

# 16-Bit

Architecture

## XE166M Derivatives

16-Bit Single-Chip

Real Time Signal Controller

XE166 Family / Base Line

Errata Sheet

V1.6 2013-06

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# 1 History List / Change Summary

**Table 1 History List**

| Version | Date       | Remark <sup>1)</sup>  |
|---------|------------|---|
| 1.0     | 26.06.2008 | new Errata Sheet  |
| 1.1     | 05.09.2008 |   |
| 1.2     | 30.01.2009 | Errata Sheet name is changed from "XE166xM Derivatives" to "XE166M Derivatives"; Documentation Updates are added into the Errata Sheet          |
| 1.3     | 12.10.2009 | Errata No. 01544AERRA   |
| 1.4     | 23.09.2010 | Errata No. 01871AERRA   |
| 1.5     | 22.02.2013 | Errata No. 02400AERRA   |
| 1.6     | 18.06.2013 | Errata No. 02629AERRA. Removed EES-AA, ES-AA Marking/Step references. Added ES-AB, AB Marking/Step references. DPRAM_X.002 is fixed in AB step. |

- 1) Errata changes to the previous Errata Sheet are marked in **Chapter 5 "Short Errata Description"**.

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## 2 General

This Errata Sheet describes the deviations of the XE166M Derivatives from the current user documentation.

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
  - **X**: XC166 / XE166 / XC2000 Family
- **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.

This Errata Sheet applies to all temperature and frequency versions and to all memory size variants of this device, unless explicitly noted otherwise.

*Note: This device is equipped with a C166S V2 Core. 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.*

Some errata of this Errata Sheet do not refer to all of the XE166M Derivatives, please look to the overview:

**Table 2** for Functional Deviations

**Table 3** for Deviations from Electrical and Timing Specification

**Table 4** for Application Hints

**Table 5** for Documentation Updates

### **3 Current Documentation**

The Infineon XE166 Family comprises device types from the XE162x Series, the XE164x Series and the XE167x Series.

|              |                                      |
|--------------|--------------------------------------|
| Device       | XE16xxM                              |
| Marking/Step | AA, ES-AB, AB                        |
| Package      | PG-LQFP-64, PG-LQFP-100, PG-LQFP-144 |

This Errata Sheet refers to the following documentation:

- XE166M Derivatives User's Manual
- XE162xM Data Sheet
- XE164xM Data Sheet
- XE167xM Data Sheet
- Documentation Addendum (if applicable)

Make sure you always use the corresponding documentation for this device available in category 'Documents' at [www.infineon.com/xe166](http://www.infineon.com/xe166).

The specific test conditions for EES and ES are documented in a separate Status Sheet.

*Note: 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.*



## 4 Errata Device Overview

This chapter gives an overview of the dependencies of individual errata to devices and steps. An **X** in the column of the sales codes shows that this erratum is valid.

### 4.1 Functional Deviations

**Table 2** shows the dependencies of functional deviations in the derivatives.

**Table 2 Errata Device Overview:  
Functional Deviations**

| Functional Deviation | XE16xxM  |                           |
|----------------------|----------|---------------------------|
|                      | AA       | ES-AB<br>AB <sup>1)</sup> |
| <b>BROM_TC.006</b>   | <b>X</b> | <b>X</b>                  |
| <b>BSL_CAN_X.001</b> | <b>X</b> | <b>X</b>                  |
| <b>DPRAM_X.002</b>   | <b>X</b> |                           |
| <b>EBC_X.007</b>     | <b>X</b> | <b>X</b>                  |
| <b>ECC_X.002</b>     | <b>X</b> | <b>X</b>                  |
| <b>ESR_X.001</b>     | <b>X</b> | <b>X</b>                  |
| <b>ESR_X.004</b>     | <b>X</b> | <b>X</b>                  |
| <b>GPT12E_X.002</b>  | <b>X</b> | <b>X</b>                  |
| <b>OCDS_X.003</b>    | <b>X</b> | <b>X</b>                  |
| <b>PAD_X.001</b>     | <b>X</b> | <b>X</b>                  |
| <b>PARITY_X.001</b>  | <b>X</b> | <b>X</b>                  |
| <b>RESET_X.003</b>   | <b>X</b> | <b>X</b>                  |
| <b>RESET_X.004</b>   | <b>X</b> | <b>X</b>                  |
| <b>SCU_X.012</b>     | <b>X</b> | <b>X</b>                  |
| <b>StartUp_X.003</b> | <b>X</b> | <b>X</b>                  |

**Table 2 Errata Device Overview:**  
**Functional Deviations (cont'd)**

| Functional Deviation | XE16xxM |                           |  |
|----------------------|---------|---------------------------|--|
|                      | AA      | ES-AB<br>AB <sup>1)</sup> |  |
| USIC_AI.004          | X       | X                         |  |
| USIC_AI.005          | X       | X                         |  |
| USIC_AI.016          | X       | X                         |  |
| WDT_X.002            | X       | X                         |  |

1) From AA step to AB step, 1 erratum has been fixed.

## 4.2 Deviations from Electrical and Timing Specification

**Table 3** shows the dependencies of deviations from the electrical and timing specification in the derivatives.

**Table 3 Errata Device Overview:**  
**Deviations from Electrical and Timing Specification**

| AC/DC/ADC<br>Deviation | XE16xxM |              |  |
|------------------------|---------|--------------|--|
|                        | AA      | ES-AB,<br>AB |  |
| FLASH_X.P001           | X       | X            |  |
| SWD_X.P002             | X       | X            |  |

### 4.3 Application Hints

**Table 4** shows the dependencies of application hints in the derivatives.

**Table 4 Errata Device Overview:  
Application Hints**

| Hint                             | XE16xxM |              |  |
|----------------------------------|---------|--------------|--|
|                                  | AA      | ES-AB,<br>AB |  |
| <a href="#">ADC_AI.H002</a>      | X       | X            |  |
| <a href="#">CAPCOM12_X.H001</a>  | X       | X            |  |
| <a href="#">CC6_X.H001</a>       | X       | X            |  |
| <a href="#">ECC_X.H001</a>       | X       | X            |  |
| <a href="#">GPT12_AI.H001</a>    | X       | X            |  |
| <a href="#">GPT12E_X.H002</a>    | X       | X            |  |
| <a href="#">INT_X.H002</a>       | X       | X            |  |
| <a href="#">INT_X.H004</a>       | X       | X            |  |
| <a href="#">LXBUS_X.H001</a>     | X       | X            |  |
| <a href="#">MultiCAN_AI.H005</a> | X       | X            |  |
| <a href="#">MultiCAN_AI.H006</a> | X       | X            |  |
| <a href="#">MultiCAN_AI.H007</a> | X       | X            |  |
| <a href="#">MultiCAN_AI.H008</a> | X       | X            |  |
| <a href="#">MultiCAN_TC.H002</a> | X       | X            |  |
| <a href="#">MultiCAN_TC.H003</a> | X       | X            |  |
| <a href="#">MultiCAN_TC.H004</a> | X       | X            |  |
| <a href="#">OCDS_X.H003</a>      | X       | X            |  |
| <a href="#">PVC_X.H001</a>       | X       | X            |  |
| <a href="#">RESET_X.H003</a>     | X       | X            |  |
| <a href="#">RTC_X.H003</a>       | X       | X            |  |

**Table 4**      **Errata Device Overview:**  
**Application Hints (cont'd)**

| Hint         | XE16xxM |              |  |
|--------------|---------|--------------|--|
|              | AA      | ES-AB,<br>AB |  |
| SCU_X.H009   | X       | X            |  |
| SWD_X.H001   | X       | X            |  |
| USIC_AI.H001 | X       | X            |  |
| USIC_AI.H002 | X       | X            |  |
| USIC_AI.H003 | X       | X            |  |

## 4.4 Documentation Updates

**Table 5** shows the dependencies of documentation updates in the derivatives.

**Table 5 Errata Device Overview:  
Documentation Updates**

| Documentation Updates        | XE16xxM |           |  |
|------------------------------|---------|-----------|--|
|                              | AA      | ES-AB, AB |  |
| <a href="#">EBC_X.D001</a>   | X       | X         |  |
| <a href="#">ECC_X.D002</a>   | X       | X         |  |
| <a href="#">RESET_X.D001</a> | X       | X         |  |
| <a href="#">USIC_X.D001</a>  | X       | X         |  |
| <a href="#">USIC_X.D002</a>  | X       | X         |  |

## 5 Short Errata Description

This chapter gives an overview on the deviations and application hints. Changes to the last Errata Sheet are shown in the column “Chg”.

### 5.1 Errata Removed in this errata sheet

**Table 6** shows a short description of the errata removed from this version if errata shete.

**Table 6 Errata removed in this Errata Sheet**

| <b>Errata</b> | <b>Short Description</b>                        | <b>Chg</b>   |
|---------------|---|--|
| ECC_X.001     | SBRAM ECC Disabled in FSM                       | Applicable only to EES-AA, ES-AA Marking/Steps. EES-AA, ES-AA reference removed from this ES |
| HARR_X.001    | Not Requested HARR after User Reset             | Applicable only to EES-AA, ES-AA Marking/Steps. EES-AA, ES-AA reference removed from this ES |
| Startup_X.001 | RAM Initialization before ECC/Parity Activation | Applicable only to EES-AA, ES-AA Marking/Steps. EES-AA, ES-AA reference removed from this ES |

