FCE
Flexible CRC Engine

XMC™ microcontrollers
September 2016

Agenda

1 Overview

2 Key feature: support 3 independent CRC polynomials

3 Key feature: data reflection and XOR

4 Key feature: signature check

5 System integration

6 Application examples

Agenda

1 Overview

2 Key feature: support 3 independent CRC polynomials

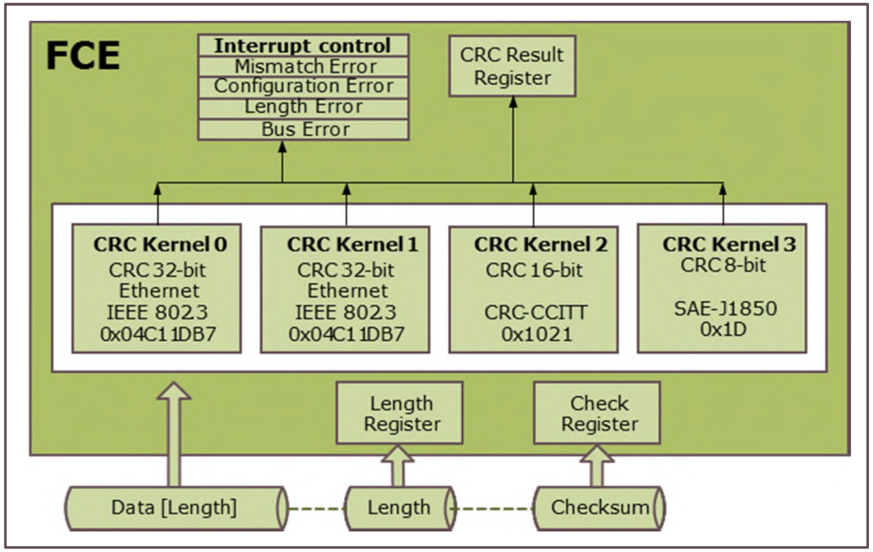
3 Key feature: data reflection and XOR

4 Key feature: signature check

5 System integration

6 Application examples

FCE
Flexible CRC Engine



Highlights

The FCE for the XMC™4000 microcontroller implements the IEEE 802.3 Ethernet CRC32, the CCITT CRC16 and the SAE J1850 CRC8 polynomials.

The primary target of FCE is to be used as a hardware acceleration engine for software applications or operating systems services using CRC signatures.

Key feature

- Support 3 independent CRC polynomials
- Equipped with data reflection and XOR feature
- Interrupt error notification and signature check

Customer benefits

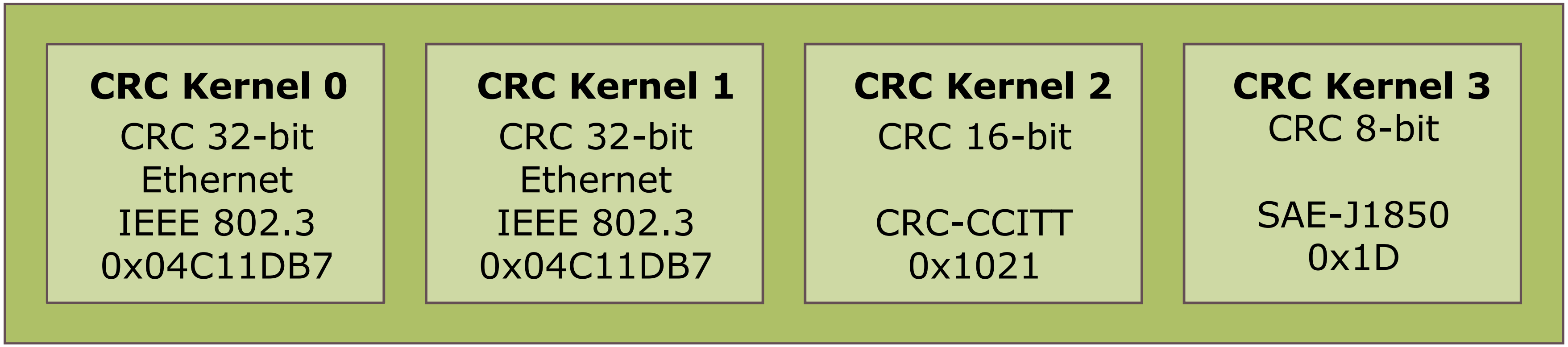
- 3 independent CRC algorithms can be used concurrently by different software tasks
- No software loading to perform data reflection with and without XOR operation
- Less software through hardware length and checksum mismatch alerted

