. Disable the SCR generated reset sources. OR
3. Disable the entire SCR (no SCR reset can occur): i.e. set
   - PMSWCR0.SCRWKEN = 0_B – wake-up via SCR disabled;
   - PMSWCR4.SCREN = 0_B – SCR disabled.

SCR_TC.020 Stored address in mon_RETH may be wrong after a break event

Note: This problem is only relevant for tool development, not for application development.

When setting a breakpoint via the SCR debugger connection on address xxFE$_H$ of an instruction, the stored address in mon_RETH is wrong if mon_RETL contains 00$_H$ (see also section “Calculation of the return address upon a break event” in the SCR chapter). This effect will happen whenever a carry bit should be propagated from the lower 8 bits to the upper 8 bits of the address.

Workaround

If mon_RETL contains 00$_H$ after a breakpoint was hit, the debugger tool must increment mon_RETH by 1 before performing the calculation of the return address as described in section “Calculation of the return address upon a break event” in the SCR chapter.

SCR_TC.021 RTC not counting after reset if P33.10 is high

The Real-Time Clock (RTC) in the SCR module may not reliably start counting if a high level was present on P33.10 (SCR_P01.2) during LVD reset. If enabled, the RTC will only start counting after the first high-to-low transition on P33.10 (SCR P01.2).

Note: Applications using an external (32 / 32.768 kHz) oscillator on P33.10 as clock source for the RTC are not affected.

Workaround 1

Ensure a low level on P33.10 (SCR_P01.2) during LVD reset, for example via a pull-down.

Workaround 2

Generate a high-to-low transition on P33.10 (SCR_P01.2) after LVD reset (by software or external hardware).

SCR_TC.022 Effect of application or system reset and warm PORST on MC77_ECCD and MC78_ECCD for SCR RAMs

Unlike for ECCD registers of other modules, error flags in MC77_ECCD (for SCR_XRAM) and MC78_ECCD (for SCR_RAMINT) are not cleared upon application or system reset.

As consequence the corresponding alarms ALM6[19], ALM6[20] and ALM6[21] in AG6 are not cleared by an application and system reset (if ECCD is not cleared by SW before triggering the reset).

Furthermore, flags in MC77_ECCD are not cleared upon warm PORST.

Workaround

Clear flags in register MC77_ECCD and MC78_ECCD via software by writing ‘0’ to the respective bits.

SCR_TC.023 External interrupts EXINT0, EXINT1 may get locked

As described in chapter “Interrupt System” of the SCR chapter in the TC3xx User’s Manual, if the external interrupt is positive (negative) edge triggered, the external source must hold the request pin low (high) for at least one CCLK cycle, and then hold it high (low) for at least one CCLK cycle to ensure that the transition is recognized.

However, for external interrupts EXINT0 and EXINT1, respectively, if the time between two triggering edges is shorter than 2 CCLK cycles, no further interrupt request is triggered after the first triggering edge. Further EXINT0 or EXINT1 interrupts are locked until the next application reset.

Note: This problem only occurs if interrupt generation on both rising and falling edge is selected, i.e. for EXINT0 if EXICON0.EXINT0 = 10_B, and for EXINT1 if EXICON0.EXINT1 = 10_B, respectively.

Workaround:

If using interrupt generation on both edges, ensure that the time between two triggering edges for EXINT0, EXINT1 is > 2 CCLK cycles. To include some margin for clock jitter and external signal slope asymmetries etc., the external

source should hold the request pin low (high) e.g. for 2.1/f_{CCLK} to ensure that the transitions are correctly recognized.

Otherwise, only use external interrupts EXINT2..15.

SCU_TC.031 Bits SCU_STSTAT.HWCFGx (x=1-5) could have an unexpected value in application if pins HWCFGx are left unconnected

An unexpected value for the HWCFGx pin state (x=1-5) may be latched in register field SCU_STSTAT.HWCFGx after application reset if the corresponding HWCFGx pin is not externally connected to a pull-up or a pull-down and the default reset state of port pins is set to tristate (pin P14.4/HWCFG[6] is pulled to GND).

EVRC start-up function after cold reset is not affected (HWCFG2).

EVR33 start-up function after cold reset is not affected (HWCFG1).

Only the intended function of HWCFG[3-5] pin configuration options in the corresponding reset cases is affected when BMI.PINDIS=0_B and DMU_HF_PROCONTP.BML=00_B (application boot defined by HWCFG[3-5] pins).

Workaround

Do not leave pins HWCFGx (x=1-5) unconnected if the default reset state of port pins is set to tristate (HWCFG[6] pulled to GND).

Note: This is not a general option for devices in QFP-80 and QFP-100 packages where P14.2/HWCFG2 is internally left unconnected.

If HWCFG2 is left unconnected, alternatively the application shall not rely on bit SCU_STSTAT.HWCFG[2] and may check for the correct state in the registers PMSWSTAT.HWCFGEVR or EVRSTAT.EVRC.

SMU_TC.012 Unexpected alarms when registers FSP or RTC are written

Due to a synchronization issue, ALM6[7] and ALM10[21] are sporadically triggered if the PRE2 field of register FSP is written while the SMU is configured either

- in Time Switching protocol (FSP.MODE = 10_B) and FSP[0] is toggling with a defined T_{SMU_FFS} period,
- or in Dual Rail protocol (FSP.MODE = 01_B) and FSP[1:0] are toggling with a defined T_{SMU_FFS} period.

Also, ALM6[7] and ALM10[21] are sporadically triggered if the PRE1 or TFSP_HIGH fields of register FSP are written while the SMU is in the Fault State and T_{FSP_FS} has not yet been reached (STS.FSTS=0_B) (regardless of the FSP.MODE configuration).

In addition, an unexpected ALM10[16] or ALM10[17] is sporadically triggered if field FSP.PRE1 or RTC.RTD is written, and at least one recovery timer is running based on a defined T_{SMU_FS} period (regardless of the FSP.MODE configuration).

The alarms can only be cleared with cold or warm Power-On reset.

Workaround

To avoid unexpected alarms, perform the configuration of the PRE1, PRE2 or TFSP_HIGH fields only when the SMU is not in the Fault State and FSP is in Bi-stable protocol mode (FSP.MODE = 00_B). Mode switching and configuration shall not be done with the same write access to register FSP.

This means that in the Fault Free State:

- before writing to PRE1, PRE2 or TFSP_HIGH while Time Switching or Dual Rail protocol is enabled:
  - disable Time Switching or Dual Rail protocol by setting FSP in Bi-stable protocol mode (FSP.MODE = 00_B);
  - wait until Bi-stable protocol mode is active (read back register FSP twice);
  - write desired value to PRE1, PRE2 or TFSP_HIGH;
  - then switch FSP.MODE to the desired protocol (optional step).
- If the mode shall be changed after writing to PRE1, PRE2 or TFSP_HIGH while in Bi-Stable protocol mode (FSP.MODE = 00_B):
  - write desired value to PRE1, PRE2 or TFSP_HIGH;
  - then switch FSP.MODE to Time Switching or Dual Rail protocol.

If field FSP.PRE1 or RTC.RTD shall be written, make sure no recovery timer is running. It is not allowed to write to the PRE1 or RTD field when at least one

recovery timer is running (indicated by bits RTS0 and RTS1 in the STS register).

SMU_TC.013 Unexpected setting of Alarm Missed Event bit xAEM in Alarm Executed Status register SMU_AEX

Note: This problem only applies to alarms of Alarm Type: Level (see tables "Alarm Mapping related to ALM group" in the product specific Appendix to the TC3xx User's Manual).*

While servicing an alarm with alarm type Level, request status bit xSTS in the SMU_AEX register is set. However, the corresponding alarm missed event bit xAEM is also set, 1 cycle after the xSTS bit is set for the same alarm event (x can be any of IRQ0..2, RST0..5, NMI, EMS).

Workaround

While clearing the xSTS bit the corresponding xAEM bit should also be cleared for the alarm event.

If the xAEM bit is not cleared while clearing xSTS, only the alarm missed event xAEM functionality will not be available for later alarm events, and it does not impact any alarm action generation and xSTS bit functionality.

3 Deviations from Electrical- and Timing Specification

ADC_TC.H040 Selection of masters for synchronization groups - Documentation update to TC33x/TC32x Appendix

The 4 converter kernels of the TC33x/TC32x can be connected to synchronization groups to achieve parallel conversion of several input channels.

Figure “Synchronization via ANON and Ready Signals” in the EVADC chapter of the TC3xx User’s Manual shows how a master is selected via bit field GxSYNCTR.STSEL. In this figure, kernels ADC0 and ADC1 relate to converter group G0 and G1, while ADC2 and ADC3 relate to G8 and G9 of the TC33x/TC32x, respectively.

However, the mapping in the rows for G8 and G9 in the corresponding table “Synchronization Groups” in the EVADC chapter of the TC33x/TC32x Appendix is incorrect and shall be updated as follows.

Documentation Update

The following table summarizes which kernels can be synchronized for parallel conversions in the TC33x/TC32x (corrections in rows for G8 and G9 shown in **bold**).

Table 11 Synchronization Groups of TC33x/TC32x

ADC Kernel	Synchr. Group	Master selected by control input CIx[1]			
		CI0[2]	CI1	CI2	CI3
G0 (Prim.)	A	G0	G1	G8	G9
G1 (Prim.)	A	G1	G0	G8	G9
G8 (Sec.)	A	G8	**G0**	**G1**	**G9**
G9 (Sec.)	A	G9	**G0**	**G1**	**G8**

1) The control input is selected by bitfield STSEL in register GxSYNCTR. Select the corresponding ready inputs accordingly by bits EVALRx.
2) Control input CI0 always selects the own control signals of the corresponding ADC kernel. This selection is meant for the synchronization master or for stand-alone operation.

ADC_TC.P014 Equivalent Circuitry for Analog Inputs - Additional information

Figure “Equivalent Circuitry for Analog Inputs” will be modified in future revisions of the Data Sheet, including the term $C_{Parasit} \leq 30$ pF, as shown in the following figure:

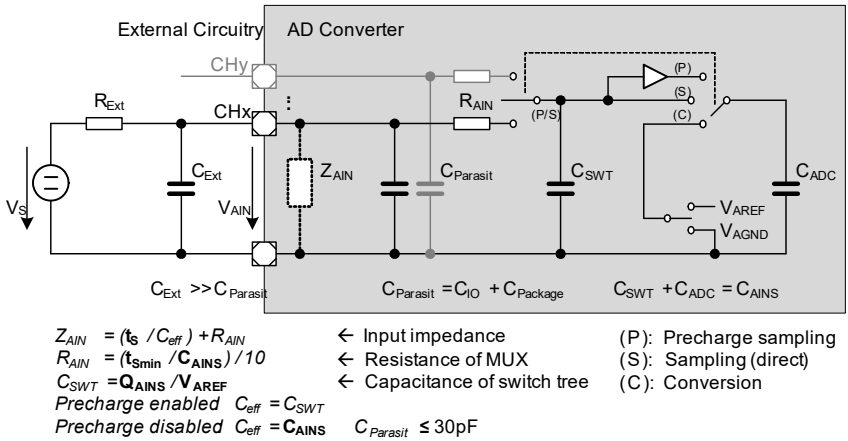

Figure 4 Equivalent Circuitry for Analog Inputs

ADC_TC.P017 Increased RMS noise for TC33x/32x devices

Note: This problem depends on the package type and affects the variants
TC333/TC323* (devices in TQFP-100 package),*
TC334/TC324* (devices in TQFP-144 package),*

TC337/TC327* (devices in BGA-292 package), and*
TC336 (devices in BGA-180 package).*

For these devices, on some or all channels the specified RMS noise (EN_{RMS}) increases, independent of the noise reduction mode, as listed in **Table 12** below.

Table 12 RMS Noise for TC33x and TC32x, independent of noise reduction mode

Device Variant	Package	Analog channel ANx	EN_{RMS} (Max.)
TC333*, TC323*	TQFP-100	AN37, AN38, AN39	1.0 LSB
TC334*, TC324*	TQFP-144	AN0, AN39	1.0 LSB
TC337*, TC327*	BGA-292	all ANx	1.0 LSB
TC336*	BGA-180	AN0	1.2 LSB
		AN2, AN3, AN5, AN6, AN39	1.0 LSB

FLASH_TC.P003 Program Flash Erase Time per Multi-Sector Command

The maximum value for parameter “Program Flash Erase Time per Multi-Sector Command” can be

- $t_{MERP} \leq 0.52$ s (instead of 0.5 s as specified in the Data Sheet).

Consequently, the maximum value for parameter “Complete Device Flash Erase Time PFlash and DFlash” can also increase by 0.04 s/Mbyte, resulting in

- $t_{ER\_Dev} \leq 3.08$ s (instead of 3 s as specified in the Data Sheet).

The increased values should be considered e.g. when defining erase timeout limits.

PWR_TC.P015 Power pattern definition - Documentation update to TC33x/TC32x Data Sheet V1.1

The TC33x/TC32x includes one TC1.6.2P core with lockstep (checker) core.

Therefore, the bullet points related to these cores in the description of the real and max power pattern in chapter “Power Supply Current” of the TC33x/TC32x Data Sheet shall be changed as follows:

Documentation update

The real (realistic) power pattern defines the following conditions:

- one core is active with lockstep core (IPC=0.6)
  (instead of “one cores is active without lockstep core (IPC=0.6)”

The max power pattern defines the following conditions:

- one core is active with lockstep core (IPC=1.2)
  (instead of “all cores are active including one lockstep core (IPC=1.2)”

RESET_TC.P003 Parameter limits for t_{PI} (Ports inactive after ESR0 reset active) – Documentation update

In table “Reset Timing” of the current version of the Data Sheet, parameter “Ports inactive after ESR0 reset active” (symbol t_{PI}) specifies a maximum value of $8/f_{SPB}$ (or $8/f_{BACKT}$, respectively) and/or unit (ns) which is incorrect.

