

Downloading an s19 file Using the EzPORT Module on the MCF521x ColdFire® Microcontroller

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1 Introduction

This document intends to demonstrate how an object code in the s19 format file can be downloaded to the MCF521x internal flash memory using a serial peripheral interface (SPI) called EzPORT. This application note provides an example that demonstrates how two MCF521x MCUs interact with each other. One MCU is configured to drive the SPI and UART communication. This communication programs the second MCU. The example software code the goes with this application note can be modified to suit your programming needs.

2 MCF521x EzPORT Software Features

The EzPORT is a module on all ColdFire processors with internal flash memory (except for the MCF528x) that allows other devices to erase, read, or write internal flash

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memory using the SPI interface. The EzPort uses some SPI command codes like page program or bulk erase.

2.1 Description

Figure 1 shows how the EzPORT demo software works. The software has the following features:

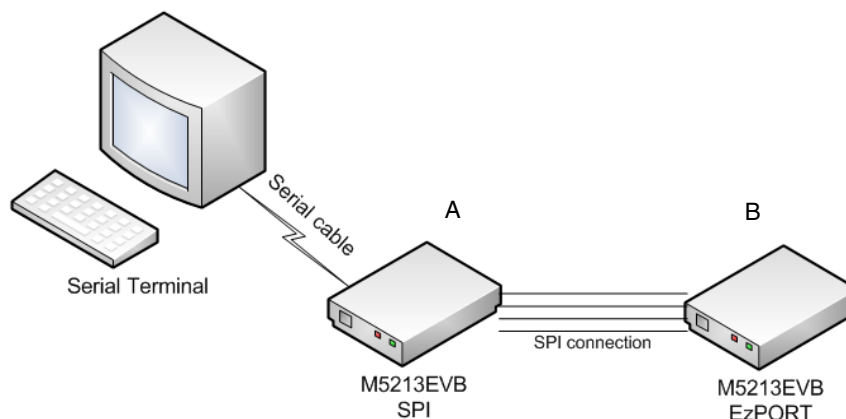


Figure 1. EzPORT Demo Software

- Serial communication between the MCF521x and the serial terminal settings are 115.2 Kbps 8-N-1 with software flow control (XON and XOFF commands).
- The M5213EVB SPI (A) accepts only the s19 file format software for programming the second processor (M5213EVB SPI (B)).
- The M5213EVB SPI (A) uses XON and XOFF serial commands to allow or decline serial communication to the serial terminal. Therefore, software flow control is mandatory.
- For an 80 MHz core frequency microcontroller the SPI baudrate communication between the M5213EVBs (A and B) is fixed at the highest value of 10 Mbps.
- The SPI software from the M5213EVB SPI (A) uses a queued serial peripheral interface (QSPI) in a wraparound mode, this allows a constant SPI baudrate during long transfers.
- There are pins that must be connected between the M5213EVBs, see [Table 1](#).
- The jumpers QSPI_SCLK, QSPI_CS0, LED_EN, and ZIGBEE_EN must be removed from both boards to avoid interaction with other on-board components.
- After the EzPORT demo software is downloaded to the M5213EVB SPI (A), it requests an s19 file for the M5213EVB EzPORT (B) internal flash memory. After downloading software, the M5213EVB SPI (A) shows a failure or successful message through the UART interface.
- Demo software for the M5213EVB SPI (A) is designed to fit on almost all ColdFire processors. If a migration to other ColdFire processors is required, then a few changes are necessary:
 - The RSTO and RSTI pin selection — PTC0 and PTC1 are used to control pins on the M5213EVB EzPORT (B).