## 5.2 Functional Deviations

**Table 7** shows a short description of the functional deviations.

**Table 7 Functional Deviations**

| Functional Deviation | Short Description  | Chg | Pg        |
|----------------------|--|-----|-----------|
| <b>BROM_TC.006</b>   | <b>Baud Rate Detection for CAN Bootstrap Loader</b>                                    |     | <b>22</b> |
| <b>BSL_CAN_X.001</b> | <b>Quartz Crystal Settling Time after PORST too Long for CAN Bootstrap Loader</b>      |     | <b>22</b> |
| <b>DPRAM_X.002</b>   | <b>Undefined Data read from Dual-Port RAM (DPRAM)</b>                                  |     | <b>23</b> |
| <b>EBC_X.007</b>     | <b>Bus Arbitration not Properly Working</b>  |     | <b>27</b> |
| <b>ECC_X.002</b>     | <b>Incorrect ECC Error Indication for DPRAM</b>  |     | <b>28</b> |
| <b>ESR_X.001</b>     | <b>ESREXSTAT1 and ESREXSTAT2 Status Bits are Cleared by Hardware</b>                   |     | <b>29</b> |
| <b>ESR_X.004</b>     | <b>Wrong Value of SCU_RSTCONx Registers after ESRy Application Reset</b>               |     | <b>29</b> |
| <b>GPT12E_X.002</b>  | <b>Effects of GPT Module Microarchitecture</b>   |     | <b>30</b> |
| <b>OCDS_X.003</b>    | <b>Peripheral Debug Mode Settings cleared by Reset</b>                                 |     | <b>32</b> |
| <b>PAD_X.001</b>     | <b>Additional Edges in the Input Signal</b>  |     | <b>32</b> |
| <b>PARITY_X.001</b>  | <b>PMTSR Register Initialization</b>   |     | <b>37</b> |
| <b>RESET_X.003</b>   | <b>P2.[2:0] and P10.[12:0] Switch to Input</b>   |     | <b>37</b> |
| <b>RESET_X.004</b>   | <b>Sticky “Register Access Trap” forces device into power-save mode after reset.</b>   |     | <b>38</b> |
| <b>SCU_X.012</b>     | <b>Wake-Up Timer RUNCON Command</b>  |     | <b>38</b> |
| <b>StartUp_X.003</b> | <b>Debug Interface Configuration from Flash can Fail Upon Power-On</b>                 |     | <b>39</b> |
| <b>USIC_AI.004</b>   | <b>Receive shifter baudrate limitation</b>   |     | <b>40</b> |
| <b>USIC_AI.005</b>   | <b>Only 7 data bits are generated in IIC mode when TBUF is loaded in SDA hold time</b> |     | <b>40</b> |



**Short Errata Description**

**Table 7      Functional Deviations (cont'd)**

| <b>Functional Deviation</b> | <b>Short Description</b>   | <b>Chg</b> | <b>Pg</b> |
|-----------------------------|--|------------|-----------|
| <b>USIC_AI.016</b>          | <b>Transmit parameters are updated during FIFO buffer bypass</b>           |            | <b>41</b> |
| <b>WDT_X.002</b>            | <b>Clearing the Internal Flag which Stores Preceding WDT Reset Request</b> |            | <b>41</b> |

### **5.3 Deviations from Electrical and Timing Specification**

**Table 8** shows a short description of the electrical- and timing deviations from the specification.

**Table 8 Deviations from Electrical and Timing Specification**

| <b>AC/DC/ADC<br/>Deviation</b> | <b>Short Description</b>                                      | <b>Chg</b> | <b>Pg</b> |
|--------------------------------|---|------------|-----------|
| <b>FLASH_X.P001</b>            | <b>Test Condition for Flash parameter NER in Data Sheets</b>  |            | <b>44</b> |
| <b>SWD_X.P002</b>              | <b>Supply Watchdog (SWD) Supervision Level in Data Sheet.</b> |            | <b>44</b> |

## 5.4 Application Hints

**Table 9** shows a short description of the application hints.

**Table 9 Application Hints**

| Hint                    | Short Description   | Chg | Pg        |
|-------------------------|---|-----|-----------|
| <b>ADC_AI.H002</b>      | <b>Minimizing Power Consumption of an ADC Module</b>            |     | <b>45</b> |
| <b>CAPCOM12_X.H001</b>  | <b>Enabling or Disabling Single Event Operation</b>             |     | <b>45</b> |
| <b>CC6_X.H001</b>       | <b>Modifications of Bit MODEN in Register CCU6x_KSCFG</b>       |     | <b>47</b> |
| <b>ECC_X.H001</b>       | <b>ECC Error Indication Permanently Set</b>                     |     | <b>47</b> |
| <b>GPT12_AI.H001</b>    | <b>Modification of Block Prescalers BPS1 and BPS2</b>           |     | <b>47</b> |
| <b>GPT12E_X.H002</b>    | <b>Reading of Concatenated Timers</b>                           |     | <b>48</b> |
| <b>INT_X.H002</b>       | <b>Increased Latency for Hardware Traps</b>                     |     | <b>49</b> |
| <b>INT_X.H004</b>       | <b>SCU Interrupts Enabled After Reset</b>                       |     | <b>50</b> |
| <b>LXBUS_X.H001</b>     | <b>Do Not Access Reserved Locations on the LxBus</b>            |     | <b>50</b> |
| <b>MultiCAN_AI.H005</b> | <b>TxD Pulse upon short disable request</b>                     |     | <b>51</b> |
| <b>MultiCAN_AI.H006</b> | <b>Time stamp influenced by resynchronization</b>               |     | <b>51</b> |
| <b>MultiCAN_AI.H007</b> | <b>Alert Interrupt Behavior in case of Bus-Off</b>              |     | <b>51</b> |
| <b>MultiCAN_AI.H008</b> | <b>Effect of CANDIS on SUSACK</b>                               |     | <b>51</b> |
| <b>MultiCAN_TC.H002</b> | <b>Double Synchronization of receive input</b>                  |     | <b>52</b> |
| <b>MultiCAN_TC.H003</b> | <b>Message may be discarded before transmission in STT mode</b> |     | <b>53</b> |
| <b>MultiCAN_TC.H004</b> | <b>Double remote request</b>                                    |     | <b>53</b> |
| <b>OCDS_X.H003</b>      | <b>Debug Interface Configuration by User Software</b>           |     | <b>54</b> |
| <b>PVC_X.H001</b>       | <b>PVC Threshold Level 2</b>                                    |     | <b>54</b> |

**Table 9      Application Hints (cont'd)**

| <b>Hint</b>         | <b>Short Description</b>                                | <b>Chg</b> | <b>Pg</b> |
|---------------------|---|------------|-----------|
| <b>RESET_X.H003</b> | <b>How to Trigger a PORST after an Internal Failure</b> |            | <b>56</b> |
| <b>SCU_X.H009</b>   | <b>WUCR.TTSTAT can be set after a Power-Up</b>          |            | <b>56</b> |
| <b>SWD_X.H001</b>   | <b>Application Influence on the SWD</b>                 |            | <b>57</b> |
| <b>USIC_AI.H001</b> | <b>FIFO RAM Parity Error Handling</b>                   |            | <b>57</b> |
| <b>USIC_AI.H002</b> | <b>Configuration of USIC Port Pins</b>                  |            | <b>57</b> |
| <b>USIC_AI.H003</b> | <b>PSR.RXIDLE Cleared by Software</b>                   |            | <b>58</b> |

## **5.5 Documentation Updates**

**Table 10** gives a short description of the documentation updates.

**Table 10 Documentation Updates**

| <b>Documentation Updates</b> | <b>Short Description</b>   | <b>Chg</b> | <b>Pg</b> |
|------------------------------|--|------------|-----------|
| <b>EBC_X.D001</b>            | <b>Visibility of Internal LxBus Cycles on External Address Bus</b> |            | <b>59</b> |
| <b>ECC_X.D002</b>            | <b>Initialization of the Read-Control Logic</b>                    |            | <b>59</b> |
| <b>RESET_X.D001</b>          | <b>Reset Types of Trap Registers</b>                               |            | <b>60</b> |
| <b>USIC_X.D001</b>           | <b>Connection from CCU6x to USICx</b>                              |            | <b>60</b> |
| <b>USIC_X.D002</b>           | <b>USIC1 Channel 0 Connection DX0C and DX0D</b>                    |            | <b>60</b> |

## **6 Detailed Errata Description**

This chapter provides a detailed description for each erratum. If applicable a workaround is suggested.

### **6.1 Functional Deviations**

#### **BROM\_TC.006 Baud Rate Detection for CAN Bootstrap Loader**

In a specific corner case, the baud rate detected during reception of the initialization frame for the CAN bootstrap loader may be incorrect. The probability for this sporadic problem is relatively low, and it decreases with decreasing CAN baud rate and increasing module clock frequency.

##### **Workaround:**

If communication fails, the host should repeat the CAN bootstrap loader initialization procedure after a reset of the device.

#### **BSL\_CAN\_X.001 Quartz Crystal Settling Time after PORST too Long for CAN Bootstrap Loader**

The startup configuration of the CAN bootstrap loader when called immediately after  $\overline{\text{PORST}}$  limits the settling time of the external oscillation to 0.5 ms. For typical quartz crystal this settling time is too short. The CAN bootstrap loader generates a time-out and goes into Startup Error State.

##### **Workaround**

- For low performance CAN applications a ceramic resonator with settling time less than 0.5 ms can be used.
- An alternative is the Internal Start from on-chip Flash memory as startup mode after  $\overline{\text{PORST}}$ . Then switch the system clock to external source and trigger a software reset with CAN bootstrap loader mode selected. Now the

device starts with a CAN bootstrap loader without limitation of the oscillator settling time.

### **DPRAM X.002 Undefined Data read from Dual-Port RAM (DPRAM)**

Under special conditions, undefined data may be read from up to two word locations  $L_1$ ,  $L_2$  in the DPRAM (address range  $F600_H \dots FDFH_H$ ).

The problem (affecting  $L_1$  and/or  $L_2$ ) is due to a redundancy circuit that may not be properly disabled during the internal power-up reset sequence.

The problem may only occur when an operand that was written via port B is (later) read via port A of the DPRAM. This is only the case when dual read transfers are performed on both port A and B in parallel, which can only happen in the two scenarios described below.