The actual limits are as follows:

Table 13 Ports inactive after ESR0 reset active – Update

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Ports inactive after ESR0 reset active	t_{PI} CC	$8000/f_{BACKT}$		$18000/f_{BACKT}$	s

Details

t_{PI} defines the pad reset delay on System Reset and Application Reset scenarios triggered by external ESR0 requests. These reset cases trigger

execution of the shutdown sequence in the SCU within the t_{PI} time window followed by pad reset generation. The maximum time limit is defined by the timeout counter TOUTCNT which generates reset regardless of the execution state of the shutdown sequence.

4 Application Hints

ADC_TC.H026 Additional Waiting Phase in Slow Standby Mode

When a conversion is requested while slow standby mode is configured and the respective converter currently is in standby state, the extended wakeup time t_{WU} must be added to the intended sample time (see section “Analog Converter Control” in the Target Specification/User’s Manual).

While idle precharge is disabled (GxANCFG.IPE = 0_B), an additional waiting phase of 1.6 µs (@f_{ADC} = 160 MHz) is inserted automatically. Operation starts after this phase.

However, if the slow standby state is left after just 1 clock cycle, this waiting phase is omitted.

Recommendation

It is, therefore, recommended to add the specified extended wakeup time (t_{WU}) when leaving the standby state in all cases, to ensure proper operation.

ADC_TC.H032 ADC accuracy parameters - Definition

Chapter “VADC Parameters” in the Data Sheet contains the following introduction section:

“The accuracy of the converter results depends on the reference voltage range. The parameters in the table below are valid for a reference voltage range of (V_{AREF} - V_{AGND}) >= 4.5 V. If the reference voltage range is below 4.5 V by a factor of k (e.g. 3.3 V), the accuracy parameters increase by a factor of 1.1/k (e.g. 1.1 × 4.5 / 3.3 = 1.5).”

Accuracy parameters in the context of the statement above are:

- Total Unadjusted Error (TUE),
- INL Error (EA_{INL}),
- DNL Error (EA_{DNL}),
- Gain Error (EA_{GAIN}),

- Offset Error (EA_{OFF}),
- RMS Noise (EN_{RMS}),
- Converter diagnostics voltage accuracy (dV_{CSD}),
- Deviation of IVR output voltage V_{DDK} (dV_{DDK}).

ADC_TC.H033 Basic Initialization Sequence for Primary and Secondary EVADC Groups

For consistency, to ensure that the maximum value for the settling time of the analog module is always considered in the basic initialization sequence, the start-up calibration should be started **after** a waiting time equal or higher than the extended wakeup time (t_{WU}). The related basic initialization sequence is described in the following execution scheme.

*Note: Compared to the sequence listed in chapter "Basic Initialization Sequence" in the present version of the EVADC chapter of the User's Manual, step "WAIT" (third step below) has been shifted **before** the begin of the start-up calibration.*

```
EVADC_GxANCFG = 0x00300000
  ;Analog clock frequency is 160 MHz / 4 = 40 MHz (example)
  ;CALSTC = 00
EVADC_GxARBCFG = 0x00000003 ;Enable analog block
WAIT   ;Pause for extended wakeup time (≥ 5 µs)
       ;(other operations can be executed in the meantime)
EVADC_GLOBCFG = 0x80000000  ;Begin start-up calibration
EVADC_GxARBPR = 0x01000000  ;Enable arbitration slot 0
EVADC_GxQMR0 = 0x00000001   ;Enable request source 0
EVADC_GxICLASS0 = 0x00000002
  ;Select 4 clocks for sampling time: 4 / 40 MHz = 100 ns
  ;The default setting stores results in GxRES0,
  ;service requests are issued on GxSR0
EVADC_GxRCR0 = 0x80000000
  ;Enable result service requests, if required
EVADC_GxQINR0 = 0x00000020
  ;Request channel 0 in auto-repeat mode
WAIT   ;Wait for start-up calibration to complete *)
```

```
    ;(other operations can be executed in the meantime)
    ;=> This starts continuous conversion of the channel
*)time tSUCAL or flag GxARBCFG.CAL=0
```

ADC_TC.H034 Effect of reduced reference voltage on parameter QCONV - Data Sheet footnote update

The following footnote on parameter QCONV (Reference input charge consumption per conversion (from VAREF)) in table “VADC 5V” in the current version of the Data Sheet

- “For reduced reference voltages the consumed charge is reduced by factor k”

shall be changed to

- “For reduced reference voltages VAREF < 3.375V, the consumed charge QCONV is reduced by the factor of k_2 = VAREF [V] / 3.375. For reduced reference voltages 4.5V < VAREF ≤ 3.375V, QCONV is not reduced.”

ADC_TC.H035 Effect of input leakage current on Broken Wire Detection

The Broken Wire Detection (BWD) feature uses the sample capacitor of the ADC input to discharge (BWG: Broken Wire Detection against V_{AGND}) or to charge (BWR: Broken Wire Detection against V_{AREF}) the input node of the ADC.

This mechanism can be seen as small current sink (BWG) or current source (BWR). When the BWD feature is enabled, in case the ADC input is not connected to an external voltage source (i.e. the wire is broken), the ADC input voltage is drifting down or up. When a defined voltage level (i.e. the detection threshold) is reached, “broken wire detected” is claimed.

Broken Wire Detection currents I_{BWG}, I_{BWR} are quite small and must overwhelm input leakage currents I_{OZ} on the same node. Input leakage currents depend exponentially on junction temperature.

It is therefore required to check whether an application using Broken Wire Detection can deal with leakage currents also under worst case conditions.

Application Considerations

1. Get the input leakage current (I_{OZ}) limits from the Data Sheet, depending on used ADC pins and maximum junction temperature T_J of your application.
2. Compare this limit against the Broken Wire Detection currents I_{BWG}, I_{BWR}, which can be calculated as follows:

- Broken Wire Detection against V_{AGND}(BWG):
  – $I_{BWG} = V_{AIN} * C_{AINS} * CR$
- Broken Wire Detection against V_{AREF} (BWR):
  – $I_{BWR} = (V_{AIN} – V_{AREF}) * C_{AINS} * CR$

where

- V_{AIN}: ADC input voltage at the detection threshold (typ. 10% of full scale for BWD, 80% of full scale for BWR)

- C_{AINS}: ADC input sampling capacitance, typ. 2.5 pF

- CR: Conversion Rate, i.e. number of conversions per second per input

Recommendation

The absolute value of the Broken Wire Detection current (I_{BWG} or I_{BWR}) at the BWD threshold shall be at least 2x the maximum input leakage current I_{OZ} (absolute value).

Examples

1. Typical Case Example

Assuming that $T_J \leq 150°C$ (max) and ADC inputs are used in a configuration where $I_{OZ} \leq 150$ nA (see Data Sheet), I_{BWG} should be ≥ 300 nA according to the recommendation above.

With C_{AINS} = 2.5 pF and V_{AIN} = 0.5V (10% of full scale) it can be calculated from the formula for I_{BWG} above that CR should be ≥ 240 000 samples per second and input.

2. Worst Case Example

Assuming that $T_J \leq 170°C$ (max) and ADC inputs are used in a configuration where $I_{OZ} \leq 800$ nA (see Data Sheet), I_{BWG} should be ≥ 1600 nA according to the recommendation above.

With C_{AINS} = 2.5 pF and V_{AIN} = 0.5V (10% of full scale) it can be calculated from the formula for I_{BWG} above that CR should be ≥ 1 280 000 samples per second and input.

Recommendations for increasing the Broken Wire Detection current

In order to increase the Broken Wire Detection current,

1. Relax the detection threshold, e.g. for BWG from 10% to 20% of the full scale voltage.
2. Increase the conversion rate CR per input by introducing additional conversions.

ADC_TC.H036 Minimum Input Buffering Time - Additional information

As described in section “Buffer for the Analog Input” in the EVADC chapter “Analog Signal Buffering”, the analog input buffer boosts the selected analog input signal for a certain time, when enabled. The time during which the input buffer is active can be adapted to the configured sample time by bitfields AIPS/AIPE in register GxICLASSi (i=0-1;x=0-11) / GLOBICLASSi (i=0-1), or by bitfield AIPF in register FCxFCCTRL (x=0-7)[1)], respectively. The input precharge time can be configured to 8, 16, or 32 clocks of f_{ADC}.

After the programmed buffer time the sampling is continued directly from the selected input. The effective overall sampling time must cover the specified minimum sampling time t_S (see Data Sheet), i.e. the programmed sample time (in bitfields STC*) must cover both phases, buffered sampling (configured in bitfields AIP*) and direct sampling.

Note: Sampling times with input buffer enabled specified in the Data Sheet consider a buffered sample time of 200 ns, that means for f_{ADC} = 160 MHz the input precharge time (in bitfields AIP) has to be configured to 32 clocks of f_{ADC}. For input precharge times lower than 200 ns, the charge consumption from the analog input is increased accordingly.*

1) in TC39x step AA: GxFCCTRL (x=12-19)

ADC_TC.H037 CPU read access latency to result FIFO buffer

Using the result FIFO buffer, data consistency for a sequence of conversion results can be guaranteed. This means, the results of the conversion sequence can be read by the CPU at a deterministic point in time. The data transfer from the result FIFO buffer to the CPU is usually done with a consecutive procedure of single read commands.

The read access latency between a CPU and the result FIFO buffer is defined by 6 system peripheral bus clock cycles (f_{SPB}) and 6 ADC clock cycles (f_{ADC}). The architecturally determined access time from a CPU via the system peripheral bus to the result FIFO is given by 5 system peripheral bus cycles (f_{SPB}).

Recommendation

Therefore, a waiting time between consecutive reads from the result FIFO buffer of 1 f_{SPB} cycle + 6 f_{ADC} cycles must be considered to ensure conversion results are correctly read from the FIFO. Otherwise, if this waiting time is not met for consecutive reads, the FIFO may get stuck.

The preferred way is to read the FIFO after the corresponding service request has been generated.

ADC_TC.H039 DMA read access latency to result FIFO buffer

Using the result FIFO buffer, data consistency for a sequence of conversion results can be guaranteed. Initiated by a service request, the results of the conversion sequence can be read by the DMA, as soon as the last conversion result is available in the result FIFO buffer. This approach enables data integrity for application cases where the EVADC trigger scheme is asynchronous to the related SW task. To update the output of the result FIFO buffer, the latency is defined by 6 system peripheral bus clock cycles (f_{SPB}) and 6 ADC clock cycles (f_{ADC}).

To ensure a deterministic and interrupt-free transfer of the complete content of the FIFO buffer, single DMA transfer with the related number of data moves is the most efficient approach. For this purpose, the DMA source address is assigned to the output stage of the FIFO buffer and the destination address in

the corresponding memory (DLMU, EMEM, …) has to increment or decrement linearly. In this mode, the initial data move needs 6 f_{SPB} cycles and 13 system resource interface clock cycles (f_{SRI}), and every subsequent data move needs 3 f_{SPB} clock cycles and 11 f_{SRI} clock cycles.

That means, this DMA configuration cannot be used to read the content of the FIFO buffer. Starting from the second data move, the corresponding latency ($3 \times f_{SPB} + 11 \times f_{SRI}$) is shorter than the time ($6 \times f_{SPB} + 6 \times f_{ADC}$) required to update the output stage of the FIFO buffer. As this waiting time is not met for consecutive reads, this leads to an inconsistent representation in the corresponding memory region (DLMU, EMEM, …) because the FIFO may get stuck.

Recommendation

To use the result FIFO buffer together with the DMA, a Linked List DMA configuration could be used. Using this kind of configuration, it is ensured that the DMA latency ($6 \times f_{SPB} + 13 \times f_{SRI}$) is longer than the time to update the result FIFO buffer ($6 \times f_{SPB} + 6 \times f_{ADC}$).

Note: See also ADC_TC.H037 for CPU read access.

ASCLIN_TC.H001 Bit field FRAMECON.IDLE in LIN slave tasks

For LIN performing slave tasks, bit field FRAMECON.IDLE has to be set to 000_B (default after reset), i.e. no pause will be inserted between transmission of bytes.

If FRAMECON.IDLE > 000_B, the inter-byte spacing of the ASCLIN module is not working properly in all cases in LIN slave tasks (no bit errors are detected by the ASCLIN module within the inter-byte spacing).

BROM_TC.H008 CAN BSL does not support DLC = 9 and DLC = 11

The CAN Bootstrap loader (BSL) only supports messages where the number of data bytes is a multiple of 8.

Therefore, Data Length Code settings DLC = 11 (number of data bytes = 20) and DLC = 9 (number of data bytes = 12) are not allowed (see also chapter “CAN BSL flow” of chapter “AURIX™ TC3xx Platform Firmware”).

Recommendation

When using the CAN Bootstrap loader, only use settings where DLC ≠ 9 or DLC ≠ 11.

BROM_TC.H009 Re-Enabling Lockstep via BMHD

For all CPUs with lockstep option, the lockstep functionality is controlled by Boot Mode Headers (BMHD) loaded during boot upon a reset trigger.

If lockstep is disabled for a CPUx with lockstep functionality, re-enabling (e.g. via a different BMHD) is not reliably possible if warm PORST, System or Application reset is executed.

Recommendation

Use cold PORST if lockstep is disabled and shall be re-enabled upon the reset trigger.

