XMC4000

XMC4500 Family

CCU4 and External Load

Timer Reload on External Events

User Guide

Device Guide

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1 Timer Reload on External Events

Each CAPCOM4 (CCU40/../43) is a multi-purpose timer unit for many use cases. It is designed with repetitive structures with multiple timer slices that have all the same base functionalities. This allows the development of re-usable SW low level drivers. The main function blocks of 1 of the 4 CC4y slices on a CCU4x are shown here.

See Figure 1.

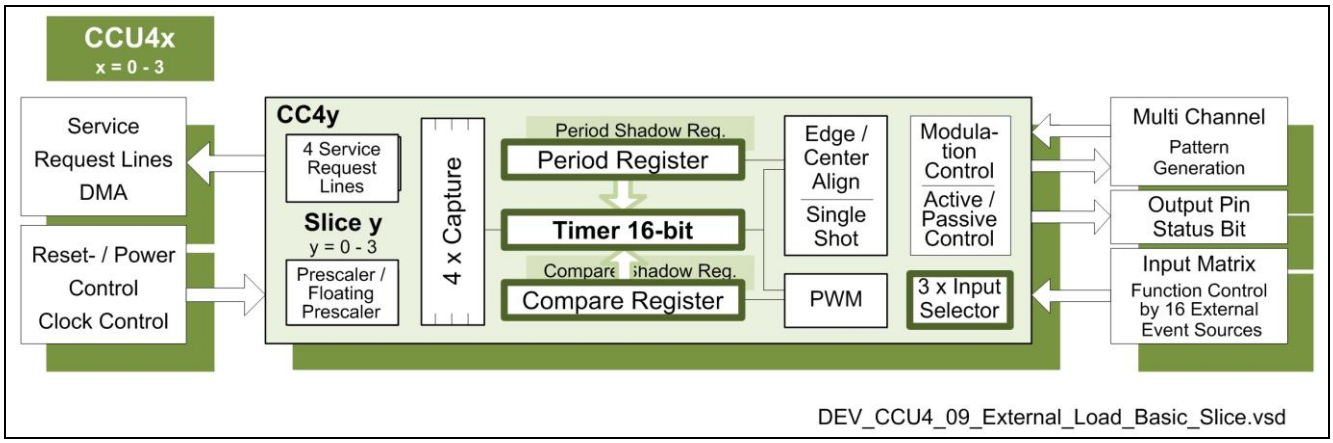

Figure 1 CCU4 Basic Slice and Timer Load on External Events

1.1 Timer Load Basics

See Figure 2.

An external source may trigger a Timer Reload transfer from *either* the compare register **CRy** (if counting up) *or* from the period register **PRy** (if counting down). The count direction bit **CC4yTCST.**CDIR can be set by HW by *another* source. The *input source(s)* and *function(s)* should be mapped to the **CC4yINS** & **CC4yCMC** registers.