*Note: Field experience has shown that the probability for this problem is relatively low, as it further depends on several other conditions, e.g.:*

- For an initial power-on reset without residual voltage, the problem is less likely to occur at room temperature and above.*
- The problem is more likely to occur when a residual voltage at VDDI1 was present at the last power-off/on cycle.*
- If the problem does occur, then it is "latched" at power up. If it hasn't occurred in the current power cycle, then the problem only has the possibility of occurring at the next power-off/on cycle.*
- The addresses of  $L_1$  and  $L_2$  may vary from device to device and from one power-off/on cycle to the next, but will not change for a given device until the next power-off/on cycle; i.e. if  $L_1$  and  $L_2$  are not read via port A in one of the critical scenarios described below, the problem has no effect on the application.*

#### **Scenario 1 (Context Switch)**

In this scenario, the problem may occur under the following sequence of conditions (all conditions must be met):

1.  $L_1$  and/or  $L_2$  are located in the DPRAM in an area that is used to store the context of a global register bank, and

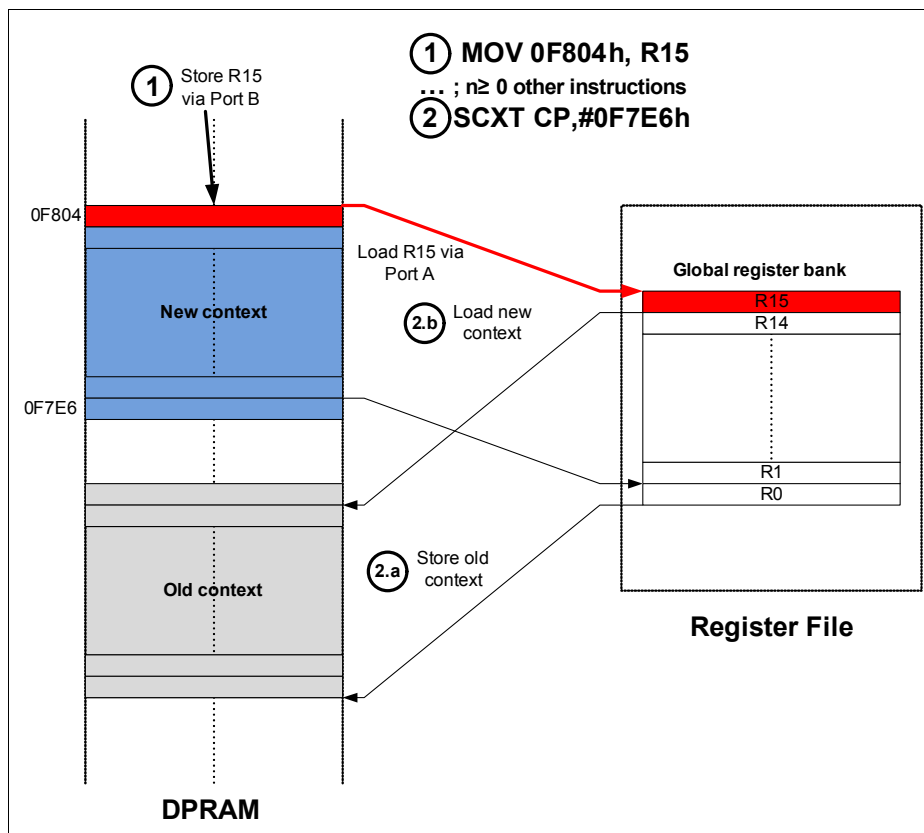
**Detailed Errata Description**

2. An explicit software write operation (i.e. no context switch) to  $L_1$  and/or  $L_2$  is performed, and
3. The Context Pointer (register CP) is modified (e.g. by MOV/POP/SCXT CP, ... ) in one of the following instructions, leading to a context store (old context) and a context load (new context) of the global bank into/from DPRAM, and
4. One of the General Purpose Registers Rx with an odd register number x ( $x = 1, 3, \dots, 15$ ) is loaded from locations  $L_1$  or  $L_2$ .

In this case, the contents of Rx may be incorrect.

This scenario may typically occur at the beginning of interrupt routines when a GPR (e.g. R15 used as user stack pointer) is saved into the new GPR context in DPRAM, as shown in the following **Figure 1**.





**Figure 1 Context Switch with Pointer Passing in R15**

### Scenario 2 (CoXXX Instructions)

In this scenario, the problem may occur when one of the CoXXX instructions CoABS, CoADD<sup>1)</sup>, CoCMP, CoLOAD\*, CoMAC\*, CoMAX, CoMIN, CoMUL\*, CoSUB\* reads  $L_1$  or  $L_2$  via the addressing mode [IDX $i^{*2)}$ ], [RWm\*].

*Note: All other CoXXX instructions (CoASHR, CoMOV, CoNEG, CoNOP, CoRND, CoSHL/R, CoSTORE) and addressing modes are not affected.*

1) \* stands for all variants of the respective CoXXX instruction

2) \* stands for all variants of the [IDX $i^{*}$ ], [RWm\*] addressing mode

## Analysis of Development Tools/Summary of Supplier Feedback

- **TASKING VX-toolset for C166** (latest version v3.1r1)<sup>1)</sup>
  - **Scenario 1 (Context Switch):** In the most basic form (without `__registerbank(...)` function qualifier), the compiler uses push/pop instructions to save/restore registers in the interrupt frame, i.e. the critical scenario does not occur.
  - When the `__registerbank(...)` function qualifier is used to define a **global** register bank, the user stack-pointer (R15) is copied and the context-pointer is set to the new register bank. This is rated as **critical only** if R15 is used to access the user stack within the interrupt routine. Exception: In the routine for the reset vector, the user stack-pointer is not copied (makes no sense for the reset vector). This is rated as uncritical.
  - **Scenario 2 (CoXXX Instructions):** The compiler currently does not use the [IDX<sup>\*</sup>] addressing-mode.  
In `setjmp.src` from the C-library and `macmull.src` from the runtime-library CoSTORE instructions are used. This is rated as uncritical.
- **“Classic” TASKING C166/ST10 toolset** (latest version v8.9r1)
  - **Scenario 1 (Context Switch):** In all cases where the user stack-pointer is copied, register R0 (even register number) is used. This is rated as uncritical.
  - **Scenario 2 (CoXXX Instructions):** The compiler currently does not use the [IDX<sup>\*</sup>] addressing-mode.  
In the runtime library modules: `cp*w.asm` and `udil.asm / umol.asm`, CoXXX instructions may be used, but none of them belongs to the category of critical instructions in the scope of this problem.
- **Keil C166 Development Tools**
  - **Scenario 1 (Context Switch):** Without the `using` attribute, the critical scenario will not occur. With the `using` attribute, in all cases where the user stack-pointer is copied, register R0 (even register number) is used. This is rated as uncritical.

1) Analysis also applicable to derived free toolsets VX-toolset Lite Edition, resp. XE166 toolset

- **Scenario 2 (CoXXX Instructions):** The compiler (including the intrinsics) currently does not use the [IDX<sup>i</sup>\*] addressing-mode.

### **Workaround (Scenario 1)**

- On **assembler** level, do not perform a context switch of the global register bank in case locations in the DPRAM corresponding to the location of a register Rx with an odd register number are written by software (see example for critical scenario in [Figure 1](#)).
- With the **compiler** of the TASKING VX-toolset, do not use the `__registerbank(...)` function qualifier to define a **global** register bank.
- With the **compiler** of the “Classic” TASKING C166/ST10 toolset, no workaround for this scenario is required (see analysis above).
- With the **compiler** of the Keil C166 toolset, no workaround for this scenario is required (see analysis above).

### **Workaround (Scenario 2)**

- On **assembler** level, do not use the CoXXX instructions CoABS, CoADD\*, CoCMP, CoLOAD\*, CoMAC\*, CoMAX, CoMIN, CoMUL\*, CoSUB\* with the addressing mode [IDX<sup>i</sup>\*], [RWm\*]. Instead, use e.g. the other addressing modes of these instructions.
- For **compilers** of the Keil and TASKING toolsets, no workaround is required (see analysis above).

### **Usage of 3<sup>rd</sup> Party Software**

When using operating systems and/or other 3<sup>rd</sup> party software or libraries, please check with your supplier.

### **EBC\_X.007 Bus Arbitration not Properly Working**

Due to a mismatch of pad propagation delays and internal operation cycle time the arbitration feature of the External Bus Controller (EBC) can only be used with severe restrictions. It is recommended not to use this feature, as future members of the XC2000/XE166 Family will no longer support bus arbitration.

## **Workaround**

The usable conditions also depend on the application system and can only be defined for a specific use case.

### **ECC X.002 Incorrect ECC Error Indication for DPRAM**

Under certain conditions, the ECC error flag for the dual port memory (DPRAM) may indicate an error when none exists.

Conditions under which ECC error is incorrectly indicated:

- ECC memory protection has been selected for DPRAM (`SCU_MCHKCON.SELDP = 0`).
- The ECC check is enabled for DPRAM (`SCU_ECCCON.DPEN = 1`).
- A concurrent read and write access is made to the same byte or word in the DPRAM (possible due to instruction pipeline).

Under the above conditions, an ECC error may be indicated for DPRAM (flag `SCU_ECCSTAT.DP = 1`), although there is no error in DPRAM.

It should be noted that despite the incorrect ECC error indication, the data are delivered error free, and the ECC logic still functions correctly (correcting data single bit errors, if present).

There is no data corruption in this case. The ECC bits that were written are generated correctly, as well as check and correction is not affected for that was read.

This problem is limited to the DPRAM. All other SRAM memories cannot perform concurrent read and write accesses, and therefore cannot have this issue.

## **Workaround**

Use parity protection for DPRAM (`SCU_MCHKCON.SELDP = 1`).

Single-bit errors will be correctly indicated by parity logic, but will not be corrected.

**ESR\_X.001 ESREXSTAT1 and ESREXSTAT2 Status Bits are Cleared by Hardware**

The status bits of register `ESREXSTAT1` and `ESREXSTAT2` are set as the trigger signal was active. The status bits are not stored and are only set as long as the external trigger inputs are active.

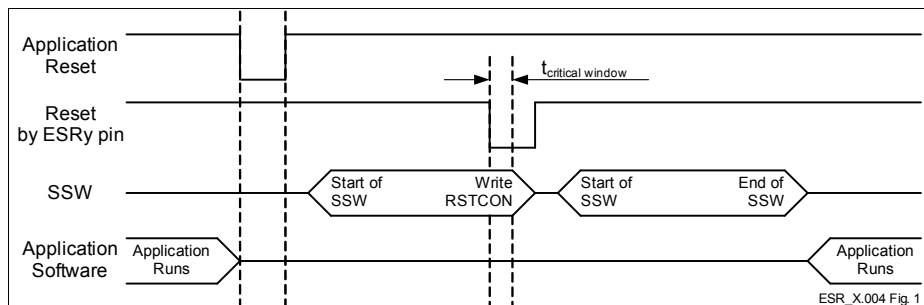
**Workaround**

None.