BROM_TC.H014 SSW behavior in case of wrong state or uncorrectable error in UCBs - Documentation Update

The boot sequence terminates and the device is put into error state (endless loop) in the following cases:

- **Wrong state** - i.e. different from CONFIRMED or UNLOCKED (in case an UCB has ORIGINAL and COPY: wrong state of the both) – for the following UCBs:
  – UCB_BMHDx, UCB_SWAP, UCB_SSW, UCB_USER, UCB_PFLASH, UCB_DFLASH, UCB_DBG, UCB_HSM, UCB_HSMCOTP0...1, UCB_HSMCFG, UCB_ECPRIO, UCB_OTP0...7, UCB_REDSEC, UCB_TEST, UCB_RETEST.
- **Uncorrectable ECC error** within the used locations when state valid (CONFIRMED or UNLOCKED) – for the following UCBs:

  - UCB_SSW, UCB_PFLASH, UCB_DFLASH, UCB_DBG, UCB_HSM, UCB_HSMCOTP0...1, UCB_ECPRIO, UCB_OTP0...7, UCB_REDSEC, UCB_RETEST.
- For UCB_SWAP ORIGINAL/COPY – according to the descriptions in User's Manual.

Recommendation

Instructions to be followed for UCB-reprogramming (in order to avoid unexpected boot termination):

- always verify the changed contents before confirming the UCB state
- strictly follow the sequence in section "UCB Confirmation" in the "Non Volatile Memory (NVM)" chapter of the User's Manual[1)].

BROM_TC.H017 CHSW results after LBIST execution

In AURIX™ TC3xx devices, LBIST execution terminates – independent whether successfully finished or interrupted by power-drop or external PORST - with a warm reset.

The Startup Software executed afterwards follows the flow as after cold power-on with the purpose to perform full device initialization.

If Checker Software (CHSW) is activated by the user configuration, the checks will be executed as required after cold power-on and the results are indicated in registers SCU_STMEM3...6 accordingly. Consequently, a successful device start-up will be indicated with the SCU_STMEM3...6 values shown in row "Cold power-on" of table "ALL CHECKS PASSED indication by CHSW for TC3xx" in the Firmware chapter of the TC3xx Appendix for the corresponding TC3xx device.

Recommendation

If using Checker Software, check bits SCU_STMEM3...6.[7:4] after start-up to determine which type of reset has been processed by device firmware. Then

1) For TC39x A-step: chapter "Program Memory Unit (PMU)" of the Target Specification.

verify the SCU_STMEM3...6 contents against the values defined for the respective reset type in table “ALL CHECKS PASSED..” of the TC3xx Appendix for the corresponding TC3xx device.

CCU_TC.H012 Configuration of the Oscillator- Documentation Update

As described in chapter „Configuration of the Oscillator” in the CCU chapter of the User’s Manual, configuration of the oscillator is always required before an external crystal / ceramic resonator can be used as clock source.

Depending on the supply voltage ramp-up characteristics the behavior described in the following note may be observed:

Note: If VEXT is present then the oscillator could start oscillating (crystal/resonator connected). As soon as Cold PORST of AURIX™ is released, the oscillator is set to External Input Mode and the oscillation decays. This characteristic behavior has no impact on the oscillator start-up as initiated by software.

CLC_TC.H001 Description alignment for bits DISR, DISS, EDIS in register CLC - Documentation Update

For the description of bits DISR, DISS, and EDIS (if available) in register CLC (and CLC1 for I2C), different styles are used in the current version of the TC3xx User’s Manual.

For the following modules, the function of these bits depending on their status (0_B or 1_B) is not explicitly described:

- ASCLIN, CIF, E-RAY, FCE, GETH, GTM, HSPDM, HSSL (incl. HSCT), I2C, MCMCAN, MSC, PSI5, PSI5-S, QSPI, SDMMC, SENT, STM,

For these modules, the missing parts of the bit description can be taken from the following general description:

Table 14 General description of bits DISR, DISS, EDIS in register CLC

Field	Bits	Type	Description
DISR	0	rw	**Module Disable Request Bit** Used for enable/disable control of the module 0_B No disable requested 1_B Disable requested
DISS	1	rh	**Module Disable Status Bit** Bit indicates the current status of the module 0_B Module is enabled 1_B Module is disabled
EDIS	3	rw	**Sleep Mode Enable Control** Used for module Sleep Mode control 0_B Sleep Mode request is regarded. Module is enabled to go into Sleep Mode on a request. 1_B Sleep Mode request is disregarded: Sleep Mode cannot be entered on a request.

Note:

1. *Bit EDIS is not implemented for the following of the modules listed above: CIF, GETH, I2C, SDMMC*
2. *In the FCE module, the bit at position of EDIS is of type ‘rw’, but without function and not shown in the User Manual*
3. *In the EDSADC, GTM, STM modules bit DISS is of type ‘rh’, but shown as ‘r’ in the User’s Manual*

CPU_TC.H020 Inconsistent register description in CPU chapter - Documentation update

1. Overview

The current version of the CPU chapter in the TC3xx family User's Manual uses incorrect names for some of the Bus MPU registers. In multiple places the register names are combined with an incorrect index variable 'x'. Variable 'x' normally refers to the CPU instance. For these registers the intention was to refer to a particular range number.

The following description provides a summary of all the incorrect references as well as their actual intended values.

Note: Absolute chapter numbers refer to CPU chapter version V1.1.19 included in the TC3xx User's Manual V1.4.0. They may change if used in other versions of this document.

2. Chapter "Summary of SFR Reset Values and Access modes"(5.3.4.22.2)

Both of the tables named

- **Register Overview – SPR** (ascending Offset Address)
- **Register Overview – DLMU** (ascending Offset Address)

incorrectly use the letter 'x' as an index variable where '**i**' was intended in the Short Name, Long Name and Offset Address columns.

Corrected description of Register Overview tables

Corrected parts of these tables ('**i**' intended in 3 places per row) see below:

Table 15 Corrections to table "Register Overview – SPR"

Short Name	Long Name	Offset Address
SPR_SPROT_ RGNACCENA**i**_R	CPUx Safety Protection Region SPR Read Access Enable Register A**i**	$0E088_H$+**i***10_H
SPR_SPROT_ RGNACCENB**i**_R	CPUx Safety Protection Region SPR Read Access Enable Register B**i**	$0E08C_H$+**i***10_H

Table 16 Corrections to table “Register Overview – DLMU”

Short Name	Long Name	Offset Address
DLMU_SPROT_ RGNLA**i**	CPUx Safety Protection DLMU Region Lower Address Register **i**	$0E200_H$+**i***10_H
DLMU_SPROT_ RGNUA**i**	CPUx Safety Protection DLMU Region Upper Address Register **i**	$0E204_H$+**i***10_H
DLMU_SPROT_ RGNACCENA**i**_W	CPUx Safety Protection Region DLMU Write Access Enable Register A**i**	$0E208_H$+**i***10_H
DLMU_SPROT_ RGNACCENB**i**_W	CPUx Safety Protection Region DLMU Write Access Enable Register B**i**	$0E20C_H$+**i***10_H
DLMU_SPROT_ RGNACCENA**i**_R	CPUx Safety Protection Region DLMU Read Access Enable Register A**i**	$0E288_H$+**i***10_H
DLMU_SPROT_ RGNACCENB**i**_R	CPUx Safety Protection Region DLMU Read Access Enable Register B**i**	$0E28C_H$+**i***10_H

3. Section “Scratch Pad SRAMs” in chapter “Bus MPU” (5.4.6.1)

This section uses incorrect index variable ‘x’ or no index variable in references to the SPR_SPROT_* registers.

Corrected description of section “Scratch Pad SRAMs”

Each scratchpad region is defined using the registers, SPR_SPROT_RGNLAi (i=0-7) to define the lower address of the region, SPR_SPROT_RGNUAi (i=0-7) to define the upper address of the region.

Each region may be enabled for writes on a per bus master basis using the register SPR_SPROT_RGNACCENAi_W (Masters 31-0) and SPR_SPROT_RGNACCENBi_W (Masters 63-32).

Each region may be enabled for reads on a per bus master basis using the register SPR_SPROT_RGNACCENAi_R (Masters 31-0) and SPR_SPROT_RGNACCENBi_R (Masters 63-32).

A write access to the PSPR/DSPR memory is seen as valid if the master tag of the access is enabled in the SPR_SPROT_RGNACCENi_W register and the address of the access satisfies the following relationship:-

SPR_SPROT_RGNLAi <= address < SPR_SPROT_RGNUAi

A read access to the PSPR/DSPR is seen as valid if the master tag of the access is enabled in the SPR_SPROT_RGNACCENi_R register and the address of the access satisfies the following relationship:-

SPR_SPROT_RGNLAi <= address < SPR_SPROT_RGNUAi

If any of these conditions are not satisfied, the access is seen as invalid.

Accesses from all masters to the local DSPR (excluding data access from the local CPU) are checked by the SPR safety mechanism.

Accesses from all masters to the local PSPR (excluding fetch access from the local CPU) are checked by the SPR safety mechanism

4. Section “DLMU SRAMs” in chapter “Bus MPU” (5.4.6.1)

This section uses incorrect index variable ‘x’ or no index variable in references to the DLMU_SPROT_* and SPR_SPROT_RGNACCEN* registers.

Corrected description of section “DLMU SRAMs”

Each DLMU region is defined using the registers, DLMU_SPROT_RGNLAi (i=0-7) to define the lower address of the region, DLMU_SPROT_RGNUAi (i=0-7) to define the upper address of the region.

Each region may be enabled for writes on a per bus master basis using the register DLMU_SPROT_RGNACCENAi_W (Masters 31-0) and DLMU_SPROT_RGNACCENBi_W (Masters 63-32).

Each region may be enabled for reads on a per bus master basis using the register DLMU_SPROT_RGNACCENAi_R (Masters 31-0) and DLMU_SPROT_RGNACCENBi_R (Masters 63-32).

A write access to the local DLMU memory is seen as valid if the master tag of the access is enabled in the DLMU_SPROT_RGNACCENi_W register and the address of the access satisfies the following relationship:-

DLMU_SPROT_RGNLAi <= address < DLMU_SPROT_RGNUAi

A read access to the local DLMU memory is seen as valid if the master tag of the access is enabled in the DLMU_SPROT_RGNACCENi_R register and the address of the access satisfies the following relationship:-

DLMU_SPROT_RGNLAi <= address < DLMU_SPROT_RGNUAiIf any of these conditions are not satisfied, the access is seen as invalid.

Accesses from all masters to the local DLMU (including those from the local CPU) are checked by the DLMU safety protection mechanism.

5. Chapter “Register access enable Protection” (5.4.6.2)

This chapter uses incorrect index variable ‘x’ in reference to the SFR_SPROT_ACCEN*_W registers.

Corrected paragraphs of chapter “Register access enable Protection”

The CPUs implement the standard memory protection scheme for peripheral registers using the SFR_SPROT_ACCENA_W (Masters 31-0) and SFR_SPROT_ACCENB_W (Masters 63-32) register. This allows all CPU CSFR and SFR registers to be protected from write access by untrusted masters.

The SFR_SPROT_ACCENA_W and SFR_SPROT_ACCENB_W registers define which masters may write the SFR and CSFR registers via bus access through the SRI slave interface.

The SFR_SPROT_ACCENA_W and SFR_SPROT_ACCENB_W registers are protected by the safety_endinit signal.

6. Chapter “Safety Protection registers” (5.4.7.2)

This chapter describes all the registers in detail. The register names and descriptions of the registers listed in **Table 15** and **Table 16** all use incorrect index ‘x’ when ‘i’ was intended

- in the register name,
- in the offset calculation,
- in the register description.

DTS_TC.H002 Unexpected alarms after start-up/wake-up when temperature is close to lower/upper limit

The result of the first temperature measurement received from the Die Temperature Sensor (DTS) after start-up from cold PORST or wake-up from standby mode is inaccurate due to parallel processing of sensor trimming.

Effect

If temperature is close (< 10 K) to the thresholds defined in register DTSLIM, alarms ALM9[0] or ALM9[1] in SMU_core and ALM21[9] or ALM21[8] in SMU_stdby can be triggered falsely indicating lower temperature limit underflow or upper limit overflow, respectively. Also, the corresponding flag DTSLIM.LLU or DTSLIM.UOF is set.

Recommendation

The application software shall clear the respective flag in DTSLIM and **afterwards** clear related SMU alarms. In case alarms are retriggered, application SW shall consider these as real alarms, and trigger a reaction within the FTTI (Fault Tolerant Time Interval) of the respective application.

FLASH_TC.H019 Write Burst Once command – Documentation update

For the Write Burst Once command, the current version of the TC3xx User's Manual states in section "Command Sequence Definitions":

"This function starts the programming process for an aligned group of pages as the normal "Write Burst" does. But before programming it checks if the pages are erased. If the page is not erased (allowing correctable errors) the command fails with PVER and EVER."

*Note: The actual implementation of the Write Burst Once command is similar to the Write Page Once command, therefore it will be updated in the next version of the TC3xx User's Manual as follows (changes marked in **bold** below:*

Documentation Update - Write Burst Once

"This function starts the programming process for an aligned group of pages as the normal "Write Burst" does. But before programming it checks if the pages are erased. If the **pages are** not erased (allowing correctable errors) the command fails with **EVER**."

FlexRay_AI.H004 Only the first message can be received in External Loop Back mode

If the loop back (TXD to RXD) will be performed via external physical transceiver, there will be a large delay between TXD and RXD.

A delay of two sample clock periods can be tolerated from TXD to RXD due to a majority voting filter operation on the sampled RXD.

Only the first message can be received, due to this delay.

To avoid that only the first message can be received, a start condition of another message (idle and sampling '0' -> low pulse) must be performed.

The following procedure can be applied at one or both channels:

- wait for no activity (TEST1.AOx=0 -> bus idle)
- set Test Multiplexer Control to I/O Test Mode (TEST1.TMC=2), simultaneously TXDx=TXENx=0
- wait for activity (TEST1.AOx=1 -> bus not idle)
- set Test Multiplexer Control back to Normal signal path (TEST1.TMC=0)
- wait for no activity (TEST1.AOx=0 -> bus idle)

Now the next transmission can be requested.