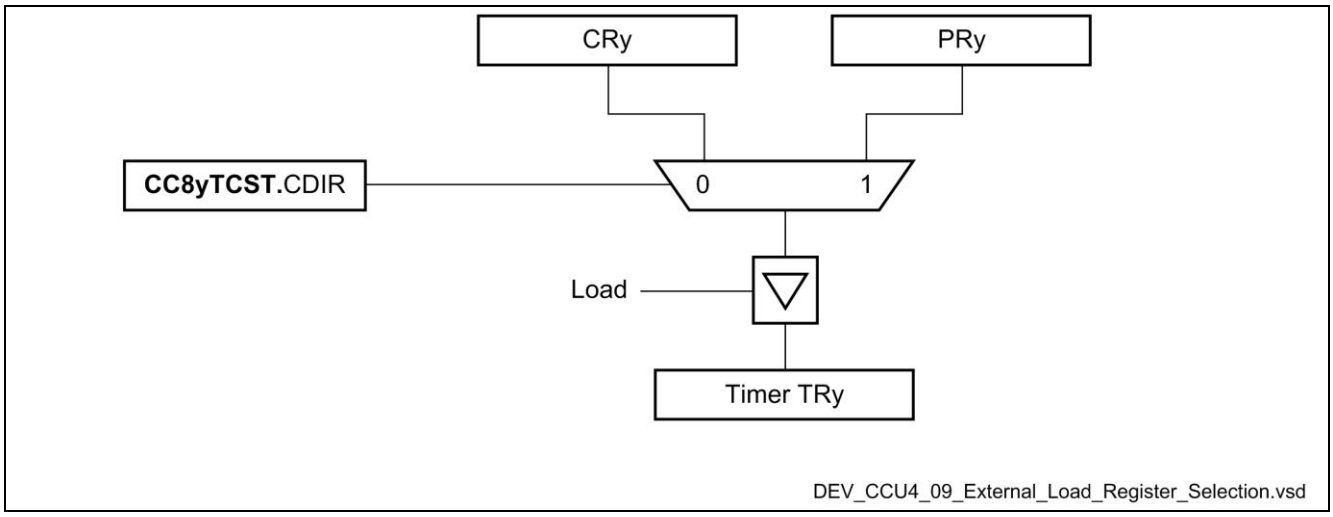

Figure 2 Timer Load Selection Control

1.2 Timer Load by External Events Control

This scenario regards how to link the *Timer Load* input function to external trigger requests – from any of the following sources: *GPIO, ERU, POSIF, CAN, CCU4x, USIC, ADC, CCU8x or SCU*. **Pin Connections** are given by the **Top-Level Interconnect** and the **CC4yINS**[P:A] *Input Select* **-** and *Load function* by the **CC4yCMC**.LDS.

See Figure 3.

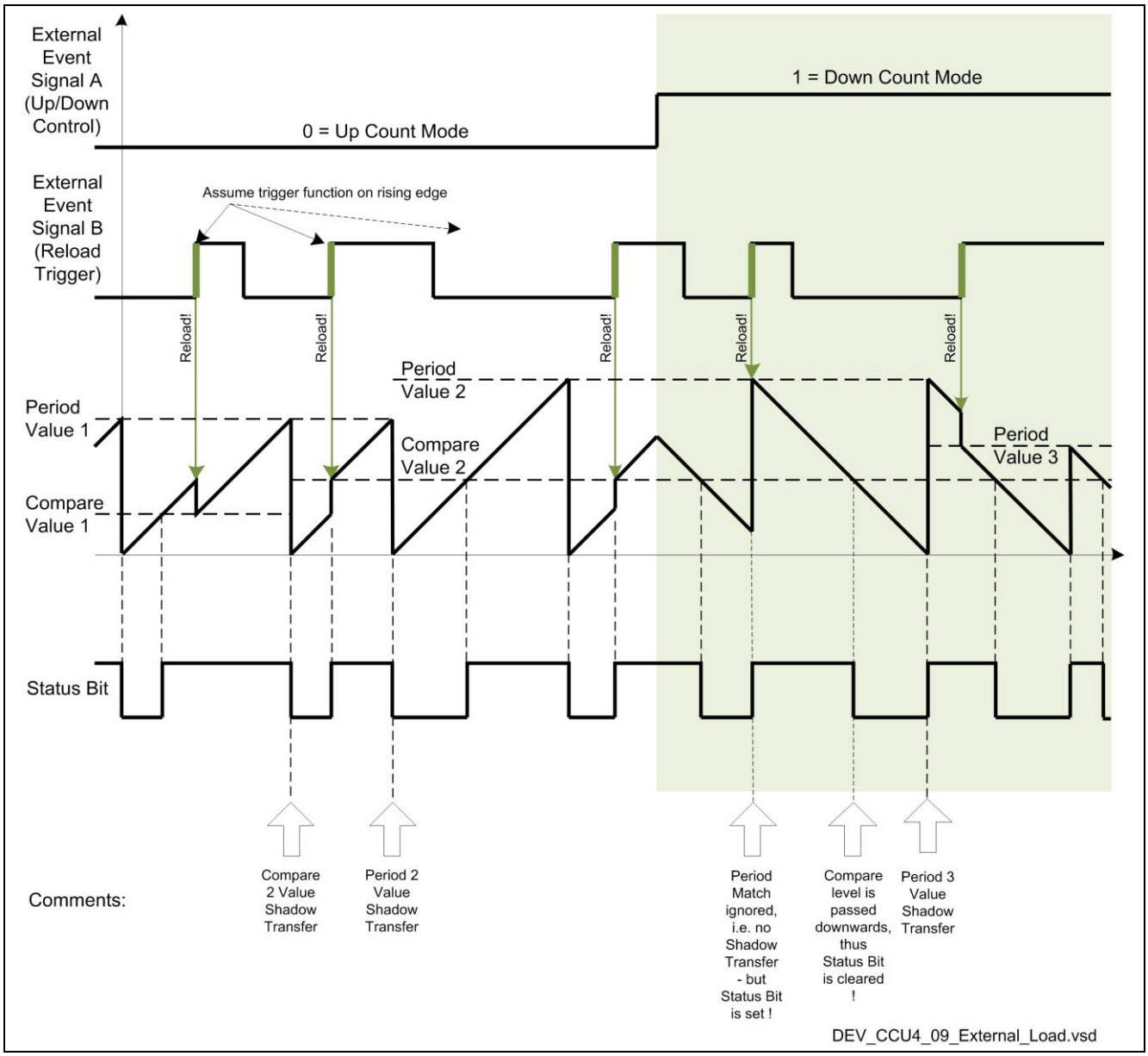

Figure 3 Timer Reload from Compare Register or Period Register on External Events