**ESR\_X.004 Wrong Value of `SCU_RSTCONx` Registers after ESRy Application Reset**

`SCU_RSTCONx` registers are reset only by Power-On, but they may be wrongly affected after a second application reset requested by an ESRy pin. This may lead to the `SCU_RSTCONx` register values being set to zero, which could unexpectedly disable reset sources within the user application. The conditions which lead to this behavior are:

1. First, an application reset by SW (software), CPU (Central Processing Unit), MP (Memory), WDT (Watchdog Timer) or ESRy (External Service Request y) occurs.
2. Following this, an application reset on an ESRy pin occurs.
3. If the above mentioned ESRy reset occurs during a critical time window of the SSW (startup software), then it's possible that the application will operate with the wrong `SCU_RSTCONx` register value. The critical time window occurs when the SSW is writing the `SCU_RSTCONx` registers, and at the same time, the ESRy reset request is processed by the reset circuitry. The width of this critical window  $f_{\text{critical window}}$  is less than 13 cycles.



**Figure 2 Critical application reset sequence**

### Workaround

- Initialize `SCU_RSTCONx` registers by user software after any reset, or
- assure that a second application reset request with an ESR pin does not occur during the critical time window.

### **GPT12E\_X.002 Effects of GPT Module Microarchitecture**

The present GPT module implementation provides some enhanced features (e.g. block prescalers `BPS1`, `BPS2`) while still maintaining timing and functional compatibility with the original implementation in the C166 Family of microcontrollers.

Both the GPT1 and GPT2 blocks use a finite state machine to control the actions within each block. Since multiple interactions are possible between the timers (`T2 .. T6`) and register `CAPREL`, these elements are processed sequentially within each block in different states. However, all actions are normally completed within one basic clock cycle.

The GPT2 state machine has 4 states (2 states when `BPS2 = 01B`) and processes `T6` before `T5`. The GPT1 state machine has 8 states (4 states when `BPS1 = 01B`) and processes the timers in the order `T3 - T2` (all actions except capture) - `T4 - T2` (capture).

In the following, two effects of the internal module microarchitecture that may require special consideration in an application are described in more detail.

### 1.) Reading T3 by Software with T2/T4 in Reload Mode

When T2 or T4 are used to reload T3 on overflow/underflow, and T3 is read by software on the fly, the following unexpected values may be read from T3:

- when T3 is counting **up**, 0000<sub>H</sub> or 0001<sub>H</sub> may be read from T3 directly after an overflow, although the reload value in T2/T4 is higher (0001<sub>H</sub> may be read in particular if  $BPS1 = 01_B$  and  $T3I = 000_B$ ),
- when T3 is counting **down**, FFFF<sub>H</sub> or FFFE<sub>H</sub> may be read from T3 directly after an underflow, although the reload value in T2/T4 is lower (FFFE<sub>H</sub> may be read in particular if  $BPS1 = 01_B$  and  $T3I = 000_B$ ).

*Note: All timings derived from T3 in this configuration (e.g. distance between interrupt requests, PWM waveform on T3OUT, etc.) are accurate except for the specific case described under 2.) below.*

#### **Workaround:**

- When T3 counts **up**, and value\_x < reload value is read from T3, value\_x should be replaced with the reload value for further calculations.
- When T3 counts **down**, and value\_x > reload value is read from T3, value\_x should be replaced with the reload value for further calculations.

Alternatively, if the intention is to identify the overflow/underflow of T3, the T3 interrupt request may be used.

### 2.) Reload of T3 from T2 with setting $BPS1 = 01_B$ and $T3I = 000_B$

When T2 is used to reload T3 in the configuration with  $BPS1 = 01_B$  and  $T3I = 000_B$  (i.e. fastest configuration/highest resolution of T3), the reload of T3 is performed with a delay of one basic clock cycle.

#### **Workaround 1:**

To compensate the delay and achieve correct timing,

- increment the reload value in T2 by 1 when T3 is configured to count **up**,
- decrement the reload value in T2 by 1 when T3 is configured to count **down**.

**Workaround 2:**

Alternatively, use T4 instead of T2 as reload register for T3. In this configuration the reload of T3 is not delayed, i.e. the effect described above does not occur with T4.

**OCDS X.003 Peripheral Debug Mode Settings cleared by Reset**

The behavior (run/stop) of the peripheral modules in debug mode is defined in bitfield SUMCFG in the KSCCFG registers. The intended behavior is, that after an application reset has occurred during a debug session, a peripheral re-enters the mode defined for debug mode.

For some peripherals, the debug mode setting in SUMCFG is erroneously set to normal mode upon any reset (instead upon a debug reset only). It remains in this state until SUMCFG is written by software or the debug system.

Some peripherals will **not** re-enter the state defined for debug mode after an application reset:

**GPT12, CAPCOM2, and MultiCAN** will resume normal operation like after reset, i.e. they are inactive until they are initialized by software.

In case the **RTC** has been running before entry into debug mode, and it was configured in SUMCFG to stop in debug mode, it will resume operation as before entry into debug mode instead.

All other peripheral modules, i.e. ADC, CCU6 and USIC, will correctly re-enter the state defined for debug mode after an application reset in debug mode.

For **Flash** and **CPU**, bitfield SUMCFG must be configured to normal mode anyway, since they are required for debugging.

**Workaround**

None.

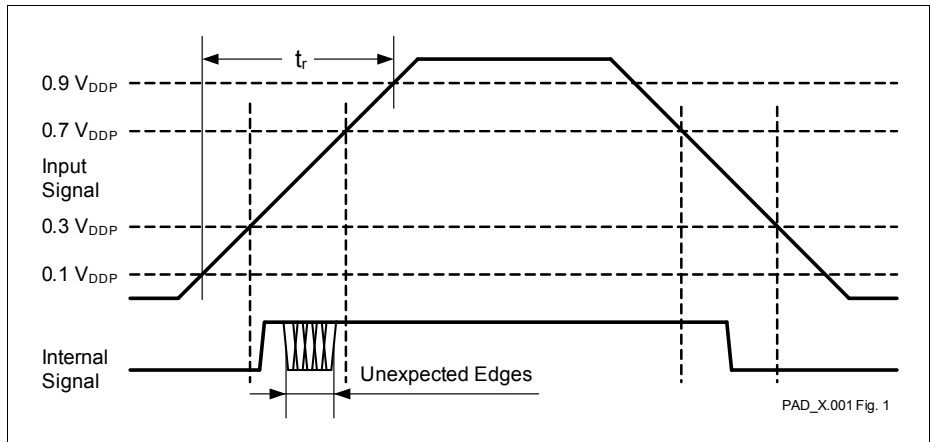
**PAD X.001 Additional Edges in the Input Signal**

The digital input- and I/O-pins are designed using Schmitt trigger input structures with hysteresis. Even with this structure, it is possible that very slow



rising edges may generate spikes, resulting in unexpected additional edges at the input signal.

The next picture **Figure 3** is an example for a slow input signal, with spikes shown on the slow rising input signal.



**Figure 3 Example for a Slow Input Signal**

The first rising edge in **Figure 3** of the internal signal is always valid. The edges which are marked with "Unexpected Edges" must be ignored.

Measurements have shown that a spike can be generated under the following conditions.

**Table 11 Conditions for Additional Edges in the Input Signal**

| Parameter              | Symbol    | Typ. Value | Unit | Note                |
|------------------------|-----------|------------|------|---------------------|
| Digital supply voltage | $V_{DDP}$ | 4.5 to 5.5 | V    | Upper Voltage Range |
| Junction Temperature   | $T_J$     | full range | °C   |                     |
| System frequency       | $f_{sys}$ | all        | MHz  |                     |
| Rising Slope           | $t_r$     | >1         | μs   |                     |

The reaction to this spike generation strongly depends on the application (hardware, software, internal and external noise). Although it is not possible to define how the application will react in all cases, it is possible to categorize how applications are typically affected, as shown below.

Applications which can be affected by a spike:

- CCU6, CAPCOM2 and GPT inputs
- Port inputs
- Interrupts input

Applications which should not be affected by a spike due to faster rising slope  $t_r$  which is necessary for the application, due the interface protocol or due multiple sampling of the hardware:

- USIC
- CAN
- Others

## **Workaround for Input Capture Conditions**

### **1. Workaround for all Affected Applications**

Use rising edges with faster rising slope  $t_r$  than defined in [Table 11](#).

### **2. Workaround for CCU6, CAPCOM2 and GPT Inputs**

No generic solution is available for these applications. Add or switch to a software solution.

For example, the software could check whether the measured signal values are in the expected range.

### **3. Workaround for Port Inputs**

1. The captured time interval value should be checked whether it is in a reasonable range.

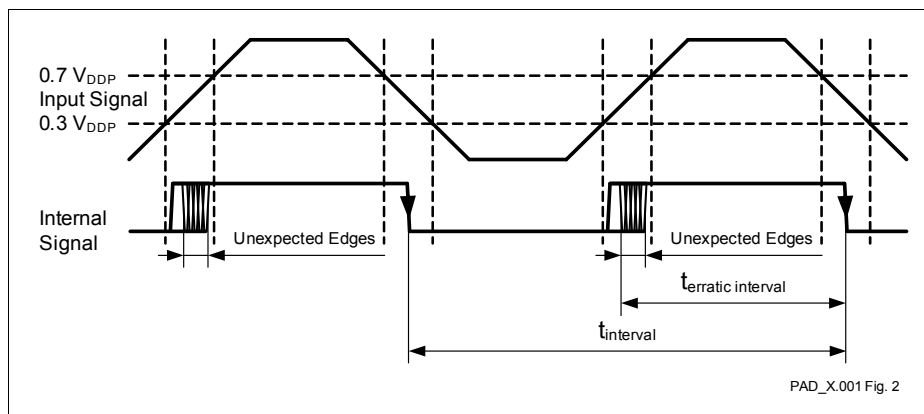
2. The input pin should be read several times, and a majority decision may be made to decide whether the edge was correct or erratic.