FlexRay_AI.H005 Initialization of internal RAMs requires one eray_bclk cycle more

The initialization of the E-Ray internal RAMs as started after hardware reset or by CHI command CLEAR_RAMS (SUCC1.CMD[3:0] = 1100_B) takes 2049 eray_bclk cycles instead of 2048 eray_bclk cycles as described in the E-Ray Specification.

Signalling of the end of the RAM initialization sequence by transition of MHDS.CRAM from 1_B to 0_B is correct.

FlexRay_AI.H006 Transmission in ATM/Loopback mode

When operating the E-Ray in ATM/Loopback mode there should be only one transmission active at the same time. Requesting two or more transmissions in parallel is not allowed.

To avoid problems, a new transmission request should only be issued when the previously requested transmission has finished. This can be done by checking registers `TXRQ1/2/3/4` for pending transmission requests.

FlexRay_AI.H007 Reporting of coding errors via `TEST1.CERA/B`

When the protocol engine receives a frame that contains a frame CRC error as well as an FES decoding error, it will report the FES decoding error instead of the CRC error, which should have precedence according to the non-clocked SDL description.

This behaviour does not violate the FlexRay protocol conformance. It has to be considered only when `TEST1.CERA/B` is evaluated by a bus analysis tool.

FlexRay_AI.H009 Return from test mode operation

The E-Ray FlexRay IP-module offers several test mode options

- Asynchronous Transmit Mode
- Loop Back Mode
- RAM Test Mode
- I/O Test Mode

To return from test mode operation to regular FlexRay operation we strongly recommend to apply a hardware reset via input eray_reset to reset all E-Ray internal state machines to their initial state.

Note: The E-Ray test modes are mainly intended to support device testing or FlexRay bus analyzing. Switching between test modes and regular operation is not recommended.

FlexRay_AI.H011 Behavior of interrupt flags in FlexRay™ Protocol Controller (E-Ray)

In the corner case described below, the actual behavior of the interrupt flags of the FlexRay™ Protocol Controller (E-RAY) differs from the expected behavior.

Note: This behaviour only applies to E-RAY interrupts INT0 and INT1. All other E-RAY interrupts are not affected.

Expected Behavior

When clearing an interrupt flag by software, the resulting value of the flag is expected to be zero.

A hardware event that occurs afterwards then leads to a zero to one transition of the flag, which in turn leads to an interrupt service request.

Actual Behavior in Corner Case

When the interrupt flag is being cleared by software in the same clock cycle as a new hardware event sets the flag again, then the hardware event wins and the flag remains set without being cleared.

As interrupt requests are generated only upon zero to one transitions of the flag, no interrupt request will be generated for this flag until the flag is successfully cleared by software later on.

Workaround

After clearing the flag, the software shall read the flag and repeat clearing until the flag reads zero.

FlexRay_TC.H003 Initialization of E-Ray RAMs - Documentation Update

After Power-On reset, the E-Ray RAMs hold arbitrary values which causes ECC errors (MHDS) when a read operation is performed on an E-Ray RAM location. Hence the E-Ray RAMs should be initialized always after a Power-On reset.

Recommendation

The E-Ray RAMs initialization can be performed using the CLEAR_RAMS command of the E-Ray module. A safe initialization sequence of the E-Ray RAM blocks using the CLEAR_RAMS command is described in section “CLEAR_RAMS Command” of chapter “FlexRay™ Protocol Controller (E-Ray)” in the AURIX™ TC3xx Target Specification/User’s Manual.

Documentation Update

Note: In order to ensure proper FlexRay communication, RAM test mode must be explicitly disabled via TEST1.TMC = 00b at the end of the initialization sequence.

Therefore, Step16 in section “CLEAR_RAMS Command” of the TC3xx User’s Manual must be updated from

- 16. Switch off Test Mode: TEST1.WRTEN = 0b

to

- 16. Switch off Test Mode: **TEST1.TMC = 00b and** TEST1.WRTEN = 0b

FlexRay_TC.H004 Bit WRECC in register TEST2 has no function

In the AURIX™ implementation of the E-Ray module, bit WRECC in register TEST2 has no function.

Recommendation

The value read from WRECC should not be evaluated by software, the value written (0_B or 1_B) to it is irrelevant.

For new software projects, keep bit WRECC at its reset value (0_B) for easier migration to future AURIX™ generations.

FPI_TC.H003 Burst write access may lead to data corruption

For the FPI slave modules listed below, if a write burst access is aborted on the last beat, this may lead to data corruption of all future accesses. No error is generated when the burst access is aborted.

This problem only affects the following modules:

- CONVCTRL, EVADC, PMS, SCR XRAM

Recommendation

Do not perform burst accesses to registers in CONVCTRL, EVADC, PMS, and to SCR XRAM.

GTM_TC.H010 Trigger Selection for EVADC and EDSADC

If the GTM output selection in the SELz bit fields for ADC triggers (registers ADCTRIGxOUTy, DSADCOUTSELxy) is changed during SW runtime, multi-bit changes may lead to unintended ADC triggering.

Recommendation

Before changing the trigger source in the GTM output selection fields SELz, ensure that the ADCs at the trigger destination will not react on intermediate state changes of the trigger signals.

GTM_TC.H019 Register GTM_RST - Documentation Update

In the current documentation, bit 0 in register GTM_RST is described as

- **Type**: r
- **Description**: Reserved - Read as zero, should be written as zero.

Documentation Update

Actually, bit 0 in register GTM_RST is implemented as follows:

- **Type**: **rw**
- **Description**: Reserved - Read as zero, **shall** be written as zero.

Note: This Application Hint relates to problem GTM-IP-316 reported by the GTM IP supplier. On this AURIX™ TC3xx device step, the reported problem has no effect, independent of the value written to bit GTM_RST.0.

However, GTM_RST.0 shall always be written with 0_B as documented in the register description to ensure compatibility with future versions.

GTM_TC.H021 Interrupt strategy mode selection in IRQ_MODE

The default setting for field IRQ_MODE in register IRQ_MODE is Interrupt Level mode (00_B).

Figure “GTM interrupts” in chapter “GTM Implementation” of the TC3xx User’s Manual shows how the interrupt signal (GTM_IRQ_XXX) triggers an interrupt towards the Interrupt Router (IR), depending on IRQ_MODE.

As described in the text below this figure, while using Level mode, if more internal “interrupt” events are generated (i.e. two TOM channels generating a CCU0 interrupt), just one interrupt signal is sent to the IR, and no more interrupts are triggered until the SW clears the GTM_IRQ_XXX line towards the IR.

Hence, in Level Mode, in some scenarios where another interrupt request is generated by GTM while the ISR handle also requests a SW clear, then, as the interrupt event is dominant over the clear event (for simultaneous interrupt and clear events), GTM_IRQ_XXX is not cleared and remains high. As a consequence, the IR observes no transition on GTM_IRQ_XX. Thus, any forthcoming interrupt events in this scenario are lost as there is no chance to release the CPU IRQ when a collision happens as shown in Figure below.

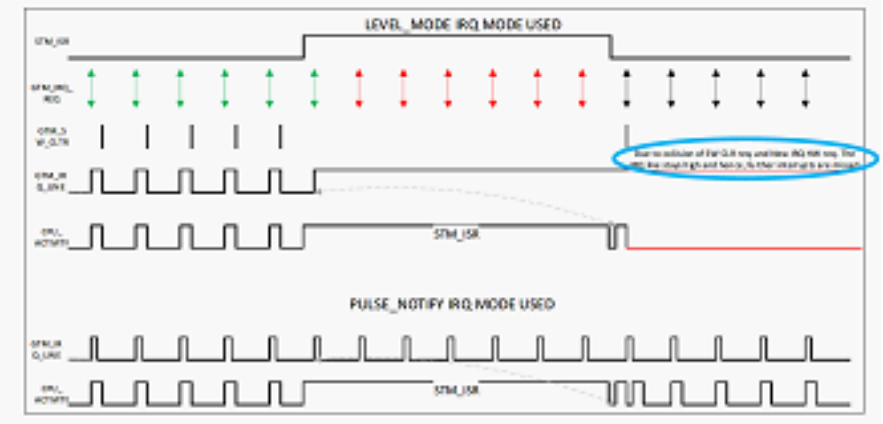

Figure 5 Interrupt Level vs. Pulse-Notify mode - Corner Case Example

If Pulse-Notify mode is selected, every internal trigger will be forwarded to the IR, irrespective of the time of occurrence and the clear event, as the pulse-notify leads to set and reset of GTM_IRQ_XXX as compared to only setting of the GTM_IRQ_XXX line in Level mode.

Recommendation

Therefore, it is recommended to use the Pulse-Notify mode to ensure that none of the interrupts might be lost by the IR even in corner timing cases.

As described above, this scenario in Level mode is only a corner case due to the timing of the SW and ISR handle. If using a different IRQ_MODE setting, evaluate your system performance for sufficient timing margin.

GTM_TC.H022 Field ENDIS_CTRLx in register ATOMi_AGC_ENDIS_CTRL - Documentation Update

The description for settings ENDIS_CTRLx = 10_B and ENDIS_CTRLx = 11_B in register ATOMi_AGC_ENDIS_CTRL in the current version of the TC3xx User's Manual is incorrect.

In will be updated in future revisions of the TC3xx User's Manual as shown in **Figure 6** below.

Field	Bits	Type	Description
ENDIS_CTRLx (x=0-7)	2*x+1:2*x	rw	**ATOM channel x enable/disable update value** If FREEZE=0: If an ATOM channel is disabled, the counter **CN0** is stopped and the output register of SOU unit is set to the inverse value of control bit SL. On an enable event, the counter **CN0** starts counting from its current value. If FREEZE=1: If an ATOM channel is disabled, the counter CN0 is stopped (SOMP, SOMS mode) and each comparison is stopped (SOMC, SOMB mode). On an enable event, the counter CN0 starts counting from its current value or a comparison is restarted. Write of following double bit values is possible: *Note: If the output is disabled (OUTEN[x]=0), the ATOM channel x output ATOM_OUT[x] is the inverted value of bit SL.* 00_B Don't care, bits 1:0 of register ENDIS_STAT will not be changed on an update trigger 01_B Disable channel on an update trigger 10_B Enable channel on an update trigger 11_B Don't change bits 1:0 of this register

Figure 6 Updated description for settings ENDIS_CTRLx = 10B and ENDIS_CTRLx = 11B in register ATOMi_AGC_ENDIS_CTRL

INT_TC.H006 Number of SRNs supporting external interrupt/service requests – Documentation update

As correctly described in the SCU chapter "Output Gating Unit" of the TC3xx User's Manual, **four** interrupt/service requests can be generated by the ERU OGU[0-3] via its outputs ERU_IOUT[0-3]. These outputs are connected to the IR Service Request registers SRC_SCUERU[0-3] via the signals ERU_INT[0-3].

Documentation update

The following statement in the IR chapter “External Interrupts” of the TC3xx User’s Manual is conflicting with the description above:

- “Eight SRNs (Int_SCUSRC[7:0]) are reserved to handle external interrupts.”

Therefore, it shall be changed as follows:

- “Four SRNs (SRC_SCUERUx (x=0-3)) are reserved to handle external interrupts.”

ISTANDBY_TC.H001 Characteristics of Standby current ISTANDBY on TC33x/TC32x in QFP-80 and QFP-100 packages

Note: This effect only applies to TC332 and TC322 in QFP-80 and TC333 and TC323* in QFP-100 packages, and only affects the use case where VEXT is not switched off during Standby mode.*

As pin P33.12 is unavailable on TC33x/TC32x in QFP-80 and QFP-100 packages, and the internal pad is floating in Standby mode in these variants and no pull devices are active when VEXT is not switched off, during Standby entry the Standby current value $I_{STANDBY}$ as specified in the Data Sheet is reached after a transient delay of 10 - 100 ms (typical).

The Standby current has a higher value during the transient phase of 200 µA – 600 µA @-40°C and <170 µA @25°C after which it settles to the $I_{STANDBY}$ target value as specified in the Data Sheet.

Note: If VEXT is switched off during Standby mode the internal pull-up at pad P33.12 is activated, this means no floating state at this pad and therefore no additional cross current.

Note: If pin P33.12 is available in higher pin-count packages, the pin level can be driven either using external pull devices or internal port IO functions and also be controlled by the PMSWCR5.TRISTREQ function.

MCMCAN_AI.H001 Behavior of interrupt flags in CAN Interface (MCMCAN)

In the corner case described below, the actual behavior of the interrupt flags of the CAN Interface (MCMCAN) differs from the expected behavior as follows.

Expected Behavior

When clearing an interrupt flag by software, the resulting value of the flag is expected to be zero.

A hardware event that occurs afterwards then leads to a zero to one transition of the flag, which in turn leads to an interrupt service request.

Actual Behavior in Corner Case

When the interrupt flag is being cleared by software in the same clock cycle as a new hardware event sets the flag again, then the hardware event wins and the flag remains set without being cleared.

As interrupt requests are generated only upon zero to one transitions of the flag, no interrupt request will be generated for this flag until the flag is successfully cleared by software later on.

Note: This behavior applies to all Interrupt flags of MCMCAN, with the exception of the receive timeout event (flag NTRTRi.TE).

Workaround

After clearing the flag, the software shall read the flag and repeat clearing until the flag reads zero.

MCMCAN_AI.H002 Busoff Recovery

Note: The following text is copied from Application Note M_CAN_AN004 V1.1 by Robert Bosch GmbH and describes the busoff recovery handling in the MCMCAN module used in AURIX™ TC3xx devices.

The M_CAN enters Busoff state according to CAN protocol conditions. The Busoff state is reported by setting PSR.BO. Additionally, the M_CAN sets CCCR.INIT to stop all CAN operation.

To restart CAN operation, the application software needs to clear CCCR.INIT.