Agenda

1. Overview
2. Key feature: support 3 independent CRC polynomials
3. Key feature: data reflection and XOR
4. Key feature: signature check
5. System integration
6. Application examples

FCE
Support 3 independent CRC polynomials

- The FCE offers 3 different independent polynomials for CRC calculations
  - CRC kernel 0 and 1: **IEEE 802.3 CRC32 Ethernet polynomial**: 0x04C11DB7
  - CRC kernel 2: **CCITT CRC16 polynomial**: 0x1021
  - CRC kernel 3: **SAE J1850 CRC8 polynomial**: 0x1D
- The CRC calculation of these 4 kernels can be executed in parallel, hence they can be used concurrently by different software tasks



CRC Kernel 0
CRC 32-bit
Ethernet
IEEE 802.3
0x04C11DB7

CRC Kernel 1
CRC 32-bit
Ethernet
IEEE 802.3
0x04C11DB7

CRC Kernel 2
CRC 16-bit

CRC-CCITT
0x1021

CRC Kernel 3
CRC 8-bit

SAE-J1850
0x1D

Agenda

1 Overview

2 Key feature: support 3 independent CRC polynomials

3 Key feature: data reflection and XOR

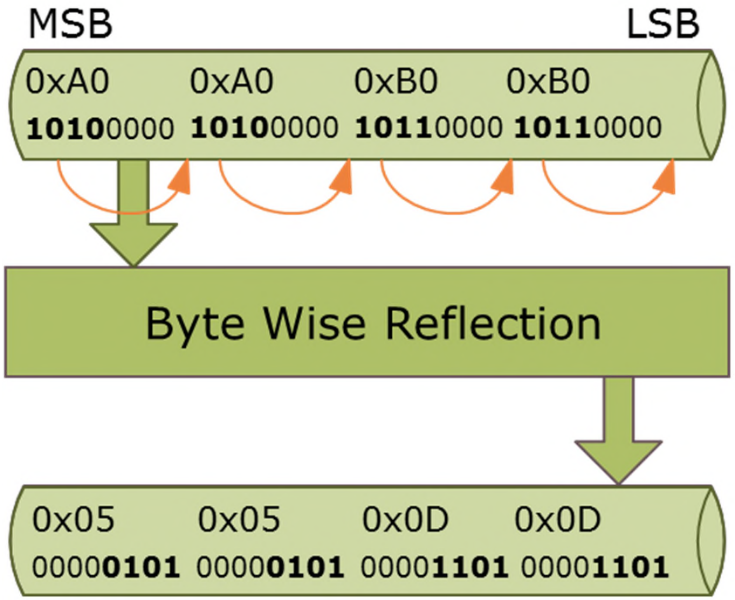
4 Key feature: signature check

5 System integration

6 Application examples

FCE
Equipped with data reflection and XOR feature

- Result XOR, indicates if a final XOR operation is done before returning the CRC result
- Data reflection feature for both input and result
  - Byte wise reflection
  - Bit wise reflection