- The clock configuration command sent to the M5213EVB EzPORT (B) depends on the crystal used. Due to the phase lock loop (PLL) registers default value after reset a 48 MHz core frequency is used in the second board.
- Flash space used on the M5213EVB EzPORT (B) is 256 KB

Table 1. Connection Between Boards

M5213EVB SPI (A)	M5213EVB EzPORT (B)
DOUT	DIN
DIN	DOUT
SCLK	SCLK
CS0	RCON
TC0	RSTO
TC1	RSTI
GND	GND

3 Demo Software Explanation

The example code shows how the ColdFire QSPI controller must be initialized to interact with the EzPORT interface on another ColdFire board. There are only two ways to write into the internal flash memory: BDM and EzPORT. The BDM requires a 26-pin standard interface and the EzPORT only 7-pin. The EzPORT can go down to 5-pin if the following situations are met:

- The RSTO pin is not needed if:
 - the RSTI pin has been deasserted
 - a software delay of 512 CPU clocks is included
- The RSTI pin is manually triggered to enter EzPORT mode:
 - M5213EVB EZPORT (B) — A hot reset is requested after EzPORT connection.
 - M5213EVB SPI (A) — The user must recognize the hot reset condition in M5213EVB EZPORT (B) and inform the M5213EVB SPI (A).

If a 7-pin connection is followed, the demo software can easily be migrated to all the ColdFire microcontrollers with the EzPORT controller.

The following must be considered during software use.

- After the MCF521x is in EzPORT mode it remains the same until the next reset. The MCF521x cannot do anything else but be accessed by the SPI.
- The page term used by the EzPORT module (256 Bytes) is not the same as the logical page (2 KBytes) used by the ColdFire flash module (CFM). It uses 256 Bytes for compatibility with existing SPI programs.
- The SPI code implements the wraparound mode avoiding chip select deassertion after 16 words have been sent by the MCF521x. The wraparound mode allows the SPI controller to send continuous data through the queue until it is turned off. The first half of the queue is send and receive, while the other half is read and write. Then both halves continuously alternate functions.

The EzPORT Software DEMO implements all the commands used by the EzPORT module:

- Write enable (WREN)
- Write disable (WRDI)
- Read status register (RDSR)
- Write configuration register (WRCR)
- Read data (READ)
- Read data at high speed (FAST_READ)
- Page program (PP)
- Sector erase (SE)
- Bulk erase (BE)
- Reset chip (RESET)

For more details about a particular command, see the *MCF5213RM — MCF5213 ColdFire® Integrated Microcontroller Reference Manual* document on the Freescale website.

3.1 Correct Use of EzPORT Commands

The EzPORT mode can only be entered after a reset and clearing the RCON signal. The signal must then be set to high. Afterwards, the RCON signal behaves as a chip select during SPI communication, see [Figure 2](#). The SPI communication will be active when the RCON signal is clear and idle when it is set.

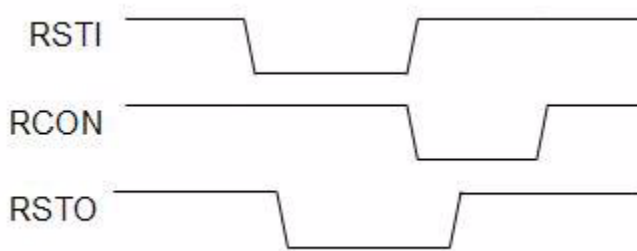


Figure 2. EzPORT hardware initialization

The following algorithm must be followed for an external EzPORT programmer on another device.

EzPORT initialization:

- EzPORT initialization obey [Figure 2](#).
- Execute the RDSR command and continue only if the FS flag is cleared, this means the internal flash is not secured.
- Execute WREN command
- Execute RDSR and see if WEN flag is set
- Execute WRCR command sending clock configuration
- Execute RDSR command and wait until the write in progress (WIP) flag is cleared.
- Execute RDSR command and check the configuration register loaded (CRL) flag is set. Verify CRL is the only flag set (no WEP), otherwise there is an error.

EzPORT chip erase:

- Execute a WREN command
- Execute RDSR and see if the WEN flag is set
- Execute a BE command
- Execute RDSR command and wait until the WIP flag is cleared. Verify CRL is the only flag set (no WEP), otherwise there is an error.