After CCCR.INIT is cleared, the M_CAN's CAN state machine waits for the completion of the Busoff Recovery Sequence according to CAN protocol (at least 128 occurrences of Bus Idle Condition, which is the detection of 11 consecutive recessive bits).

In the MCMAN chapter of the TC3xx User's Manual the description of Busoff Recovery states that "Once CCCR.INIT has been cleared by the CPU, the device will then wait for 129 occurrences of Bus Idle (129 * 11 consecutive recessive bits) before resuming normal operation. At the end of the Busoff Recovery sequence, the Error Management Counters will be reset".[1)]

The M_CAN uses its Receive Error Counter to count the occurrences of the Bus Idle Condition. If need be, that can be monitored at ECR.REC. Additionally, each occurrence of the Bus Idle condition is flagged by PSR.LEC = 5 = Bit0Error, which triggers an interrupt (IR.PEA) when IR.PEAE is enabled.

While the Busoff Recovery proceeds, the CAN activity is reported as "Synchronizing", PSR.ACT = 0 and PSR.BO remains set. The time from resetting CCCR.INIT to the clearing of PSR.BO will be (in the absence of dominant bits on the CAN bus) 1420 (11 * 129 + 1) CAN bit times plus synchronization delay between clock domains.

The M_CAN does not receive messages while the Busoff Recovery proceeds.

The M_CAN does not start transmissions while the Busoff Recovery proceeds. When a transmission is requested while the Busoff Recovery proceeds, it will be started after the Recovery has completed and CAN activity entered Idle state, PSR.ACT = 1.

When the Busoff Recovery has completed, PSR.BO, ECR.TEC, and ECR.REC are cleared, and one CAN bit time later PSR.ACT is set to Idle.

After PSR.ACT reaches Idle, it will remain in Idle for at least one CAN bit time. The M_CAN's CAN state machine will become receiver (PSR.ACT = 2) when it samples a dominant bit during Idle state or it will become transmitter (PSR.ACT = 3) when it detects a pending transmission request during Idle state.

1) See Note in description of field LEC and footnote 1) in description of bit BO in Protocol Status Register i (PSRi).

MCMCAN_TC.H006 Unintended Behavior of Receive Timeout Interrupt

On following conditions:

1. Receive timeout feature is enabled (i.e. NTRTR.RELOAD != 0), **and**
2. Received CAN frames are stored in RxFIFO 0/1 or Dedicated Rx Buffers, **and**
3. Respective New CAN frame received interrupts are disabled (i.e. bits IE.RF0NE, IE.RF1NE or IE.DRXE are 0),

then an unintended receive timeout interrupt (if enabled, i.e. NTRTR.TEIE = 1) is triggered, although a valid CAN frame is newly received and stored in the respective RxFIFO 0/1 or Dedicated Rx Buffers.

Recommendation

Enable the corresponding receive interrupt via bits IE.RF0NE, IE.RF1NE, or IE.DRXE, depending on the usage of RxFIFO0/1 or dedicated Rx Buffers for proper function of the receive timeout interrupt.

Example

If RxFIFO 0 is used, set IE.RF0NE =1.

MCMCAN_TC.H007 Delayed time triggered transmission of frames

The value written in the bit-field RELOAD of register NTATTRi(i=0-3), NTBTTRi(i=0-3), NTCTTRi(i=0-3) represents the reload counter value for the timer used for triggered transmission of message objects (Classical CAN or CAN FD frames).

The timer source and the prescaler value is defined in the NTCCRi(i=0-3) register.

Once a value is written to bit-field RELOAD with bit STRT=1 the timer starts counting. This timer counts one value more than the written value in bit-field RELOAD, then it triggers the transmission of a message object.

Effect

The message object transmission is delayed by one counter cycle with respect to the desired count time written in bit-field RELOAD.

Recommendation

In order to transmit a message object at a specific time, when using one of these registers:

- NTATTRi(i=0-3), NTBTTRi(i=0-3), NTCTTRi(i=0-3),

set bit-field RELOAD one value less than the calculated counter value.

MCMCAN_TC.H008 Parameter “CAN Frequency” - Documentation update to symbol in Data Sheet

As described in chapter “Clocking System” of the AURIX™ TC3xx User’s Manual,

- f_{MCANH} defines the frequency for the internal clocking of the MCMCAN module,
- f_{MCAN} defines the basic frequency for the MCMCAN module used for the baud rate generation.

Documentation Update

For consistency with the description in the TC3xx User’s Manual, the symbol for parameter “CAN frequency” in table “Operating Conditions” in the Data Sheet shall be changed from “f_{CAN}” to “$\mathbf{f_{MCAN}}$” as shown below:

Table 17 Operating Conditions - CAN Frequency: symbol update

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
CAN Frequency	f_{MCAN} SR	-	-	80	MHz	

MTU_TC.H015 ALM7[0] may be triggered after cold PORST

During firmware start-up after cold PORST, alarm status flag AG7.SF0 (correctable SRAM error) may erroneously be set to 1, although no error occurred. This is due to a dummy read to an uninitialized SRAM by firmware.

Note: No entry into any of the ETRR registers is made due to this issue.

Recommendation

As alarms for correctable errors are uncritical in general, no action is required (alarm can be ignored). The application may only react on the error overflow.

In addition, to ensure that SMU alarm ALM7[0] does not correspond to a real SRAM correctable error, the user may refer to the ESM MCU_FW_CHECK described in the Safety Manual.

MTU_TC.H016 MCi_FAULTSTS.OPERR[2] may be triggered at power-up in case LBIST is not run

After power-up and before initialization by the SSW the safety flip-flops in the SSH can indicate a fault since some internal registers are not initialized. As a consequence MCi_FAULTSTS.OPERR[2] could be set and result in an alarm.

This is not a real error. LBIST does initialize the internal registers and clears the error.

Recommendation

Alarms resulting from MCi_FAULTSTS.OPERR[2] should be ignored during start-up and cleared right after execution of the SSW in case LBIST was not run.

MTU_TC.H017 Behavior of MCi_ECCS register for SSH instances with DED - Documentation update

The MCi_ECCS register description in the MTU chapter of the AURIX™ TC3xx User's Manual is generic (MCi_ECCS (i=0-95)).

The behavior for SSH instances with ECC type "double bit error detection" (see symbol "DED" e.g. in table "SSH instances" in the product specific appendix to

the TC3xx User's Manual) deviates since error correction is not implemented here.

Bit ECE (Error Correction Enable) is also implemented in ECCS registers of SSH instances with DED, and its reset value is 1_B.

Documentation update

To reflect this behavior of MCi_ECCS registers for SSH instances with ECC type "DED", section "SRAM Error Detection & Correction (EDC/ECC)" in the MTU chapter shall be updated:

Following the sentence

- "DED codes can detect upto a double bit error, but cannot correct any error."

this sentence shall be added

- "ECCS.ECE does exist and can be written and read for SSH with DED. However, it has no functionality."

OCDS_TC.H014 Avoiding failure of key exchange command due to over-write of COMDATA by firmware

Note: This problem is only relevant for tool development, not for application development.

After PORST the UNIQUE_CHIP_ID_32BIT is written to the COMDATA register by firmware (time point T1). Then, firmware evaluates whether a key exchange request (CMD_KEY_EXCHANGE) is contained inside of the COMDATA register at a time point (T2). If yes, firmware will expect the 8 further words (password) from the COMDATA. If no, firmware will write again the UNIQUE_CHIP_ID_32BIT value for external tools to identify the device.

If the key exchange request cannot arrive between time points T1 and T2, firmware will skip the unlock procedure and will not unlock the device. For example, the device is locked and the external tool writes the CMD_KEY_EXCHANGE value to COMDATA before T1. Then, this value is overwritten by firmware at T1. After this, firmware doesn't see the CMD_KEY_EXCHANGE value and skips the unlock procedure. The device stays locked.

Recommendation

The external tool shall write the CMD_KEY_EXCHANGE to the COMDATA register between T1 and T2. As different derivatives and firmware configurations may have different execution time, it is recommended to poll the content of COMDATA after PORST until the UNIQUE_CHIP_ID_32BIT is available. Then, the external tool shall write the CMD_KEY_EXCHANGE immediately. In this way, the overwrite of key exchange request by firmware can be avoided.

When LBIST is activated during startup, the execution time stays the same after the PORST triggered by LBIST. Therefore, the end of LBIST should be detected by the external tool. This can be achieved by polling the device state via JTAG/DAP. During LBIST, the debug interface is disabled and no response can be received. After LBIST, the response can be received normally. This symptom can be utilized to determine whether LBIST is done. The details are described in the section “Halt after PORST with DAP” in the OCDS chapter of the device documentation.

OCDS_TC.H015 System or Application Reset while OCDS and lockstep monitoring are enabled

After a System or Application Reset the Lockstep Alarm ALMx[0] gets activated if all of the following conditions are met (x = index of CPU with checker core):

1. Lockstep monitoring is enabled by BMI.LSENAx = 1_B for CPUx, AND
2. Debug System is enabled (CBS_OSTATE.OEN = 1_B), AND
3. CPUx is halted (either in boot-halt state or stopped by debugger tool or in idle mode) when reset is triggered OR CPUx Performance Counters are enabled.

Recommendation

To avoid the unintended ALMx[0] under the conditions described above, either:

- Keep the debug system disabled. OR
- Ensure all CPUs that have lockstep monitoring enabled are out of halted state AND CPUx Performance Counters are disabled before executing a System or Application reset. OR

- Use PORST instead of a System or Application reset.

OCDS_TC.H016 Release of application reset via OJCONF may fail

Note: This problem is only relevant for tool development, not for application development.

The OJCONF.OJC7 bit field can be used to send an application reset request to the SCU. The tool sets the bit to request an application reset and has to clear the bit to release the request otherwise the device will remain in reset state.

If JTAG is used in the above case and the frequency of JTAG is very low, there is a risk that the tool is not able to release the application reset request. If DAP is used, there is a low risk that the first release of reset request may fail but the second will always work.

Recommendation

It is recommended to run JTAG above 1 MHz and execute the following instructions back to back:

IO_SUPERVISOR + IO_SET_OJCONF (release) + IO_SUPERVISOR + IO_SET_OJCONF (release).

This double releasing ensures that the reset request is released reliably.

OCDS_TC.H018 Unexpected stop of Startup Software after system/application reset

Note: this problem is only relevant for tool development, not for application development.

As documented in the TriCore Architecture Manual, the settings in the Debug Status Register (DBGSR) are only cleared upon a debug or power-on reset. This may lead to unexpected behavior in the following scenario:

If CPU0 is in HALT mode, and a system or application reset is triggered, the Startup Software (SSW) starts execution on CPU0, but it is stopped again (due to the settings in DBGSR) before the SSW has finished the boot procedure.

Recommendation

The tool should switch the device from HALT to RUN mode via the DBGSR register.

Alternatively, a power-on reset may be performed instead of a system/application reset.

PADS_TC.H007 Connection of HWCFG[6] pad in QFP-80 and QFP-100 packages – Explanation to Data Sheet history

In QFP80 and QFP100 packages, HWCFG[2] and HWCFG[6] pins are not available. Internally, the corresponding pads are handled as follows:

- HWCFG[2] is tied to 1 (via internal pull-up) to ensure EVRC is enabled;
- HWCFG[6] is tied to 0 (connected to V_{SS} via E-PAD) to ensure pins are in tristate.

This is also documented in Note 2.) in figure “Hardware Configuration (HWCFG) pins” in the PMSLE chapter of the TC3xx User’s Manual in version V1.3.0 and later versions.

In V0.6 of the TC33x/TC32x Data Sheet, the E-PAD was listed as VSS pin 81 for QFP-80, pin 101 for QFP-100, and pin 145 for QFP-144 packages, respectively. The E-PAD is explicitly listed in the supply tables in TC33x/TC32x Data Sheet V0.7 and following (see also chapter “History” in corresponding Data Sheets).

PINNING_TC.H002 VFLEX supply for TC33* and TC32* devices in QFP packages - Data Sheet documentation note

Note: This documentation issue only applies to TC33 and TC32* devices in QFP packages. These are: TC334*, TC333*, TC332*, TC324*, TC323*, and TC322*.*

For these devices in QFP packages the VFLEX supply is internally connected to the VEXT supply.

In column “Buffer Type” of the “Port Function” tables for these devices in QFP packages the term “VFLEX” may be regarded as equivalent to “VEXT” in the context of the Data Sheet.

PMS_TC.H003 VDDPD voltage monitoring limits

The EVR pre-regulator (EVRPR) generates the internal VDDPD voltage. Its upper and lower threshold limits are monitored by the VDDPD secondary monitor, while the minimum VLVDRSTC voltage (LVD reset level) is monitored by the VDDPD detector with built-in reference.

The secondary voltage monitor’s upper and lower voltage thresholds for the VDDPD channel may be adapted in software for better centering across the nominal set point with sufficient margin accounting for static regulation and dynamic response of the VDDPD internal voltage regulator.

Note: The PREOVVAL and PREUVVAL values of EB_H and $C7_H$, respectively, mentioned in column “Note/Test Conditions” for VDDMON in the Data Sheet are only examples used to characterize the VDDMON accuracy under the specified conditions and shall not be used for the configuration of the EVROVMON2.PREOVVAL and EVRUVMON2.PREUVVAL fields in an application.

Recommendation

- The over-voltage alarm threshold setting in EVROVMON2.PREOVVAL needs not to be modified. The register reset value 0xFE = 1.460 V is appropriate (as well as the next lower value 0xFD = 1.454 V).
- For the under-voltage alarm threshold setting in EVRUVMON2.PREUVVAL:
  - The register reset value 0xBC = 1.079 V (typical) may be kept. It matches the LVD reset level (VLVDRSTC) which is at 1.074 V (typical). In this case, the reset will occur concurrently with the alarm, therefore either the reset, or the alarm and the reset will be triggered.
  - The threshold value might be set higher to the value 0xC4 = 1.125 V (typical), in order for the software to have some time to react on the alarm before the reset occurs.