MSB LSB

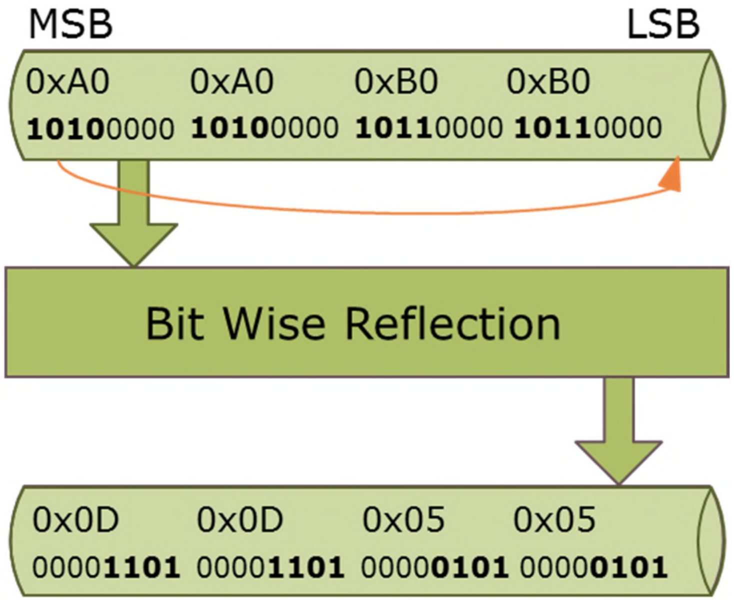
0xA0 0xA0 0xB0 0xB0

10100000 10100000 10110000 10110000

Byte Wise Reflection

0x05 0x05 0x0D 0x0D

00000101 00000101 00001101 00001101



MSB LSB

0xA0 0xA0 0xB0 0xB0

10100000 10100000 10110000 10110000

Bit Wise Reflection

0x0D 0x0D 0x05 0x05

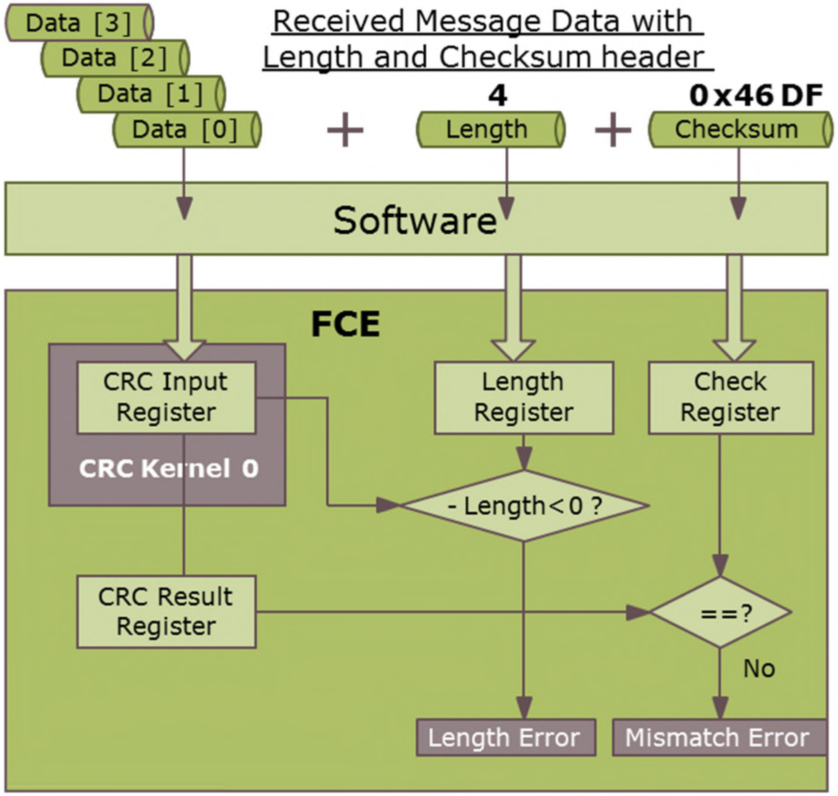
00001101 00001101 00000101 00000101

Agenda

1. Overview
2. Key feature: support 3 independent CRC polynomials
3. Key feature: data reflection and XOR
4. **Key feature: signature check**
5. System integration
6. Application examples

FCE: interrupt error notification and signature check

- CRC mismatch interrupt
  - The automatic signature check compares the signature at the end of a message with the expected signature configured in the CHECK register
  - A mismatch error interrupt will happen if both values are different
- Length error interrupt
  - The LENGTH register is configured with the number of words of the message for CRC calculation
  - Every time the IR register is written, the LENGTH register is decremented by one until it reaches zero
  - Length error interrupt is generated if software writes to IR register with LENGTH equal to 0