Page program:

- Execute a WREN command
- Execute RDSR and see if the WEN flag is set
- Execute a PP command
- Execute RDSR command and wait until the WIP flag is cleared. Verify CRL is the only flag set (no WEP), otherwise there is an error.

Read:

- Execute FAST_READ command instead of a READ command to speed up communication.

3.2 Example — Configuring EzPORT Clock

Equation 1 is the clock frequency and shows the formula applied to maintain EzPORT frequency within $150\text{KHz} \leq f_{CFM} \leq 200\text{KHz}$.

$$f_{CFM} = \frac{f_{CORE}}{(2 * DIV[5,0] * (1 + (7 * PRDIV8)))}$$

Eqn. 1

- CFMCLKD [DIV[5:0]]: Must be carefully selected.
- CFMCLKD[PRODIV8]: Is set in case the fCORE is greater than 12.8 MHz.

The F_{core} must be selected depending on:

- The external crystal used
- PLL SYNCR[MFD] default value after reset
- PLL SYNCR[RFD] default value after reset

The following f_{Core} must be considered for the following chips:

Table 2. f_{CORE} selection

MCU	Reference frequency (variable)	Predivider	PLL multiplier after reset	f_{CORE}
MCF521x	8 MHz	1	6	48 MHz
MCF5222x	48 MHz	8	6	48 MHz
MCF5223x	25 MHz	5	4	20 MHz

4 Configuration Notes

The following details are important when configuring the SPI to program the EzPORT module:

- Page program command — Data length must be a multiple of 4 because only 32-bit writes are allowed.
- Only the most significant 24 bits of an address are considered. It can be anywhere within a page. A maximum of 256 bytes can be programmed at a time because the page size is 256 bytes long. If the software starts within a page and writes a full 256 bytes, then the address wraps around to the lowest address in the same page after it reaches the end of a page.
- After a write or erase is performed, execute RDSR command and wait until the WIP flag is cleared before executing another write or erase command.
- Always set the EzPORT flash programming frequency to be between: $150\text{KHz} \leq \text{freq} \leq 200\text{KHz}$. The control register depends on ColdFire being programmed and the clock being used according to [Table 2](#).
- After a bulk erase command or an unprogrammed ColdFire, the internal flash memory bits are set. A write can only clear a bit or leave it as it is. The next write to the same bit is not able to set it, thus a bulk erase command is needed.
- Security information that allows the MCU to prevent intrusive access to the flash memory is stored in the flash configuration field. The flash configuration field is composed of 24 bytes of reserved memory space within the flash memory. The flash configuration field contains information that determines the CFM protection and access restriction scheme out of reset. This area is between addresses 0x00000400 to 0x00000417. Avoid writing random information in that area, because the internal flash might lock.
- If the internal flash memory is locked, the EzPORT interface is not able to write into the internal flash memory until a bulk erase command is requested.

5 Conclusion

The EzPORT module allows programming the internal flash memory on almost all ColdFire microcontrollers. Only seven pins are needed instead of 26 for the BDM, however software debug is not allowed for the EzPORT. The EzPORT fits as a final product feature on a customized ColdFire board with a small space to program internal flash memory and when debug is not needed.

Appendix A References

Find the newest software updates and configuration files for the MCF521x on the Freescale Semiconductor home page: www.freescale.com.

- This application note considers all Freescale ColdFire microcontrollers with the EzPORT module.
- The application note software is only suitable for the programmer board.
- For more information on EzPORT, QSPI, or UART interface refer to the *MCF5213 ColdFire Integrated Microcontroller Reference Manual. Rev 3.0* at www.freescale.com
- The EzPORTSoftwareDemo software was developed and tested with CodeWarrior for Coldfire v6.4 and v7.0.
- Download the source files for the EzPORTSoftwareDemo (EzPORTSoftwareDemo.zip) from www.freescale.com.

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