In future versions of the User's Manual, the part for the VDDPD voltage monitor in figure "Voltage Monitoring - VEVRSB, VDDM & VDDPD" in the PMS and PMSLE chapter will be updated accordingly:

- PREOVVAL range = 1.43 V - 1.48 V.
  - Register reset value: SMU alarm generated at PREOVVAL ~ 1.46 V.
- PREUVVAL range = 1.1 V - 1.15 V.
  - Register reset value: SMU alarm generated at PREUVVAL ~ 1.08 V.

PMS_TC.H005 SCR clock in system standby mode - Documentation update

The following statement in the fourth paragraph of PMS and PMSLE chapters "Standby ControlleR (SCR) Interface" is incorrect:

"The 70 kHz stand-by clock source is the default SCR clock active in Standby Mode. The SCR clock source may be switched to the internal 20 MHz (derived from the 100 MHz back-up clock) clock source via SCRCLKSEL register bit thus enabling higher performance on the SCR subsystem."

It shall be replaced by the following statement:

Correction

The 20 MHz stand-by clock source is the default SCR clock active in System Standby Mode enabling higher performance of the SCR subsystem. The SCR clock source may be switched to the internal low-power 70 kHz clock by the SCR subsystem via bit CMCON.OSCPD if bit PMSWCR4.SCRCLKSEL is set to 1_B.

PMS_TC.H006 Output buffer capacitance on V_{OUT}

In order to filter the ripple on VDDP3 (flash supply line), the value of the output buffer capacitance C_{OUT} of the EVR33 regulator shall be increased from typ. 1.0µF ± 35% to typ. 2.2µF ± 35% for TC33x devices.

The corresponding parts in the TC33x Data Sheet and in the PMSLE chapter of the TC3xx User's Manual will be modified accordingly as shown below.

Table 18 EVR33 LDO - Parameter "Output buffer capacitance on V_{OUT}"- Update to TC33x Data Sheet

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Output buffer capacitance on V_{OUT}	C_{OUT} SR	1.45	2.2	3	µF	

Table 19 EVR33 External components reference - Update to PMSLE chapter of TC3xx User's Manual

No.	Condition	Optimal Register Value	Components
1	I_{DDP3} < 100 mA		Output buffer capacitor (2.2 µF)

PMS_TC.H008 Interaction of interrupt and power management system - Additional information

The description of steps to enter Idle, Sleep and Standby Mode in chapter "Power Management Overview" of the PMS and PMSLE chapters in the current TC3xx User's Manual is not comprehensive in explaining the dependency on pending interrupts as well as received interrupts. Hence, more explanation is provided here.

For a CPU to enter Idle Mode, it must have no interrupts pending. If it is in Idle Mode it will stay in Idle Mode until one of the specified wake-up events occurs – one of these is to have a pending interrupt.

Any SRN targeting a specific CPU (i.e. TOS set to that CPU), which is enabled, i.e. has SRE set, and has received a trigger event, i.e. has SRR set (whether by a received trigger from a peripheral or a master using the SETR control bit in the SRN) is a pending interrupt. Thus, even if a peripheral is shut down by having its clocks gated off, if it has presented a trigger event to the IR, and the SRE bit for that SRN is set, there will be a pending interrupt to the specified CPU.

It is not necessary for the priority of the pending interrupt to allow it to be taken, nor is it necessary for the CPU to have interrupt servicing enabled. It is possible and valid for Idle Mode to be entered with interrupts disabled, and to only re-enable interrupt acceptance subsequent to resuming execution. Equally, the CPU's priority may well dictate that the interrupt cannot be serviced immediately on re-enabling interrupts.

There may be some interrupts in a system that a CPU will be required to service and must exit Idle Mode (or Sleep Mode) or prevent entry to Idle Mode (or Sleep or Standby Mode) on their arrival. If one of these interrupts is raised prior to, or just as Idle Mode, Sleep Mode or Standby Mode is requested then that mode will not be entered.

The description for the REQSLP field states

- "In Idle Mode or Sleep Mode, these bits are cleared in response to an interrupt for the CPU, or when bit 15 of the corresponding CPU Watchdog Timer register (bit WDTCPUxSR.TIM[15]) changes from 0 to 1."

For clarity, this also means, if a write to PMCSRx.REQSLP occurs while the IR has a pending interrupt for CPUx the write data will be ignored and the REQSLP value will remain as 00_B "Run Mode".

For the system to enter Sleep or Standby Mode by writing to PMCSRx.REQSLP (as opposed through an external low voltage condition), all CPUs must be in Idle Mode. Typically, first other CPUs will be brought into Idle Mode and then the master CPU will be the last to enter to Idle Mode as a transitional state of the request for the system mode Sleep or Standby. Consequently any pending interrupts for any CPU will prevent the entry into Sleep or Standby Mode.

Recommendation

To ensure the transition to a power save mode, for a CPU intended to enter Idle Mode or for a system entering Sleep or Standby mode, all interrupts that are not intended to cause Run Mode to be re-entered or retained, should either have the SRE bit cleared in the respective SRN or be guaranteed to have the SRR bit clear.

If modifying the SRE bit of an SRN, to ensure the new state is reflected in IR arbitration information conveyed to the PMS and CPUs, sufficient time for an arbitration must have elapsed. Hence, a subset of the synchronisation

described in subsection “Changing the SRN configuration” of the IR chapter in the TC3xx User’s Manual is required.

After the last SRN (for CPUx) has been updated

- Read back the last SRN
- Read the LWSRx register

Clearing the SRR bit or disabling the source of the trigger can also be used if there are no timing hazards; i.e. no risk of a trigger being raised just before reconfiguring the peripheral (to not raise triggers), or no risk of an SRN that has had SRR cleared being set again while other SRNs are accessed. If the timing behaviour of these interrupt sources allows them to be disabled at source or in the SRN these are also valid methods. So long as the SRE bit and SRR bit are not both set, there will not be a pending interrupt. If the SRR bits are cleared, after the last SRN is modified there also needs to be a synchronisation step for the IR outputs to reflect the update before the PMCSRx is written.

Once there are no pending interrupts, request the power saving mode by writing to the respective PMCSRx.

Note: There will still be several system clock cycles till the power saving mode is enabled by the PMS during which the CPU will continue to execute instructions.

To ensure a deterministic boundary for execution to end after the power saving mode request, the write to PMCSRx should be followed by a DSYNC and a WAIT instruction.

PMS_TC.H009 Interaction of warm reset and standby mode transitions

Chapter “Power Management” in the PMS and PMSLE chapters of the TC3xx User’s Manual in general describes how the standby mode transitions are performed from the AURIX™ system point of view (see also figure “Power down modes and transitions”).

This application hint addresses the specific use cases

- when a standby request by VEXT ramp down is issued during warm reset, or
- when a warm reset is triggered when a standby mode transition is ongoing.

The PMS and PMSLE modules have a separate state machine operating independently from the rest of the AURIX™ system. The PMS and PMSLE modules and states are not affected by warm resets (e.g. application reset). Table “Effect of Reset on Device Functions” in the SCU chapter of the TC3xx User’s Manual shows how the AURIX™ modules are affected by different reset types. The PMS and PMSLE modules behave in the same way as the EVR module listed in this table.

Therefore standby mode entry is achieved even in the reset state of the AURIX™ system modes.

PMS_TC.H010 “EVR13” to be replaced by “EVRC” in table titles of TC33x/TC32x Data Sheet - Documentation update

For consistency with the User’s Manual, the term “EVR13” shall be replaced by “EVRC” in the table titles of the following two tables in the EVR chapter of the TC33x/TC32x Data Sheet V1.1 (and earlier versions):

- Title of table “EVR13 SMPS” shall be replaced by “EVRC SMPS”
- Title of table “EVR13 SMPS external components” shall be replaced by “EVRC SMPS external components”.

QSPI_TC.H008 Details of the Baud Rate and Phase Duration Control - Documentation update

To enhance readability, the last part of the second paragraph in the QSPI chapter “Details of the Baud Rate and Phase Duration Control”, starting with “Variations in the baud rates of the slaves ..”, shall be rephrased as shown below.

For further details see also the formulas in the chapter mentioned above and in the figures in chapter “Calculation of the Baud Rates and the Delays” in the User’s Manual.

Documentation update

Variations in the baud rates of slaves of one module are supported by the ECONz.Q and the ECONz.A/B/C bitfield settings allowing for a flexible bit time variation between the channels in one module.

SAFETY_TC.H002 SM[HW]:CPU.PTAG:ERROR_DETECTION – Documentation update to Safety Manual

Section 6.97 “SM[HW]:CPU.PTAG:ERROR_DETECTION” in chapter “Safety Mechanisms” of the current version of the AURIX™ TC3xx Safety Manual contains an incorrect part marked **bold** in the sentence copied below:

Incorrect sentence

“The SRAM implements a DED ECC logic. This mechanism detects SBE and DBE during read operations. In case an DBE is detected or **ECE is disabled** an SBE is detected a critical uncorrectable error alarm is forwarded to the SMU.”

Corrected sentence

“The SRAM implements a DED ECC logic. This mechanism detects SBE and DBE during read operations. In case a DBE is detected or a SBE is detected a critical uncorrectable error alarm is forwarded to the SMU.”

Summary

The CPU.PTAG memory is protected by an error detection code ECC capable to detect both single and double bit errors. Single bit errors (SBE) will lead to an uncorrectable error alarm regardless of the ECE configuration.

CPU PTAG does not offer SBE error correction capabilities. Indeed, both SBEs and DBEs will trigger an uncorrectable critical error alarm.

The correct hardware implementation of the ECC of the CPU PTAG memory is described in section 4.2.3.3.2 “Monitoring Concept” of the Safety Manual. See the note copied below:

“NOTE: CPU.PTAG do not offer SBE error correction capabilities. SBE and DBE are detected and an uncorrectable error is generated as described in SM[HW]:CPU.PTAG:ERROR_DETECTION.”

Note: Absolute section numbers in the text above apply to V1.06 of the AURIX™ TC3xx Safety Manual.

SAFETY_TC.H006 SM[HW]:PMS:VDD_MONITOR – Documentation update

The following sentence including an absolute value of the core supply voltage (V_{DD}) in section 6.349 “SM[HW]:PMS:VDD_MONITOR” of chapter “Safety Mechanisms” in the current version of the AURIX™ TC3xx Safety Manual

- Detects whether VDD (1.3V supply generated by EVR or from external) is within expected range.

shall be changed as listed below:

Updated sentence

- Detects whether the VDD supply voltage is within the expected range.

The typical value for V_{DD} is 1.25 V. See chapter “Electrical Specification” in the corresponding TC3xx device Data Sheet for absolute values and limits.

Note: Absolute section numbers in the text above apply to V1.06 of the AURIX™ TC3xx Safety Manual.

SAFETY_TC.H007 SM[HW]:CLOCK:PLL_LOSS_OF_LOCK_DETECTION – Documentation update

The term “VCO” in the following sentence included in section 6.43 “SM[HW]:CLOCK:PLL_LOSS_OF_LOCK_DETECTION” of chapter “Safety Mechanisms” in the current version of the AURIX™ TC3xx Safety Manual

- The PLL has a lock detection that supervises the VCO part of the PLL in order to differentiate between stable and unstable VCO circuit behavior.

shall be replaced by “**DCO**” as listed below:

Updated sentence

- The PLL has a lock detection that supervises the **DCO** part of the PLL in order to differentiate between stable and unstable **DCO** circuit behavior.

As described in chapter “Clocking System” of the TC3xx User’s Manual, the PLL implementation in the TC3xx devices has a DCO, it does not have a VCO.

Note: Absolute section numbers in the text above apply to V1.06 of the AURIX™ TC3xx Safety Manual.

SAFETY_TC.H008 Link between ESM[SW]:CONVCTRL:ALARM_CHECK and SM[HW]:CONVCTRL:PHASE_SYNC_ERR - Additional information

ESM[SW]:CONVCTRL:ALARM_CHECK is the SW measure to trigger the HW mechanism SM[HW]:CONVCTRL:PHASE_SYNC_ERR (see section “Safety Measures” in the CONVCTRL chapter of the TC3xx User’s Manual).

As of today, there is no link between these two mechanisms in the Safety Manual. To provide this information to system integrators, ESM[SW]:CONVCTRL:ALARM_CHECK (section 5.13 in the current version of the AURIX™ TC3xx Safety Manual) shall be added to the “**Tests**” field of SM[HW]:CONVCTRL:PHASE_SYNC_ERR (section 6.47 in Safety Manual), as shown below:

6.47 SM[HW]:CONVCTRL:PHASE_SYNC_ERR - Update to field “Tests”

Description

The Safety Mechanism supervises the operation of the Phase Synchronizer by monitoring the parity bit of its prescaler (PHSCFG.PHSDIV) and the counter value.

...

Tests

ESM[SW]:CONVCTRL:ALARM_CHECK

...

Note: Absolute section numbers in the text above apply to V1.06 of the AURIX™ TC3xx Safety Manual.

SAFETY_TC.H013 ESM[SW]:SYS:MCU_FW_CHECK - Access to MC40 FAULTSTS register – Additional information

The FSI RAM is used to configure the PFLASH. For security related reason, the access to this RAM is restricted. Therefore, in order to avoid accesses to this RAM through its SSH, the MBIST Controller 40 (MC40) is not disclosed in the AURIX™ TC3xx Target Specification/User's Manual.

However, according to Appendix A of the Safety Manual, for SSH(40) register MC40_FAULTSTS must be compared to an expected value by ESM[SW]:SYS:MCU_FW_CHECK after reset.