Agenda

1 Overview

2 Key feature: support 3 independent CRC polynomials

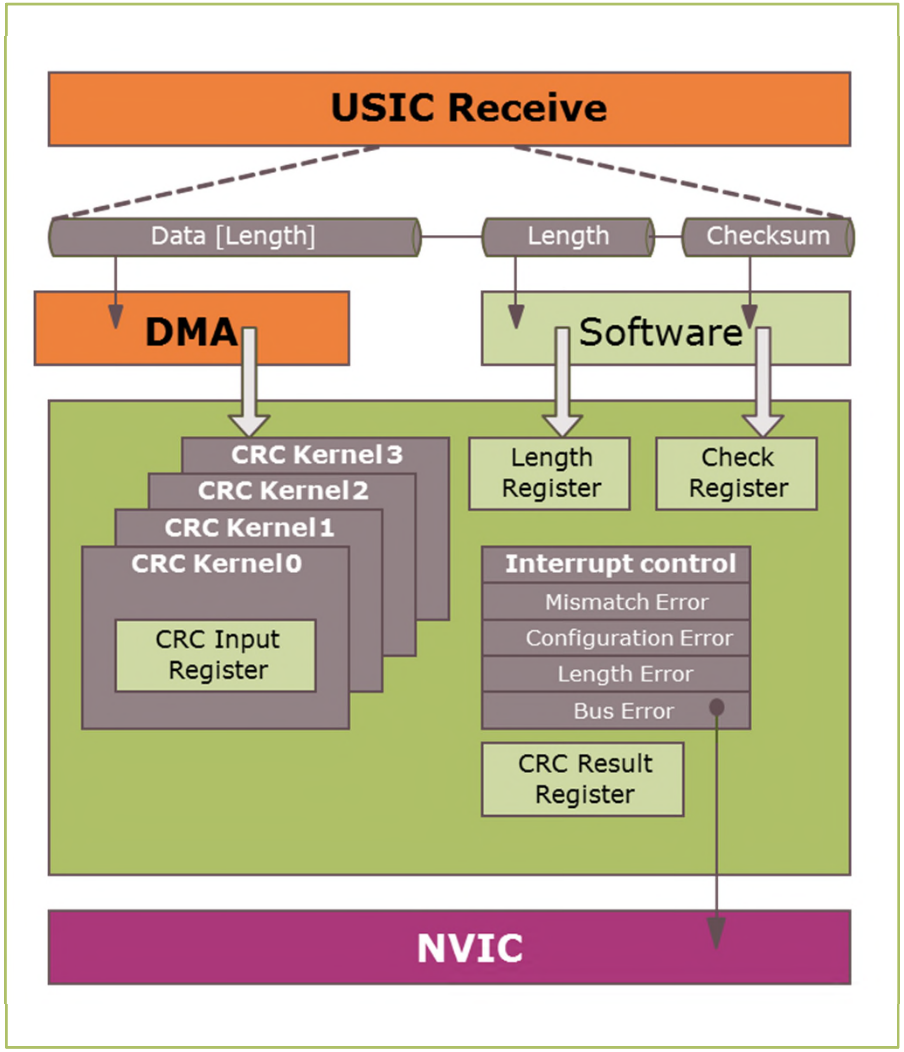
3 Key feature: data reflection and XOR

4 Key feature: signature check

5 System integration

6 Application examples

FCE
System integration



XMC™4500	XMC™4400	XMC™4200
●	●	●

- The FCE can be combined with the USIC and DMA module for an optimized system solution
  - The software can write into the length and check register for auto detection of length or mismatch error respectively
  - The DMA can transfer data into the CRC input register without any CPU loading
- Target application
  - Reliable USIC communication
  - Alternate boot mode