Only if 1) and 2) indicate that the edge was reliable, the captured value should be used for further calculations. Otherwise, a substituted (extrapolated) value might be used.

## 4. Workaround for Interrupt Inputs

### 4.1 Falling Edge Detection Approach

1. Measure the time interval since the last interrupt (shown as in  $t_{\text{interval}}$  in [Figure 4](#) below) and check that it is in the expected time range.  
 In the example, an erratic edge would cause the measured time interval  $t_{\text{erratic interval}}$  to be approximately 50% of the expected value.
2. The state of the input pin that caused the interrupt could be read several times in the interrupt service routine and a majority decision made to check if the input pin really is at a low level to determine whether this is a genuine falling edge interrupt or whether the interrupt was triggered by a spike generated by a slow rising edge.

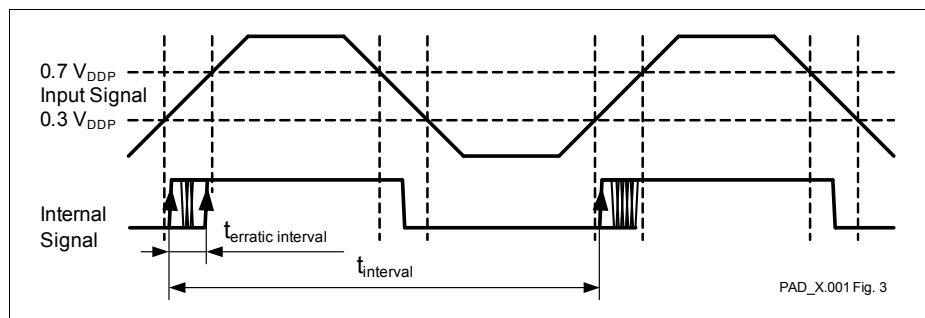


**Figure 4 Falling Edge Detection Approach**

Only if 1) and/or 2) indicate that the edge was reliable, should the rest of the interrupt service routine be executed.

## 4.2 Rising Edge Detection Approach

In case of rising edge detection multiple interrupts would be generated when the spike occurs. The time interval since the last interrupt can be measured – if it is very small compared to the expected value, this would indicate a spike and the interrupt should be ignored.



**Figure 5 Rising Edge Detection Approach**

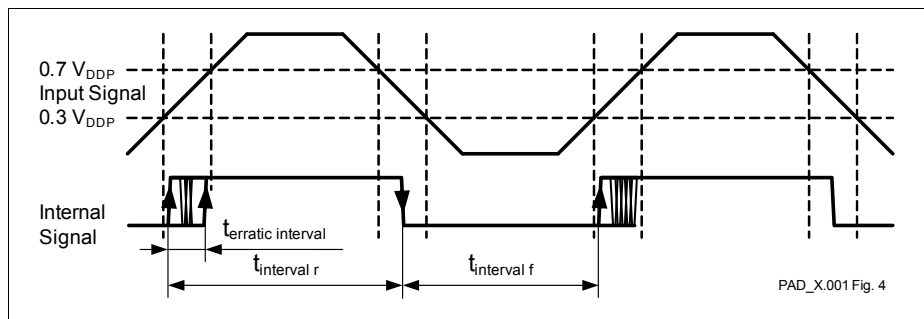
If the time between the rising signal edge and the rising edge caused by a spike  $t_{erratic}$  is less than the ISR service time, a workaround would be to clear the interrupt request (IR) flag before the return from interrupt is done. The clearing of the IR flag will avoid a further erratic interrupt.

The preferred solution for interrupt handling is to use the rising edge detection.

## 4.3 Rising Edge and Falling Edge Detection Approach

The rising edge detection workaround works also if both edges are used as trigger for interrupt and the following conditions are valid:

- $t_{erratic\ interval} \ll t_{interval\ r}$  and
- $t_{erratic\ interval} \ll t_{interval\ f}$



**Figure 6 Rising Edge and Falling Edge Detection Approach**

### **PARITY\_X.001 PMTSR Register Initialization**

The `PMTSR` register content after start-up is `0100H`, meaning the parity logic for SBRAM is not in standard mode of operation.

#### **Workaround**

If parity will be used as Memory Control mechanism for SBRAM, it must be enabled by initializing the `PMTSR` register with `8000H`.

### **RESET\_X.003 P2.[2:0] and P10.[12:0] Switch to Input**

During the execution of an Application Reset and Debug Reset the pins `P2.[2:0]` and `P10.[12:0]` are intermediately switched to input.

These pins return to their previous mode approximately 35 system clock cycles after the application reset counter has expired (approx. 0.6  $\mu$ s with default reset delay at 80 MHz).

If such a pin is used as output, make sure that this short interruption does not lead to critical system conditions.

#### **Workaround**

External pull devices can be added to have a defined level on these pins during Application and Debug Reset.

**RESET\_X.004 Sticky “Register Access Trap” forces device into power-save mode after reset.**

The system control unit (SCU) provides trap generation, to respond to certain system level events or faults. Certain trap sources maintain sticky trap flags which are only cleared explicitly by software, or by a power-on reset. These sticky trap flags are contained in the SCU register DMPMIT.

In case the “Register Access Trap” flag (DMPMIT.RAT) becomes set, but is not cleared before a debug, internal application, or application reset occurs, then the microcontroller will reset, but will fail to start-up correctly. The microcontroller start-up software will detect that the sticky trap flag is set, and will force the device into power-save mode with DMP\_1 shut down and DMP\_M powered.

**Workaround**

In response to the trap event, software must explicitly clear the sticky trap flag using the SCU register DMPMITCLR, before executing a debug, internal application, or application reset.

Note that this workaround does not address unexpected debug, internal application, or application resets which occur between the sticky trap event and the clearing of the sticky flags by software. To keep this exposure period as short as possible, it is recommended to clear the flag early in the trap routine.

*Note: Register DMPMITCLR is protected by the register security mechanism after execution of the EINIT instruction and must be unlocked before accessing.*

**SCU\_X.012 Wake-Up Timer RUNCON Command**

The Wake-Up Timer can be started and stopped by the WUCR.RUNCON bit field.

Under the precondition that the Wake-Up Timer is configured to stop when reaching zero (WUCR.ASP=1<sub>B</sub>) and if two Wake-Up Timer commands are executed successively (e.g. “start” is directly followed by “stop”) then the second command will be ignored and will not change the state of the Wake-Up Timer.

**Workaround**

After executing the first command wait at least 4 Wake-Up Timer cycles ( $f_{WUT}$ ) before writing again to the `WUCR.RUNCON` bit field and requesting the second command.

**StartUp\_X.003 Debug Interface Configuration from Flash can Fail Upon Power-On**

This erratum only affects devices with a Date Code before DC1242 (i.e. digit value < 1242).

XC2000/XE166 devices allow the user to select between a number of debug interface options including type (JTAG/DAP) and pin assignment.

The primary selection is done by configuration pins upon power-on, where one of the supported options is to install the debug interface according to the value taken from dedicated locations in user Flash (`C001F0H..C001F3H`). This option is selected by configuration pin values (`HWCFG`) `xxxxx111B` (code start from internal Flash) or `x1100000B` (code start from external memory). The other configurations directly selecting a debug mode work correctly.

The start-up procedure reads the dedicated locations in Flash too early - before Flash redundancy is installed - which can lead to an unrecoverable read error and terminate the boot process if the block from `C001F0H` to `C001FFH` is programmed by the user. A limited number of devices are affected – a rough estimation is below 1% from the production - and the (mis) behavior is constant. That means any device is either always error free or always failing if no programming of the block from `C001F0H` to `C001FFH` is done after the last power-on.

Note, that only the two mentioned modes upon power-on and only the read from dedicated locations during start-up are affected but not in general Flash and debug interface functionality.

**Workaround**

1. Do not program the page from `C00180H` to `C001FFH`. This provides an erased, error free flash read during start-up (without installed flash)

redundancy) of `DBGPRR` register value which allows start-up from internal/external memory and JTAG position A.

2. If these start-up configurations are used during development, a device that does not start-up in the desired debug configuration should be replaced by another device.
3. Alternatively, select a debug interface not from Flash data but directly using configuration pins - refer to the User's Manual. With this it is not possible to start from external memory, nor is JTAG position A available.

### **USIC AI.004 Receive shifter baudrate limitation**

If the frame length of `SCTRH.FLE` does not match the frame length of the master, then the baudrate of the SSC slave receiver is limited to  $f_{\text{sys}}/2$  instead of  $f_{\text{sys}}$ .

#### **Workaround**

None.

### **USIC AI.005 Only 7 data bits are generated in IIC mode when TBUF is loaded in SDA hold time**

When the delay time counter is used to delay the data line SDA ( $HDEL > 0$ ), and the empty transmit buffer `TBUF` was loaded between the end of the acknowledge bit and the expiration of programmed delay time `HDEL`, only 7 data bits are transmitted.

With setting `HDEL=0` the delay time will be  $t_{HDEL} = 4 \times 1/f_{\text{SYS}} + \text{delay}$  (approximately 60ns @ 80MHz).

#### **Workaround**

- Do not use the delay time counter, i.e use only `HDEL=0` (default),  
or
- write `TBUF` before the end of the last transmission (end of the acknowledge bit) is reached.



**USIC\_AI.016 Transmit parameters are updated during FIFO buffer bypass**

Transmit Control Information (TCI) can be transferred from the bypass structure to the USIC channel when a bypass data is loaded into TBUF. Depending on the setting of TCSR register bit fields, different transmit parameters are updated by TCI:

- When SELMD = 1, PCR.CTR[20:16] is updated by BYPCR.SELO (applicable only in SSC mode)
- When WLEMD = 1, SCTR.WLE and TCSR.EOF are updated by BYPCR.BWLE
- When FLEMD = 1, SCTR.FLE[4:0] is updated by BYPCR.BWLE
- When HPCMD = 1, SCTR.HPCDIR and SCTR.DSM are updated by BHPC
- When all of the xxMD bits are 0, no transmit parameters will be updated

However in the current device, independent of the xxMD bits setting, the following are always updated by the TCI generated by the bypass structure, when TBUF is loaded with a bypass data:

- WLE, HPCDIR and DSM bits in SCTR register
- EOF and SOF bits in TCSR register
- PCR.CTR[20:16] (applicable only in SSC mode)

**Workaround**

The application must take into consideration the above behaviour when using FIFO buffer bypass.