2 Getting Started with CCU4 and External Load

2.1 Ultimate Initialization Sequence

Before start and execution of a timer slice SW first time, the CAPCOM4 must have been initialized appropriately according to a specific **CAPCOM4 Initialization Sequence:** 1. *Apply Reset*, 2. *Release Reset*, 3. *Enable Clock*, 4. *Enable Prescaler Block*, 5. *Configure Global Control*, 6. *Configure Slice(s) Functions*, *Interrupts* and *Start-up*.

2.1.1 Ultimate Start-Up Enable

In the last part of the ultimate CAPCOM4 **Initialization Sequence** the startup value(s) for a specific Compare Channel Status of the Timer Slice(s) may be configured by the respective **GCSS.SyTS** bit. After that the default *IDLE mode has to be removed* from the Timer Slice(s) in register **GIDLC** and Start or Global Start can be done!

All these topics are covered in detail by the Reference Manual: <<< Link to 23.6.1 Initialization Sequence >>>

2.2 External Events Control Setup Registers

The *Input Selection* register **CC4yINS** maps *External-Event-Sources* and *Edge/Level Mode* conditions to the *Event[2:0] Input Lines*. In turn the *Connection Matrix Control* register **CC4yCMC** maps the three *Event[2:0] Input Lines* to any of the 11 *Input Functions*. The *Timer Status* bit **CC4yTCST.**CDIR controls the Counting Direction.

2.2.1 Using the External Load Control Register Bitfields

1. **CC4yCMC.**LDS Map the *Load* Function Selector to an Event Input Line Number x=0-2
2. **CC4yINS.**<Event-x bitfields> Event-x Source EVxIS (**CC4yINS**[P:A]) and Edge Mode EVxEM bitfields

2.2.2 Using the External Up/Down Control Register Bitfields

3. **CC4yCMC.**UDS Map the *Up/Down* Function Selector to an Event Input Line Number x=0-2
4. **CC4yINS.**<Event-x bitfields> Event-x Source EVxIS (**CC4yINS**[P:A]) and Level Mode EVxLM bitfields

*Note: The Up/Down Counting Direction control works indirectly via the unwritable **CC4yTCST.**CDIR status bit*

Note: The External Load function is Edge Sensitive.

Note: The External Up/Down Direction Control function is Level Sensitive.

Note: When using the index 'x' in event nomenclature, it should be understood as 'Actual Event[2:0] Number '.

Note: When using the index 'x' in CCU4x nomenclature, it should be understood as 'Actual CCU4 Unit Number'.

Note: The Ultimate Event Number 'x' for the LDS Input Function is always x == <LDS>-1 (when <LDS> != 0).

2.3 Pseudo Code for the External Load Setup

```
// This is an independent 32-bit based Pseudo Code, regarding that there are no
connections to a certain CAPCOM4 Unit (CCU4x) nor specific Variable Declarations.
// step1
// Make a MASK OPERATION first for bitfield focusing – if not first time – else:
CC4yCMC |= LDS_FUNCTION_AND_EVENT_NUMBER_BITFIELD //Initialize Load and Event Nr
// step 2
CC4yINS &= LDS_SOURCE_AND_EVENT_MODES_BITFIELDS_MASK; //Focus on bitfields
CC4yINS |= LDS_SOURCE_AND_EVENT_MODES_BITFIELDS_PATTERN;  //Paste setup pattern
// step3
CC4yCMC |= UDS_FUNCTION_AND_EVENT_NUMBER_BITFIELD //Initialize UDS and Event Nr
// step 4
```

```
CC4yINS &= UDS_SOURCE_AND_EVENT_MODES_BITFIELDS_MASK; // Focus on bitfields
CC4yINS |= UDS_SOURCE_AND_EVENT_MODES_BITFIELDS_PATTERN;  //Paste setup pattern

// step 1 & 3 could naturally be merged into one operation sequence, as follows:
// Make a MASK OPERATIONS first for bitfield focusing - if not first time - else:
CC4yCMC |= LDS_AND_UDS_FUNCTIONS_AND_EVENTS_NRS_BITFIELDS //Init Ext. Load and UDS

// step 2 & 4 could naturally be merged into one operation sequence, as follows:
CC4yINS &= LDS_UDS_SOURCES_AND_EVENTS_MODES_BITFIELDS_MASK; //Focus on bitfielfs
CC4yINS |= LDS_UDS_SOURCES_AND_EVENTS_MODES_BITFIELDS_PATTERN; //Paste all setups!
```

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