Agenda

1 Overview

2 Key feature: support 3 independent CRC polynomials

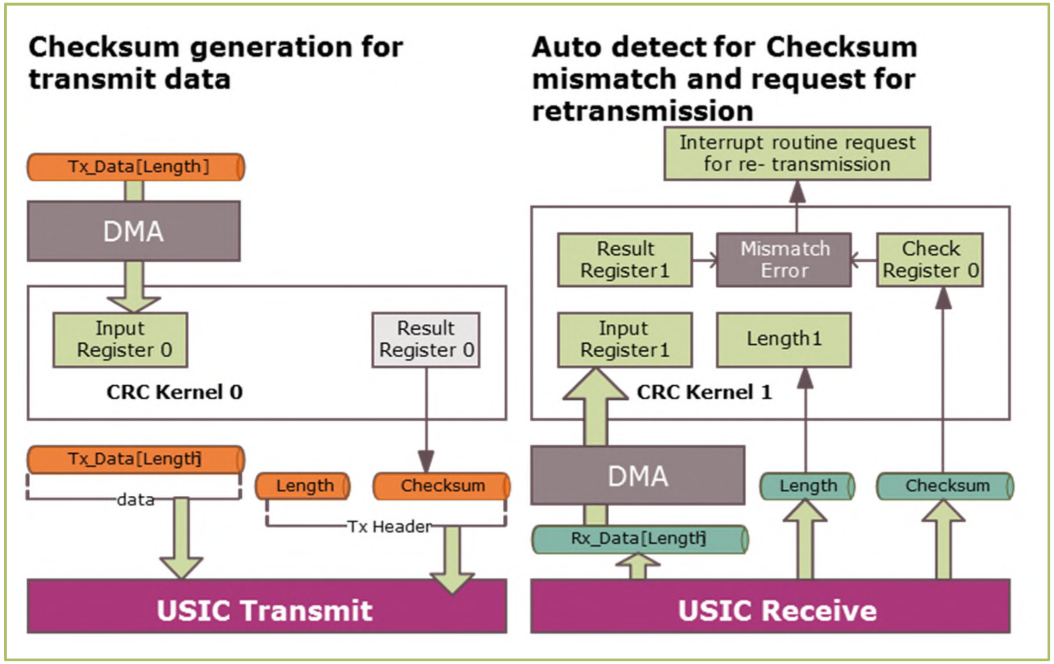
3 Key feature: data reflection and XOR

4 Key feature: signature check

5 System integration

6 Application examples

Application example
CRC for USIC communication



In brief

Both USIC transmit and receive modules are assigned to an independent CRC kernel for CRC generation and data verification. DMA is used to reduce CPU loading.

Overview

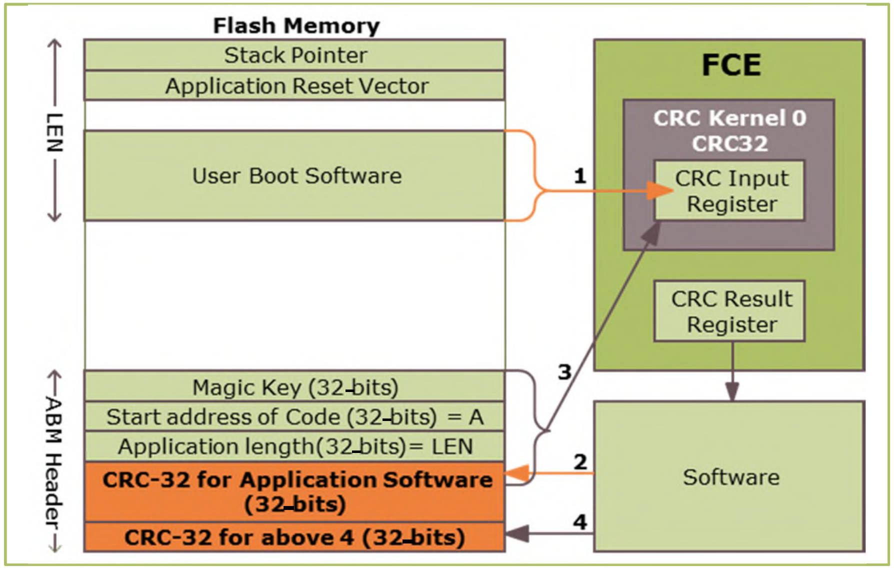
Transferring of data in a digital network are subjected to noise and other disturbances which led to accidental changes to raw data.

Hence verification needs to be done at the receiving end to ensure data correctness.

Therefore the verification process involves the transmission side to generate a CRC value which is append into the transmit header of a data frame.

At the receiving side, CRC is recalculated again and it’s calculated CRC value is compared with the received checksum for any mismatch.

Application example
Alternate boot mode header initialization



In brief

Other than using the standard boot mode, XMC™ also allows user to customize its boot software in a user defined flash memory. This is known as alternate boot mode. The alternate boot mode header requires CRC-32 polynomial calculations (04C11DB7H).

Overview

The Alternate Boot Modes (ABMs) are intended to start program code available at a user-defined address, if the ABM header check-condition is satisfied by the start up software.

To initialize the ABM header, the FCE is used to generate the CRC results for the application software and the first 4 words of the ABM header.

Lastly the software shall write the 2 CRC results into the last 2 words of the ABM header.

Support material

Collaterals and Brochures Document Info	– Product Briefs – Selection Guides – Application Brochures – Presentations – Press Releases, Ads	– www.infineon.com/XMC
Technical Material Tools Evaluation Board	– Application Notes – Technical Articles – Simulation Models – Datasheets, MCDS Files – PCB Design Data	– www.infineon.com/XMC – Kits and Boards – DAVE™ – Software and Tool Ecosystem
Videos Play	– Technical Videos – Product Information Videos	– Infineon Media Center – XMC Mediathek
Contact Support	– Forums – Product Support	– Infineon Forums – Technical Assistance Center (TAC)

Disclaimer

The information given in this training materials is given as a hint for the implementation of the Infineon Technologies component only and shall not be regarded as any description or warranty of a certain functionality, condition or quality of the Infineon Technologies component.

Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind (including without limitation warranties of non-infringement of intellectual property rights of any third party) with respect to any and all information given in this training material.

Part of your life. Part of tomorrow.

infineon