**WDT\_X.002 Clearing the Internal Flag which Stores Preceding WDT Reset Request**

The information that the WDT has already been exceeded once is stored in an internal flag. In contrary to the documentation, that this flag can be cleared by writing a 1<sub>B</sub> to bit `WDTCS.CLRIRF` at any time, clearing of the internal flag is only possible, when the WDT is in Prewarning Mode.

### **Workaround 1**

Applications following the proposal of Application Note **AP16103** (section 'Using ESR pins to trigger a PORST reset') to trigger a Power-on Reset upon a WDT event will find the internal flag cleared upon the Power-on Reset and thus will have no issue with this limitation.

### **Workaround 2**

In case the WDT triggers a User Reset upon a WDT overflow, the internal flag will not be cleared by the reset itself. Any further overflow of the WDT will lead to a permanent reset of the device.

Applications which intentionally let the WDT exceed once, e.g. in conjunction with an initial self test, might want to have the internal flag cleared to prevent a permanent reset upon a real WDT overflow.

If the internal flag shall be cleared by software, this must be done as a reaction on a WDT overflow in the time frame the WDT is in Prewarning Mode before the permanent User Reset will be triggered. The CPU is notified upon the WDT entering Prewarning Mode by issuing an interrupt request. The application can react on this request and clear the internal flag now by writing a 1<sub>B</sub> to bit `WDTCS.CLRIRF` e.g. within an ISR.

### **Workaround 3**

Some applications may not want to use or rely on the interrupt logic in conjunction with a WDT overflow event. The proposed remedy in this case is, to initiate a Power Reset to clear the internal flag by changing the settings of the active Supply Watchdog (SWD) as follows:

1. Disable SFR protection.
2. Write the inverted value of bit `LxALEV` to register `SWDCON0`, where x stands for the number of the comparator which currently would trigger a Power Reset.

In doing so, a Power Reset for `VDDI_1` and `VDDI_M` will be activated clearing the internal flag. The application may store information on preceding WDT events in the Standby-SRAM. This can be done any time after the WDT reset without timing limitations or the need to use the interrupt logic.

**Detailed Errata Description**

*Note: Although the supply for the DPRAM, DSRAM and PSRAM will be switched off during the active reset phase, it depends on the external buffer capacitance at the VDDI\_1 pins, the actual system clock frequency and the environmental conditions, whether the content of these RAMs will be preserved in this case or not. However, the Standby-RAM itself is not cleared upon this reset.*

## 6.2 Deviations from Electrical and Timing Specification

### **FLASH\_X.P001 Test Condition for Flash parameter $N_{ER}$ in Data Sheets**

The Flash endurance parameter  $N_{ER}$  'Number of erase cycles' for 15000 cycles is documented with a wrong Test Condition.

The Test Condition states today: ' $t_{RET} \geq 5$  years; Valid for up to 64 user selected sectors (data storage)'.

In fact the amount of Flash memory validated for this cycling rate is more limited and the Test Condition must therefore state the following:

- $t_{RET} \geq 5$  years; Valid for Flash module 3 (up to 64 kbytes)

*Note: The related use case for this parameter is data storage with high cycling rate in general and EEPROM emulation in particular. For these applications concurrent operation of data storage to and program execution from Flash is assumed. Refer also to parameter  $N_{PP}$ .*

### **SWD\_X.P002 Supply Watchdog (SWD) Supervision Level in Data Sheet.**

The Supply Watchdog (SWD) Supervision Level  $V_{SWD}$  tolerance boundaries for 5.5 V are changed from  $\pm 0.15$  V to  $\pm 0.30$  V.

## 6.3 Application Hints

### **ADC\_AI.H002 Minimizing Power Consumption of an ADC Module**

For a given number of A/D conversions during a defined period of time, the total energy (power over time) required by the ADC analog part during these conversions via supply  $V_{DDPA}$  is approximately proportional to the converter active time.

#### **Recommendation for Minimum Power Consumption:**

In order to minimize the contribution of A/D conversions to the total power consumption, it is recommended

1. to select the internal operating frequency of the analog part ( $f_{ADC1}$ ) near the **maximum** value specified in the Data Sheet, and
2. to switch the ADC to a power saving state (via `ANON`) while no conversions are performed. Note that a certain wake-up time is required before the next set of conversions when the power saving state is left.

*Note: The selected internal operating frequency of the analog part that determines the conversion time will also influence the sample time  $t_S$ . The sample time  $t_S$  can individually be adapted for the analog input channels via bit field `STC`.*

### **CAPCOM12\_X.H001 Enabling or Disabling Single Event Operation**

The single event operation mode of the CAPCOM1/2 unit eliminates the need for software to react after the first compare match when only one event is required within a certain time frame. The enable bit `SEEy` for a channel `CCy` is cleared by hardware after the compare event, thus disabling further events for this channel.

#### **One Channel in Single Event Operation**

As the Single Event Enable registers `CC1_SEE`, `CC2_SEE` are not located in the bit-addressable SFR address range, they can only be modified by instructions

operating on data type WORD. This is no problem when only one channel of a CAPCOM unit is used in single event mode.

### **Two or more Channels in Single Event Operation**

When two or more channels of a CAPCOM unit are independently operating in single event mode, usually an OR instruction is used to enable one or more compare events in register `CCn_SEE`, while an AND instruction may be used to disable events before they have occurred. In these cases, the timing relation of the channels must be considered, otherwise the following typical problem may occur:

- In the Memory stage, software reads register `CCn_SEE` with bit `SEEx = 1B` (event for channel CCy has not yet occurred)
- Meanwhile, event for CCy occurs, and bit `SEEx` is cleared to `0B` by hardware
- In the Write-Back stage, software writes `CCn_SEE` with bit `SEEx = 1B` (intended event for CCx enabled via OR instruction) **and** bit `SEEx = 1B`
- or, as inverse procedure, software writes `CCn_SEE` with bit `SEEx = 0B` (intended event for CCx disabled via AND instruction) **and** bit `SEEx = 1B`

In these cases, another unintended event for channel CCy is enabled.

To avoid this effect, one of the following solutions - depending on the characteristics of the application - is recommended to enable or disable further compare events for CAPCOM channels concurrently operating in single event mode:

- Modify register `CCn_SEE` only when it is ensured that no compare event in single event mode can occur, i.e. when `CCn_SEE = 0x0000`, or
- Modify register `CCn_SEE` only when it is ensured that there is a sufficient time distance to the events of all channels operating in single event mode, such that none of the bits in `CCn_SEE` can change in the meantime, or
- Use single event operation for one channel only (i.e. only one bit `SEMx` may be = `1B`), and/or
- Use one of the standard compare modes, and emulate single event operation for a channel CCs by disabling further compare events in bit field `MODs` (in register `CCn_Mz`) in the corresponding interrupt service routine. Writing to register `CCn_Mz` is uncritical, as this register is not modified by hardware.

**CC6\_X.H001 Modifications of Bit MODEN in Register CCU6x\_KSCFG**

For each module, setting bit MODEN = 0 immediately switches off the module clock. Care must be taken that the module clock is only switched off when the module is in a defined state (e.g. stop mode) in order to avoid undesired effects in an application.

In addition, for a CCU6 module in particular, if bit MODEN is changed to 0 while the internal functional blocks have not reached their defined stop conditions, and later MODEN is set to 1 and the mode is not set to run mode, this leads to a lock situation where the module clock is not switched on again.

**ECC\_X.H001 ECC Error Indication Permanently Set**

The ECC error flag of the `ECCSTAT` register for the DPRAM, DSRAM, PSRAM and SBRAM can not be cleared, if a memory location with an ECC error is selected and the ECC is enabled. The memory can be selected by an active or by the latest read or write access.

**Workaround**

Select a memory location without ECC error in the respective memory (e.g. make a read to another address) and then clear the ECC error flag. Be aware that the new selected address may also have an ECC error.

**GPT12\_AI.H001 Modification of Block Prescalers BPS1 and BPS2**

The block prescalers `BPS1` and `BPS2`, controlled via bit fields `T3CON.BSP1` and `T6CON.BPS2`, determine the basic clock for the GPT1 and GPT2 block, respectively.

After reset, when initializing a block prescaler `BPSx` to a value different from its default value (`00B`), it must be initialized first before any mode involving external trigger signals is configured for the associated GPTx block. These modes include counter, incremental interface, capture, and reload mode. Otherwise, unintended count/capture/reload events may occur.

In case a block prescaler `BPSx` needs to be modified during operation of the GPTx block, disable related interrupts before modification of `BPSx`, and afterwards clear the corresponding service request flags and re-initialize those registers (`T2`, `T3`, `T4` in block GPT1, and `T5`, `T6`, `CAPREL` in block GPT2) that might be affected by an unintended count/capture/reload event.

### **GPT12E X.H002 Reading of Concatenated Timers**

For measuring longer time periods, a core timer (`T3` or `T6`) may be concatenated with an auxiliary timer (`T2/T4` or `T5`) of the same timer block. In this case, the core timer contains the low part, and the auxiliary timer contains the high part of the extended timer value.

When reading the low and high parts of concatenated timers, care must be taken to obtain consistent values in particular after a timer overflow/underflow (e.g. one part may already have considered an overflow, while the other has not). This is a general issue when reading multi-word results with consecutive instructions, and not necessarily unique to the GPT module microarchitecture.

The following algorithm may be used to read concatenated GPT timers, represented by `Timer_high` (for auxiliary timer, here: `T2`) and `Timer_low` (for core timer, here: `T3`). In this example, the high part is read twice, and reading of the low part is repeated if two different values were read for the high part.

- read `Timer_high_temp = T2`
- read `Timer_low = T3`
- wait two basic clock cycles (to allow increment/decrement of auxiliary timer in case of core timer overflow/underflow) - see [Table 12](#) below
- read `Timer_high = T2`
  - if `Timer_high` is not equal to `Timer_high_temp`: read `Timer_low = T3`

After execution of this algorithm, `Timer_high` and `Timer_low` represent a consistent time stamp of the concatenated timers.