Recommendation

When implementing ESM[SW]:SYS:MCU_FW_CHECK, the register address listed below has to be used to access the FAULTSTS register of MBIST Controller 40:

- MC40_FAULTSTS (0xF006 38F0)

SAFETY_TC.H015 SM[HW]:NVM:STARTUP_PROTECTION – Documentation update

The description of SM[HW]:NVM:STARTUP_PROTECTION in the current version of the AURIX™ TC3xx Safety Manual shall be updated as follows:

Documentation update

Description

After start-up, the SSW automatically sets SCU_STCON.STP=1_B for preventing unintentional changes by Application SW of start-up protected SFRs, which define MCU system characteristics. This monitors the STARTUP PROTECTION property on interconnect accesses to functional block configuration addresses (TriCore segment F). The SFR configuration addresses for which this protection applies are defined at specification time. An unintentional change by Application SW triggers an SRI0 bus error, and hence an SMU alarm.

SAFETY_TC.H016 ESM[SW]:CPU:SOFTERR_MONITOR - Documentation update

Note: This issue applies to AURIX™ TC3xx Safety Manual version v1.11 or previous versions. It is fixed in v1.12 and following.

In order to provide more clarity on how to implement the ESM[SW]:CPU:SOFTERR_MONITOR external safety mechanism, additional information shall be provided in the “Notes” field as shown in the following:

Documentation update

This ESM represents the coverage offered by system level measures implemented in the application such as:

1. System plausibility checks such as ESM[SW]::PLAUSIBILITY
2. Program flow monitoring such as ESM[SW]:SYS:SW_SUPERVISION
3. External / internal watchdog
4. CPU/Bus Trap handling
5. End-to-End safe communication protocols such as ESM[SW]::SAFE_COMMUNICATION

SAFETY_TC.H017 Safety Mechanisms requiring initialization - Documentation update

In chapter “Safety Mechanisms” of the AURIX™ TC3xx Safety Manual, safety mechanisms that need to be initialized by Application SW have a link in the “Init Conditions” field to a Safety Mechanism Configuration (SMC). This SMC provides a description of what has to be implemented to activate the respective safety mechanism (SM).

This is not valid for all safety mechanisms. Some of them have no SMC as “Init Conditions”, although they need to be activated.

Documentation update

Following is the list of safety mechanisms that have to be activated with the respective “Init Conditions”, in addition to the SMs that are already listed with a link to a SMC in field “Init Conditions” in the Safety Manual:

SM[HW]:CLOCK:ALIVE_MONITOR

Init conditions

The application SW shall enable the clock alive monitoring by setting the corresponding bit in CCUCON3 register after PLLs have been set up and are running.

SM[HW]:CPU:TPS

Init conditions

The application SW shall enable the temporal protection system (configure CPU_SYSCON.TPROTEN = 1_B).

SM[HW]:CPU:TPS_EXCEPTION_TIME_MONITOR

Init conditions

The application SW shall enable the temporal protection system (configure CPU_SYSCON.TPROTEN = 1_B).

SM[HW]:CPU:CODE_MPU

Init conditions

The application SW shall configure the Code MPU according to TriCore™ TC1.6.2 Core Architecture Manual Volume 1 V1.1 - Chapter 10 “Memory Protection System”.

SM[HW]:CPU:DATA_MPU

Init conditions

The application SW shall configure the Data MPU according to TriCore™ TC1.6.2 Core Architecture Manual Volume 1 V1.1 - Chapter 10 “Memory Protection System”.

SM[HW]:CPU:UM0

Init conditions

The application SW shall configure the CPU access privilege level control to User-0 Mode (CPU_PSW.IO = 00_B).

SM[HW]:CPU:UM1

Init conditions

The application SW shall configure the CPU access privilege level control to User-1 Mode (CPU_PSW.IO = 01_B).

SM[HW]:CPU:SV

Init conditions

The application SW shall configure the CPU access privilege level control to Supervisor Mode (CPU_PSW.IO = 10_B). (Default configuration).

SM[HW]:CPU:STI

Init conditions

The application SW shall configure the safe task identifier (CPU_PSW.S = 1_B).

SM[HW]:DMA:TIMESTAMP

Init conditions

The application SW shall enable the appendage of a DMA timestamp (configure DMA_ADICRc.STAMP = 1_B).

SM[HW]:EMEM:CONTROL_REDUNDANCY

Init conditions

The application SW shall enable the EMEM module SRI control redundancy logic (EMEM_SCTRL.LSEN = 10_B).

SM[HW]:EMEM:READ_WRITE_MUX

Init conditions

The application SW shall configure the mode of the EMEM tiles via EMEM_TILECONFIG and enable access to the EMEM tiles via EMEM_TILECC and EMEM_TILECT.

SM[HW]:LMU:CONTROL_REDUNDANCY

Init conditions

The application SW shall enable the LMU control redundancy logic (LMU_SCTRL.LSEN = 10_B).

SM[HW]:NVM.PFLASH:ERROR_CORRECTION

Init conditions

The application SW shall enable the ECC error correction (CPUx_FLASHCON2.ECCCORDIS = 10_B).

Enabled after reset.

SM[HW]:NVM.PFLASH:ERROR_MANAGEMENT

Init conditions

The application SW shall enable address buffer recording (CPUx_FLASHCON2.RECDIS = 10_B).

Enabled after reset.

SM[HW]:NVM.PFLASH:FLASHCON_MONITOR

Init conditions

The application SW shall initialize CPUx_FLASHCON2.

SM[HW]:SPU:REDUNDANCY_SCC

Init conditions

SM[HW]:SPU:REDUNDANCY_SCC is enabled when either of SM[HW]:SPU:PARTIAL_REDUNDANCY or SM[HW]:SPU:REDUNDANCY are enabled.

SM[HW]:SCU:EMERGENCY_STOP

Init conditions

By default after reset, the Synchronous mode is selected; in this mode, the application SW shall enable (via EMSR.ENON = 1_B) the setting of the Emergency stop flag (EMSR.EMSF) on an inactive-to-active level transition of the port input.

Alternatively, the application SW can:

- Select the Asynchronous mode (EMSR.MODE = 1); in this mode the occurrence of an active level at the port input immediately activates the emergency stop signal.
- Configure Alarm(s) in SMU to trigger an Emergency Stop

SM[HW]:SMU:RT

Init conditions

The application SW shall enable the Recovery Timers (RTy, where y = 0,1) via RTC.RTyE = 1_B.

Recovery Timers (RTy, where y = 0,1) are enabled after Application Reset to service the WDT timeout alarms.

SM[HW]:SMU:FSP_MONITOR

Init conditions

FSP Monitor is enabled after Power-on Reset. The application SW shall ensure that the FSP is in the Fault Free State (SMU_ReleaseFSP()) before entering the RUN state with the SMU_Start() command.

SM[HW]:PMS:VDDM_MONITOR

Init conditions

SMC[SW]:PMS:Vx_MONITOR_CFG

SCR_TC.H009 RAM ECC Alarms in Standby Mode

During Standby mode, every ECC error in the RAMs of the Standby Controller (SCR) can be detected but the respective alarm signal is not propagated and not triggered by the SMU (ALM6[19], ALM6[20] and ALM6[21]).

Note: If not in Standby mode, alarm signals for ECC errors from the SCR RAMs are propagated and triggered by the SMU.

Recommendation

ECC errors from the RAMs of SCR can be checked by the application software via bit SCRECC of PMS register PMSWCR2 (Standby and Wake-up Control Register).

SCR_TC.H010 HRESET command erroneously sets RRF flag

Note: This problem is only relevant for tool development, not for application development.

The HRESET command (to reset the SCR including its OCDS) erroneously sets the RRF flag (which signals received data to the FW).

Recommendation

With the following three additional commands (a-c) after an HRESET, the issues with the HRESET command can be solved:

- Execute HRESET
  a) Execute HSTATE to remove reset bit from shift register.
  b) Perform JTAG tool reset to remove flag RRF (receive register flag).
  c) Execute HCOMRST to remove flag TRF (transmit register flag).

SCR_TC.H011 Hang-up when warm PORST is activated during Debug Monitor Mode

Note: This problem is only relevant for debugging.

When a debugger is connected and the device is in Monitor Mode (MMODE), the activation of a warm PORST will result in a hang-up of the SCR controller.

Recommendation

Perform an LVD reset (power off/on) to terminate this situation.

SCR_TC.H012 Reaction in case of XRAM ECC Error

When the double-bit ECC reset is enabled via bit ECCRSTEN in register SCR_RSTCON, and a RAM double-bit ECC error is detected, bit RSTST.ECCRST in register SCR_RSTST is set, but no reset is performed.

Recommendation

The reset of the SCR module in case of a double-bit ECC error must be performed via software.

The following steps need to be done:

- Enable the double-bit ECC reset by setting bit ECCRSTEN in register SCR_RSTCON to 1_B.
- Enable the RAM ECC Error for NMI generation by setting bit NMIRAMECC in register SCR_NMICON to 1_B.

When a RAM double-bit ECC error is detected, an NMI to the TriCore is generated, and bit RSTST.ECCRST in register SCR_RSTST is set.

The TriCore software first has to check the cause of the NMI wakeup by checking register SCR_RSTST. If bit ECCRST is set, a double-bit ECC error has occurred. In this case, do the following steps:

- Fill the XRAM memory with 0.
- Check whether an ECC error has occurred.
- If no ECC error has occurred after filling the XRAM with 0, then:
  - Reload the contents of the XRAM.
  - Perform a reset of the SCR module: Set bit SCRSTREQ in register PMSWCR4 to 1_B.

SCR_TC.H013 External clock input to RTC - Documentation update

The following note will be added to the description of register RTC_CON in TC3xx User's Manuals V1.1.0 and higher:

Note: If the application changes back from external RTC oscillator to PCLK AND at the same time, the SCR is waking up (from 70kHz to PCLK), then the RTC clock is for 3 cycles at 70kHz, before changing to PCLK.

SCR_TC.H014 Details on WDT pre-warning period

The pre-warning interrupt request (FNMIWDT) of the SCR Watchdog Timer (WDT) means that a WDT overflow has just occurred, and in 32 cycles of the SCR WDT clock there will be a reaction to this overflow – a reset of the SCR.

After this pre-warning interrupt it is not possible to stop the WDT, as it has already overflown, and it is not possible to stop this reaction (reset).

SCR_TC.H015 Page number of WCAN_MASK_ID*_CTRL registers in WUF Configuration Registers Address Map - Documentation correction

In table “WUF Configuration Registers Address Map” in the WCAN sub-chapter of the SCR chapter in the AURIX™ TC3xx User’s Manual, the page number for registers

- WCAN_MASK_ID0_CTRL .. WCAN_MASK_ID3_CTRL

is erroneously documented as 3 instead of 2.

*Note: The page number 2 for the WCAN_MASK_ID*_CTRL registers is correctly documented in table “Register Overview - WCAN (sorted by Name)” and in the header of the corresponding register description.*

Correction

The part with the corrected page number for the WCAN_MASK_ID*_CTRL registers in table “WUF Configuration Registers Address Map” is shown in the following table.

Table 20 WUF Configuration Registers Address Map - Correction of page number for WCAN_MASK_ID*_CTRL registers

Register	Addr.	Page	SCR Reset Value	Full Name of Register
WCAN_MASK_ID0_CTRL	$B4_H$	**2**	00_H	Message Identifier Acceptance Mask Register 0
WCAN_MASK_ID1_CTRL	$B5_H$	**2**	00_H	Message Identifier Acceptance Mask Register 1
WCAN_MASK_ID2_CTRL	$B6_H$	**2**	00_H	Message Identifier Acceptance Mask Register 2
WCAN_MASK_ID3_CTRL	$B7_H$	**2**	00_H	Message Identifier Acceptance Mask Register 3

SCU_TC.H016 RSTSTAT reset values - documentation update

Table “Reset Values of RSTSTAT” in the SCU chapter of the current version of the User’s Manual is missing the scenario for “LVD Reset”. In addition, the reset value for “Cold PowerOn Reset” needs to be modified as shown in the following table:

Table 21 Reset Values of RSTSTAT - Update

Reset Type	Reset Value	Note
Cold PowerOn Reset	$0XX1\ 0000_H$	
LVD Reset	$1001\ 0000_H$	

Details:

For more detailed information about the reset triggers please refer to table “Voltage Monitoring” in the PMS chapter. Following information can be found there:

- Cold PowerOn Reset:
  - As the table shows, bit PORST is always set with the corresponding reset source (SWD, EVR33 or EVRC). Therefore the “Cold PowerOn Reset” value is 0XX1 0000_H.
- LVD Reset:
  - Bit STBYR is only set when the corresponding voltage drops below the LVD voltage limit. Bit PORST is set on LVD reset as well. Therefore the “LVD Reset” value is 1001 0000_H.
  - Bits SWD, EVR33 and EVRC are not set in this case, because after LVD reset the system has an initial ramp-up which will not set these bits.

SCU_TC.H020 Digital filter on ESRx pins - Documentation update

As described in the SCU and PMS chapters of the TC3xx User’s Manual, the input signals $\overline{\text{ESR0}}$ / $\overline{\text{ESR1}}$ can be filtered. The filter for $\overline{\text{ESRx}}$ is enabled via bit PMSWCR0.ESRxDFEN = 1_B (default after reset).

If the digital filter is enabled then pulses less than 30 ns will not result in a trigger.

For pulses longer than 100 ns, the following dependency on f_{SPB} should be noted:

Note: Pulses longer than 100 ns will always result in a trigger for f_{SPB} ≥ 20 MHz in RUN mode.

SCU_TC.H021 LBIST execution affected by TCK/DAP0 state

The TCK/DAP0 pad includes an internal pull down (marked “PD2” in column “Buffer Type” in table “System I/O of the Data Sheet).

If TCK/DAP0 is pulled up by an external device, LBIST execution will be stalled.

Recommendation

TCK/DAP0 pad shall be left open or pulled down if no tool is connected.

SCU_TC.H022 Effect of LBIST execution on SRAMs - Additional information

In sub-chapter “LBIST Support” in the SCU chapter of the TC3xx User’s Manual, the section starting with:

“A successfully finished LBIST procedure is indicated by the LBISTCTRL0.LBISTDONE bit..”

shall be extended in future revisions of the SCU chapter as shown below:

Additional information

A successfully finished LBIST procedure is indicated by the LBISTCTRL0.LBISTDONE bit. Value of LBISTCTRL0.LBISTDONE bit is not affected by the System or Application reset (it preserves its value). In case of warm or cold power-on reset, it resets LBISTDONE bit to 0, and soon after, if LBIST is configured to start, it will get its new result value.

Note: SRAM redundancy registers are part of the scan chain and hence corrupted by LBIST. Therefore, SRAMs contents are not reliable after LBIST and shall be initialized after LBIST, prior to usage.
DLMU SRAM with standby capability can be used instead to store information such as the LBIST execution count.

SCU_TC.H023 Behavior of bit RSTSTAT.PORST after wake-up from standby mode

After cold-power on (power up from no power supply), bit RSTSTAT.PORST is always set independent of PORST pad level (pulled high or low by user).

After wake-up from standby, bit RSTSTAT.PORST indicates if the PORST pad was asserted after the wake-up trigger.

Recommendation

If the user expects that bit RSTSTAT.PORST is always set after wake-up from standby, the PORST pad should be kept low externally until all supplies are in operating condition.

SENT_TC.H006 Parameter V_{ILD} on pads used as SENT inputs

Some port pins may have restrictions when used as SENT inputs, depending on the number of active neighbor pins (on the pad frame) and their output driver setting.

In the implementation of the SENT module and product integration within Infineon Technologies products there are never negative values for V_{ILD}, so V_{ILDmin} is 0 mV. Considering the same tolerance as the SENT standard V_{ILDmax} is 100 mV.

Note: All SENT port pins not listed in the tables below have no restrictions on their application usage as SENT inputs.

Table 22 SENT input pads and considered neighbors for TC33x

Considered left neighbors		SENT input		Considered right neighbors	
		Pad	Channel		
P02.8	P00.0	P00.1	0B	P00.2	P00.3
P02.6	P02.6	P02.8	0C	P00.0	P00.1
P00.0	P00.1	P00.2	1B	P00.3	P00.4
P02.5	P02.6	P02.7	1C	P02.8	P00.0
P02.4	P02.5	P02.6	2C	P02.7	P02.8
P02.3	P02.4	P02.5	3C	P02.6	P02.7
P33.4	P33.5	P33.6	4C	P33.7	P33.8

Note: The table above is sorted by SENT channel numbers in ascending order. The same sorting is also used in the tables below.

The following tables summarize the results of the V_{ILD} measurements of the SENT input pads potentially exceeding the V_{ILD} limits with different neighbor (2N/4N) and different edge strength/driver strength configurations.

- **VILD(DIST4N)**: V_{ILD} measurements with four neighbor pads (two on the left and two on the right hand side of the SENT input) used in output mode alongside the SENT input pad on the pad frame.
- **VILD(DIST2N)**: V_{ILD} measurements with two neighbor pads (one on the left and one on the right hand side of the SENT input) used in output mode alongside the SENT input pad on the pad frame.

Table 23 Effect of Driver Settings Fss, Sms, Sm on SENT inputs for TC33x

SENT Channel			Neighbors: Fast pads configured as Fss, others Sms/Sm	
Name	**Number**	**Pin**	**VILD(DIST4N)**	**VILD(DIST2N)**
SENT:SENT0B	0B	P00.1	x	OK
SENT:SENT0C	0C	P02.8	x	OK
SENT:SENT1B	1B	P00.2	x	OK
SENT:SENT1C	1C	P02.7	x	OK
SENT:SENT2C	2C	P02.6	x	x
SENT:SENT3C	3C	P02.5	x	x
SENT:SENT4C	4C	P33.6	x	OK

Table 24 Effect of Driver Settings Fsm, Fm, Sms, Sm on SENT inputs for TC33x

SENT Channel			Neighbors: Fast pads configured as Fsm or Fm, others Sms/Sm	
Name	**Number**	**Pin**	**VILD(DIST4N)**	**VILD(DIST2N)**
SENT:SENT0B	0B	P00.1	OK	OK
SENT:SENT0C	0C	P02.8	OK	OK

Table 24 Effect of Driver Settings Fsm, Fm, Sms, Sm on SENT inputs for TC33x (cont'd)

SENT Channel			Neighbors: Fast pads configured as Fsm or Fm, others Sms/Sm	
Name	**Number**	**Pin**	**VILD(DIST4N)**	**VILD(DIST2N)**
SENT:SENT1B	1B	P00.2	OK	OK
SENT:SENT1C	1C	P02.7	OK	OK
SENT:SENT2C	2C	P02.6	OK	OK
SENT:SENT3C	3C	P02.5	OK	OK
SENT:SENT4C	4C	P33.6	OK	OK

Table 25 Abbreviations used for pad configuration

Symbol	Pad type	Driver Strength / Edge Mode
Fss	Fast	strong driver, sharp edge
Fsm	Fast	strong driver, medium edge
Fm	Fast	medium driver
Sms	Slow	medium driver, sharp edge
Sm	Slow	medium driver

Recommendation

From the tables above, following is the conclusion based on the measured V_{ILD} values for each pad in different configurations:

Table 26 Conclusion for SENT application usage

Symbol	Conclusion for SENT application usage
OK	V_{ILD} is below the standard threshold (100mV) and hence pin can be used in the mentioned configuration.
x	V_{ILD} is above the standard threshold (100mV) and hence pin cannot be used in the mentioned configuration. Following are possible alternatives to use the SENT pad (marked as “OK” in the tables above): • Configure the neighboring pads have to weaker edge mode / driver strength (Fsm or Fm instead of Fss), • Use SENT input with 2N neighbors instead of 4N.

SENT_TC.H007 Range for divider value DIV - Documentation correction

In section “Baud Rate Generation” and in the description of register CFDRx in the SENT chapter of the TC3xx User’s Manual, the range for the divider value DIV is documented as

- DIV = [2200, 49100]

The upper limit of this range is incorrect.

Documentation correction

The correct range that can be used for the divider value DIV is

- DIV = [2200, 52428]

SMU_TC.H010 Clearing individual SMU flags: use only 32-bit writes

The SMU registers shall only be written via 32-bit word accesses (i.e. ST.W instruction), as mentioned in table “Registers Overview” of the SMU chapter in the User’s Manual.

If any other instruction such as LDMST or SWAPMSK.W is used to modify only a few bits in the 32-bit register, then this may have the effect of modifying/clearing unintended bits.

Recommendation (Examples in C Language)

- **Example 1**: To clear status flag SF2 in register AG0, use:
  - SMU_AG0.U = 0x0000 0004;
- **Example 2**: To clear status flags EF2 in register RMEF and RMSTS, use:
  - SMU_RMEF.U = 0xFFFF FFFB;
  - SMU_RMSTS.U = 0xFFFF FFFB;

Here the <REGISTER>.U implies writing to the register as an unsigned integer, which normally results in a compiler translation into an ST.W instruction.

Safety Considerations

As long as software uses only 32-bit writes to the SMU registers, there is no risk of malfunction.

In case the software does not use 32-bit writes (and for example uses bit-wise operations such as LDMST instructions instead) – then potentially unintended flags may be written and modified in the SMU registers. Depending on the application, this may potentially have an impact on safety and/or diagnostics.

Note: The SMU reaction itself (e.g. alarm action triggering) is not affected even if the software unintentionally clears additional bits by not using a 32-bit write as recommended.

SMU_TC.H012 Handling of SMU alarms ALM7[1] and ALM7[0]

The FSI RAM is used to configure the PFLASH. For security related reason, the access to this RAM is restricted. Therefore, in order to avoid accesses to this RAM through its SSH, the MBIST Controller 40 is not disclosed in the AURIX TC3xx Target Specification/User's Manual.

However, the SMU alarms ALM7[1] and ALM7[0] are set intentionally after PORST and system reset and shall be cleared by the application SW (cf. ESM[SW]:SYS:MCU_FW_CHECK in Safety Manual v1.0).

Also, in order to clear the SMU alarms ALM7[1] and ALM7[0], it is necessary to clear the alarms within this MC40.

Recommendation

Therefore, the following register addresses have to be written to clear the FSI RAM Fault Status and ECC Detection Register:

MCi_FAULTSTS (i=40, 0xF00638F0) = (16-bit write) 0x0

MCi_ECCD (i=40, 0xF0063810) = (16-bit write) 0x0

SMU_TC.H013 Increased Fault Detection for SMU Bus Interface (SMU_CLC Register)

Transient faults can possibly affect the SMU_CLC register and lead to disabling the SMU_core. This unintended switching off of SMU_core cannot be detected if the FSP protocol is not used at all or used in FSP bi-stable mode.

Recommendation

In order to increase the capability of the microcontroller to detect such faults it is recommended to:

- **Option 1:** Use FSP Dynamic dual-rail or Time-switching protocol only, don't use FSP bi-stable protocol.
- **Option 2:** In case FSP protocol is not used at all or Recommendation Option 1 is not possible, the [Application SW] shall read periodically, once per FTTI, the SMU_CLC register to react on unintended disabled SMU.

SMU_TC.H015 Calculation of the minimum active fault state time TFSP_FS - Additional information

In Figure "Reference clocks for FSP timings" in the SMU chapter of the TC3xx User's Manual, the "**&**" symbol in the formula for the minimum active fault state time TFSP_FS designates "field concatenation":

TFSP _FS =
TSMU _FS *(SMU_FSP.TFSP_HIGH[] **&** SMU_FSP.TFSP_LOW [] + 1)

Note: Field TFSP_LOW is hardcoded to 0x3FFF in register SMU_FSP. So if SMU_FSP.TFSP_HIGH is 0x1, then SMU_FSP.TFSP_HIGH[] & SMU_FSP.TFSP_LOW[] = 0x7FFF.

SRI_TC.H001 Using LDMST and SWAPMSK.W instructions on SRI mapped Peripheral Registers (range 0xF800 0000-0xFFFF FFFF)

The LDMST and SWAPMSK.W instructions in the AURIX™ microcontrollers are intended to provide atomicity as well as bit-wise operations to a targeted memory location or peripheral register. They are also referred to as Read-Modify-Write (RMW) instructions.

The bit-manipulation functionality is intended to provide software a mechanism to write to individual bits in a register, without affecting other bits. The bits to be written can be selected via a mask in the instruction. Please refer to the TriCore Architecture Manual for further information about these instructions and their formats.

Restrictions for SRI mapped Peripherals

The bit-manipulation functionality is supported only on registers accessed via the SPB bus, and is not supported on the SRI mapped peripheral range (i.e. address range 0xF800 0000 to 0xFFFF FFFF, including (if available) DMU, LMU, EBU, DAM, SRI Crossbar, SPU, CPUx SFRs and CSFRs, AGBT, miniMCDS, ...); see table “On Chip Bus Address Map of Segment 15” in chapter “Memory Map”).

On the SRI mapped peripherals, usage of these instructions always results in all the bits of a register being written, and not just specific individual bits.

Note: The instructions are still executed atomically on the bus – i.e the SRI is locked between the READ and the WRITE transaction.

SSW_TC.H001 Security hardening measure for the startup behavior

In order to increase the robustness of the debug protection mechanism against malicious attacks, it is now strongly suggested to always apply another layer of protection in combination with it.

Recommendation

On top of the debug protection mechanism, enabled via UCB_DBG through the HF_PRONCONDBG.DBGIFLCK bit using a 256-bit password, user shall set the global PFLASH or DFLASH read protection.

Both protections can be enabled individually or together. It is not mandatory to set both protections at the same time.

In most cases PFLASH will be the preferred option since standard drivers for DFLASH (e.g. for EEPROM emulation) do not support DFLASH protection.

In order to enable the global PFLASH read protection, HF_PROCONPF.RPRO has to be set to 1 inside the UCB_PFLASH_ORIG/COPY.

In order to enable the global DFLASH read protection, HF_PROCONDF.RPRO has to be set to 1 inside the UCB_DFLASH_ORIG/COPY.

Be aware that the global read protection will apply also a write protection over the entire PFLASH or DFLASH memory respectively.

The enabled read protection is always effective for the startup hardening. For the Flash read access by CPUs it has only an effect in case the device is not booting from internal Flash.

In case a software update is needed, the write protection, inherited as side effect from the global read protection, can be temporarily disabled executing the “Disable Protection” command sequence.

The PFLASH write protection is also contained in the same UCB_PFLASH_ORIG/COPY, so this leads to have only one password (different from the Debug password) to disable write and read protection mechanisms at the same time.

If the user removes the global PFLASH read protection this will remove also the PFLASH write protection at the same time.

Same for the DFLASH write protection, which is included in the UCB_DFLASH_ORIG/COPY. Another single password is used to disable write and read protection over Data Flash 0 at the same time. Data Flash 1 and HSM PFLASH sectors are protected with another security mechanism via “exclusive protection”.

The disabled protection is valid until the next reset or executing the “Resume Protection” command sequence.

For further details please refer to AP32399 “TC3xx debug protection (with HSM)” or to chapter “Non Volatile Memory (NVM) Subsystem“ in the AURIX™ TC3xx User’s Manual.

STM_TC.H004 Access to STM registers while STMDIV = 0

If accesses to STM kernel registers are performed while field STMDIV = 0_H in CCU Clock Control register CCUCON0 (i.e. clock f_{STM} is stopped),

- the SPB bus gets locked after the first access until a timeout (defined in BCU Control register field SBCU_CON.TOUT) occurs;
- after the second access the STM slave will answer with RTY (retry) until the STM is clocked again with STMDIV > 0_H.

Recommendation

Do not access any STM kernel register while CCUCON0.STMDIV = 0_H.