The equivalent number of system clock cycles corresponding to two basic clock cycles is shown in the following [Table 12](#):



**Table 12      Equivalent Number of System Clock Cycles Required to Wait for Two Basic Clock Cycles**

| <b>Setting of BPS1</b>           | <b>BPS1 = 01</b> | <b>BPS1 = 00</b> | <b>BPS1 = 11</b> | <b>BPS1 = 10</b> |
|----------------------------------|------------------|------------------|------------------|------------------|
| Required Number of System Clocks | 8                | 16               | 32               | 64               |
| <b>Setting of BPS2</b>           | <b>BPS2 = 01</b> | <b>BPS2 = 00</b> | <b>BPS2 = 11</b> | <b>BPS2 = 10</b> |
| Required Number of System Clocks | 4                | 8                | 16               | 32               |

In case the required timer resolution can be achieved with different combinations of the Block Prescaler  $BPS1/BPS2$  and the Individual Prescalers  $T \times I$ , the variant with the smallest value for the Block Prescaler may be chosen to minimize the waiting time. E.g. in order to run T6 at  $f_{SYS}/512$ , select  $BPS2 = 00_B$ ,  $T6I = 111_B$ , and insert 8 NOPs (or other instructions) to ensure the required waiting time before reading Timer\_high the second time.

### **INT\_X.H002 Increased Latency for Hardware Traps**

When a condition for a HW trap occurs (i.e. one of the bits in register TFR is set to  $1_B$ ), the next valid instruction that reaches the Memory stage is replaced with the corresponding **TRAP** instruction. In some special situations described in the following, a valid instruction may not immediately be available at the Memory stage, resulting in an increased delay in the reaction to the trap request:

1. When the CPU is in break mode, e.g. single-stepping over such instructions as **SBRK** or **BSET TFR.x** (where  $x$  = one of the trap flags in register TFR) will have no (immediate) effect until the next instruction enters the Memory stage of the pipeline (i.e. until a further single-step is performed).
2. When the pipeline is running empty due to (mispredicted) branches and a relatively slow program memory (with many wait states), servicing of the trap is delayed by the time for the next access to this program memory, even if vector table and trap handler are located in a faster memory. However, the situation when the pipeline/prefetcher are completely empty is quite rare due to the advanced prefetch mechanism of the C166S V2 core.

**INT\_X.H004 SCU Interrupts Enabled After Reset**

Following a reset, the SCU interrupts are enabled by default (register `SCU_INTDIS = 0000H`). This may lead to interrupt requests being triggered in the SCU immediately, even before user software has begun to execute. In the SCU, multiple interrupt sources are 'ORed' to a common interrupt node of the CPU interrupt controller. Due to the "ORing" of multiple interrupt sources, only one interrupt request to the interrupt controller will be generated if multiple sources at the input of this OR gate are active at the same time. If user software enables an interrupt in the interrupt controller (`SCU_xIC`) which shares the same node as the SCU interrupt request active after reset, it may lead to the effect of suppressing the intended interrupt source. So, for all SCU interrupt sources which will not be used, make sure to disable the interrupt source (`SCU_INTDIS`) and clear any pending request flags (`SCU_xIC.IR`) before enabling interrupts in interrupt controller.

**LXBUS\_X.H001 Do Not Access Reserved Locations on the LXBus**

Some of the on-chip peripherals are connected via the LXBus. The EBC controls this access by using `CS7` to define the LXBus area.

The memory map lists several sections occupied by the on-chip LXBus peripherals MultiCAN and the USIC modules.

The reserved sections within the address range `20'0000H ... 20'FFFFH` shown in the memory map are designated to additional peripherals for future derivatives. The sizes of the reserved sections depend on the chosen device type.

These reserved sections must not be accessed by user software nor by debuggers. Access to these sections may lead to a CPU lock situation caused by a bus lock and also makes the software incompatible with other derivatives. The error mode can only be left by a reset.

### **MultiCAN\_AI.H005 TxD Pulse upon short disable request**

If a CAN disable request is set and then canceled in a very short time (one bit time or less) then a dominant transmit pulse may be generated by MultiCAN module, even if the CAN bus is in the idle state.

Example for setup of the CAN disable request:

`MCAN_KSCCFG.MODEN = 0` and then `MCAN_KSCCFG.MODEN = 1`

#### **Workaround**

Set all INIT bits to 1 before requesting module disable.

### **MultiCAN\_AI.H006 Time stamp influenced by resynchronization**

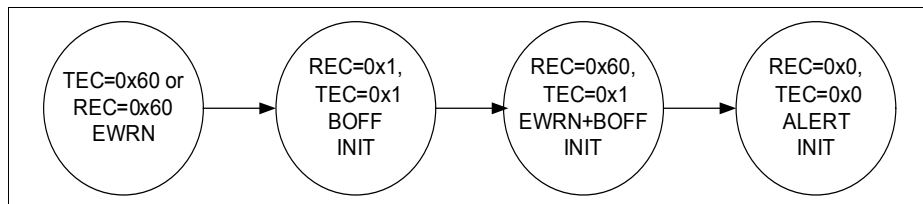
The time stamp measurement feature is not based on an absolute time measurement, but on actual CAN bit times which are subject to the CAN resynchronization during CAN bus operation. The time stamp value merely indicates the number of elapsed actual bit times. Those actual bit times can be shorter or longer than nominal bit time length due to the CAN resynchronization events.

#### **Workaround**

None.

### **MultiCAN\_AI.H007 Alert Interrupt Behavior in case of Bus-Off**

The MultiCAN module shows the following behavior in case of a bus-off status:



**Figure 7 Alert Interrupt Behavior in case of Bus-Off**

**Detailed Errata Description**

When the threshold for error warning (EWRN) is reached (default value of Error Warning Level EWRN = 0x60), then the EWRN interrupt is issued. The bus-off (BOFF) status is reached if TEC > 255 according to CAN specification, changing the MultiCAN module with REC and TEC to the same value 0x1, setting the INIT bit to 1<sub>B</sub>, and issuing the BOFF interrupt. The bus-off recovery phase starts automatically. Every time an idle time is seen, REC is incremented. If REC = 0x60, a combined status EWRN+BOFF is reached. The corresponding interrupt can also be seen as a pre-warning interrupt, that the bus-off recovery phase will be finished soon. When the bus-off recovery phase has finished (128 times idle time have been seen on the bus), EWRN and BOFF are cleared, the ALERT interrupt bit is set and the INIT bit is still set.

**MultiCAN\_AI.H008 Effect of CANDIS on SUSACK**

When a CAN node is disabled by setting bit NCR.CANDIS = 1<sub>B</sub>, the node waits for the bus idle state and then sets bit NSR.SUSACK = 1<sub>B</sub>.

However, SUSACK has no effect on applications, as its original intention is to have an indication that the suspend mode of the node is reached during debugging.

**MultiCAN\_TC.H002 Double Synchronization of receive input**

The MultiCAN module has a double synchronization stage on the CAN receive inputs. This double synchronization delays the receive data by 2 module clock cycles. If the MultiCAN is operating at a low module clock frequency and high CAN baudrate, this delay may become significant and has to be taken into account when calculating the overall physical delay on the CAN bus (transceiver delay etc.).

**MultiCAN\_TC.H003 Message may be discarded before transmission in STT mode**

If `MOFCRn.STT=1` (Single Transmit Trial enabled), bit `TXRQ` is cleared (`TXRQ=0`) as soon as the message object has been selected for transmission and, in case of error, no retransmission takes places.

Therefore, if the error occurs between the selection for transmission and the real start of frame transmission, the message is actually never sent.

**Workaround**

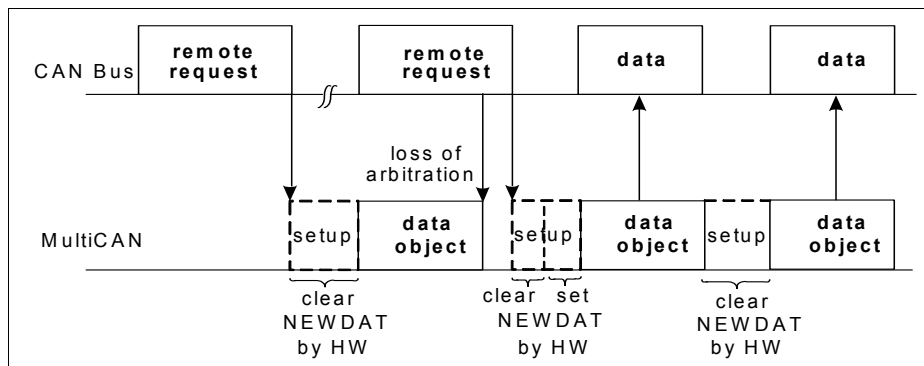
In case the transmission shall be guaranteed, it is not suitable to use the STT mode. In this case, `MOFCRn.STT` shall be 0.

**MultiCAN\_TC.H004 Double remote request**

Assume the following scenario: A first remote frame (dedicated to a message object) has been received. It performs a transmit setup (`TXRQ` is set) with clearing `NEWDAT`. MultiCAN starts to send the receiver message object (data frame), but loses arbitration against a second remote request received by the same message object as the first one (`NEWDAT` will be set).

When the appropriate message object (data frame) triggered by the first remote frame wins the arbitration, it will be sent out and `NEWDAT` is not reset. This leads to an additional data frame, that will be sent by this message object (clearing `NEWDAT`).

There will, however, not be more data frames than there are corresponding remote requests.



**Figure 8 Loss of Arbitration**

### **OCDS\_X.H003 Debug Interface Configuration by User Software**

If the debug interface must be (re)configured, the sequence of actions to follow is:

1. activate internal test-logic reset by installing `SCU_DBGPRR.TRSTGT=0`
2. disable debug interface by installing `SCU_DBGPRR.DBGEN=0`
3. install desired debug interface configuration in `SCU_DBGPRR[11:0]`
4. activate pull-devices (if internal will be used) by installing `Px_IOCry` accordingly
5. enable debug interface by installing `SCU_DBGPRR.DBGEN=1`
6. release internal test-logic reset by installing `SCU_DBGPRR.TRSTGT=1`

These steps must be performed as separate, sequential write operations.

### **PVC\_X.H001 PVC Threshold Level 2**

The Power Validation Circuits (PVC, PVC1) compare the supply voltage of the respective domain (DMP\_M, DMP\_1) with programmable levels (LEV1V and LEV2V in register `SCU_PVCMCON0` or `SCU_PVC1CON0`).

The default value of LEV1V is used to generate a reset request in the case of low core voltage.

**Detailed Errata Description**

LEV2V can generate an interrupt request at a higher voltage, to be used as a warning. Due to variations of the tolerance of both the Embedded Voltage Regulators (EVR) and the PVC levels, this interrupt can be triggered inadvertently, even though the core voltage is within the normal range. It is, therefore, recommended not to use this warning level.

LEV2V can be disabled by executing the following sequence:

1. Disable the PVC level threshold 2 interrupt request  
`SCU_PVCMCON0.L2INTEN` and `SCU_PVC1CON0.L2INTEN`.
2. Disable the PVC interrupt request flag source `SCU_INTDIS.PVCM12` and `SCU_INTDIS.PVC1I2`.
3. Clear the PVC interrupt request flag source `SCU_DMPMITCLR.PVCM12` and `SCU_DMPMITCLR.PVC1I2`.
4. Clear the PVC interrupt request flag by writing to `SCU_INTCLR.PVCM12` and `SCU_INTCLR.PVC1I2`.
5. Clear the selected SCU request flag (default is `SCU_1IC.IR`).

The Power Validation Circuits (PVC) compare the supply voltage of the respective domain (DMP\_M) with programmable levels (LEV1V and LEV2V in register `SCU_PVCMCON0`).

The default value of LEV1V is used to generate a reset request in the case of low core voltage.

LEV2V can generate an interrupt request at a higher voltage, to be used as a warning. Due to variations of the tolerance of both the Embedded Voltage Regulators (EVR) and the PVC levels, this interrupt can be triggered inadvertently, even though the core voltage is within the normal range. It is, therefore, recommended not to use this warning level.

LEV2V can be disabled by executing the following sequence:

1. Disable the PVC level threshold 2 interrupt request  
`SCU_PVCMCON0.L2INTEN`.
2. Disable the PVC interrupt request flag source `SCU_INTDIS.PVCM12`.
3. Clear the PVC interrupt request flag source `SCU_DMPMITCLR.PVCM12`.
4. Clear the PVC interrupt request flag by writing to `SCU_INTCLR.PVCM12`.
5. Clear the selected SCU request flag (default is `SCU_1IC.IR`).

### **RESET\_X.H003 How to Trigger a $\overline{\text{PORST}}$ after an Internal Failure**

There is no internal User Reset that restores the complete device including the power system like a Power-On Reset. In some applications it is possible to connect  $\overline{\text{ESR1}}$  or  $\overline{\text{ESR2}}$  with the  $\overline{\text{PORST}}$  pin and set the used  $\overline{\text{ESR}}$  pin as Reset output. With this a WDT or Software Reset can trigger a Power-On Reset.

A detailed description is in the Application Note **AP16103**.

### **RTC\_X.H003 Changing the RTC Configuration**

The count input clock  $f_{\text{RTC}}$  for the Real Time Clock module (RTC) can be selected via bit field `RTCCLKSEL` in register `RTCCLKCON`. Whenever the system clock is less than 4 times faster than the RTC count input clock ( $f_{\text{SYS}} < f_{\text{RTC}} \times 4$ ), Asynchronous Mode must be selected (bit `RTCCM` = `1B` in register `RTCCLKCON`).

To assure data consistency in the count registers `T14`, `RTCL`, `RTCH`, the RTC module must be temporarily switched off by setting bit `MODEN` = `0B` in register `RTC_KSCCFG` before register `RTCCLKCON` is modified, i.e. whenever

- changing the operating mode (Synchronous/Asynchronous) Mode in bit `RTCCM`, or
- changing the RTC count source in bit field `RTCCLKSEL`.

### **SCU\_X.H009 `WUCR.TTSTAT` can be set after a Power-Up**

After power-up the wake-up clock  $f_{\text{WU}}$  is selected for the Wake-Up Timer (WUT). In this case, the trim interrupt trigger cannot be used, because the WUT trim trigger status bit (`WUCR.TTSTAT`) might become set erroneously. This happens sporadically and is, therefore, difficult to find in the development phase of an application. If the trim interrupt trigger is enabled this may lead to unintended SCU interrupts that may also block other interrupt sources (see [INT\\_X.H004](#)).

This can be avoided by executing the following sequence:

1. Disable the trim interrupt source `SCU_INTDIS.WUTI`
2. Clear the trim interrupt request flag by writing to `INTCLR.WUTI`
3. Clear the selected SCU request flag (default is `SCU_1IC.IR`)



**SWD\_X.H001 Application Influence on the SWD**

The internal Supply Watchdog (SWD) monitors the external supply voltage of the pad I/O domain  $V_{DDPB}$  which is connected to the device. Therefore, adjustable threshold levels are defined over the complete supply voltage range. These limits are also influenced by system environment and may deviate due to external influences slightly from the values given in the Datasheet. Independent of the SWD is the internal start up and operation protected by the PVC, which monitor the core voltage.

**USIC\_AI.H001 FIFO RAM Parity Error Handling**

A false RAM parity error may be signalled by the USIC module, which may optionally lead to a trap request (if enabled) for the USIC RAM, under the following conditions:

- a receive FIFO buffer is configured for the USIC module, and
- after the last power-up, less data elements than configured in bit field `SIZE` have been received in the FIFO buffer, and
- the last data element is read from the receiver buffer output register `OUTRL` (i.e. the buffer is empty after this read access).

Once the number of received data elements is greater than or equal to the receive buffer size configured in bit field `SIZE`, the effect described above can no longer occur.

To avoid false parity errors, it is recommended to initialize the USIC RAM before using the receive buffer FIFO. This can be achieved by configuring a 64-entry transmit FIFO and writing 64 times the value `0x0` to the FIFO input register `IN00` to fill the whole FIFO RAM with `0x0`.

**USIC\_AI.H002 Configuration of USIC Port Pins**

Setting up alternate output functions of USIC port pins through `Pn.IOCRy` registers before enabling the USIC protocol (`CCR.MODE = 0001B, 0010B, 0011B or 0100B`) might lead to unintended spikes on these port pins. To avoid

the unintended spikes, either of the following two sequences can be used to enable the protocol:

- Sequence 1:
  - Write the initial output value to the port pin through Pn\_OMR
  - Enable the output driver for the general purpose output through Pn\_IOCRx
  - Enable USIC protocol through CCR.MODE
  - Select the USIC alternate output function through Pn\_IOCRx
- Sequence 2:
  - Enable USIC protocol through CCR.MODE
  - Enable the output driver for the USIC alternate output function through Pn\_IOCRx

Similarly, after the protocol is established, switching off the USIC channel by resetting CCR.MODE directly might cause undesired transitions on the output pin. The following sequence is recommended:

- Write the passive output value to the port pin through Pn\_OMR
- Enable the output driver for the general purpose output through Pn\_IOCRx
- Disable USIC protocol through CCR.MODE

### **USIC\_AI.H003 PSR.RXIDLE Cleared by Software**

If PSR.RXIDLE is cleared by software, the USIC is not able to receive until the receive line is detected IDLE again (see User's Manual chapter Idle Time).

For UART based busses with higher traffic e.g. LIN it is possible that sometimes the next frame starts sending before PSR.RXIDLE is set 1<sub>B</sub> by hardware again. This generates an error.

A solution is, that the PSR.RXIDLE bit is not cleared in software.

## **6.4 Documentation Updates**

### **EBC\_X.D001 Visibility of Internal LXBus Cycles on External Address Bus**

EBC chapter "Access Control to LXBus Modules" receives the following correction:

In the first paragraph the term "read mode" is replaced by "tri-state mode".

The following is added:

Despite the above mentioned measures, accesses to internal LXBus modules are to some extent reflected on the non-multiplexed address pins A[23:0] of the external bus.

1. During an internal LXBus access, the external address bus is tri-stated. The switch to tri-state mode occurs in the same cycle as the internal LXBus access. This may induce residual voltage which can lead to undefined logic levels on the address bus pins. Those in turn can cause unwanted switching activity on attached device input stages. Therefore attached devices should be equipped with an input hysteresis filter to avoid unwanted switching activity.
2. After an internal LXBus access is completed the address of the location accessed last on the LXBus becomes visible on the external address bus, unless an external bus cycle immediately follows the LXBus cycle. Due to this behavior, switching activity on the address bus can be observed even if no external access is active.

*Note: A functional impact due to this behavior is not expected because external bus control signals are held inactive during the internal LXBus access.*

### **ECC\_X.D002 Initialization of the Read-Control Logic**

In chapter "ECC Error Handling" (8.14.3) of the User's Manual version 2.0 the following note should be added.

*Note: The state of the read-control logic must get cleared after initialization of a RAM with ECC enabled. This is achieved with a read operation from one*

*location in each of the RAMs which was initialized before. This read operation must get executed before enabling the corresponding ECC trap.*

### **RESET\_X.D001 Reset Types of Trap Registers**

The reset type of SCU registers `TRAPDIS`, `TRAPSET`, `TRAPNP` and `TRAPNP1` is an Application Reset.

In the next revision of the user's manual the reset type of this registers will be changed from a Power-on Reset to an Application Reset.

### **USIC\_X.D001 Connection from CCU6x to USICx**

In the User's Manual V2.0 chapter 20 "Capture/Compare Unit 6 (CCU6)" the connection between CCU6x and USICx is correct described but not in chapter 21 "Universal Serial Interface Channel".

The correct description for chapter 21 "Universal Serial Interface Channel" is CCU6x\_ **COUT63** to USICx\_DX2F.

### **USIC\_X.D002 USIC1 Channel 0 Connection DX0C and DX0D**

The connectivity description for USIC1 channel 0 DX0C and DX0D in the User's Manual V2.0 chapter "Universal Serial Interface Channel", table "I/O Connections of USIC1" is not correct.

The correct I/O connection for USIC1 channel 0 DX0C is **P10.12** and for DX0D is **P10.13**.

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