AN14427

MCXW71 In-System Programming Utility

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Document information

Information	Content
Keywords	AN14427, MCX W, MCXW71, FRDM-MCXW71, ISP, In-System Programming, SPSDK, blhost, BusPal
Abstract	The document provides steps to boot the MCXW71 MCU in ISP mode and establish various serial connections to communicate with the MCU.

1 Introduction

The MCXW71 microcontroller (MCU) contains a read-only memory (ROM) bootloader, which is a boot code resident in the ROM. The ROM bootloader begins its execution when the Arm Cortex-M33 core is released from reset. The bootloader can follow different paths. One of them is the In-System Programming (ISP) path. To make the bootloader follow the ISP path, a utility, called *ISP utility*, is used. The ISP utility operates over a serial connection on the MCU. To upload/download the application code using the bootloader, you can use host-side tools.

The document provides steps to boot the MCXW71 MCU in ISP mode and establish various serial connections to communicate with the MCU. For demonstrating the ISP functionality, the FRDM-MCXW71 board is used as the MCXW71 MCU platform. For simplicity, the MCXW71 MCU is referred to as the *target MCU* at some places in the document.

2 Entering ISP mode

To make the bootloader follow the ISP path (to boot the MCXW71 MCU in ISP mode), the BOOT_CONFIG (PTA4) pin of the MCU must be active. To activate the BOOT_CONFIG (PTA4) pin and to boot the MCU in ISP mode while using the FRDM-MCXW71 board, follow these steps:

1. Disconnect the FRDM-MCXW71 board from all power sources.
2. Keep the SW3 (ISP) button on the board pressed, while connecting the board to the host computer USB port.
3. Release the SW3 (ISP) button. The MCXW71 MCU boots in ISP mode.
4. Reconnect any external power supply, if needed.

3 Software and tools

For the current document:

- The blhost utility of the SPSDK software is used, when the I^2C or SPI interface is used as the communication interface
- The standalone blhost application is used, when the CAN interface is used as the communication interface

Table 1 shows the versions of the software/tools used for the current document.

Table 1. Software/tool versions

Software/tool	Version
SPSDK	2.2.1
blhost	2.6.7

3.1 BusPal

BusPal is an embedded software tool available as a companion to the blhost application. It acts as a bus translator between blhost and the target device. It connects to the blhost application over a UART connection, and connects to the target device over an I^2C, an SPI, or a CAN connection. It assists the blhost application in performing commands and responses from the target device.

The source code for BusPal is provided with the Kinetis bootloader release. The source code is only available for selected platforms, but it can be customized to run on other platforms.

For more details on the BusPal software tool and the MCU bootloader for NXP MCUs, refer to the following link:

https://www.nxp.com/design/software/development-software/mcuxpresso-software-and-tools-/mcu-bootloader-for-nxp-microcontrollers:MCUBOOT

4 Establishing communication

This section describes how to establish communication between the host computer and the target MCU (MCXW71) using the UART, I^{2}C, SPI, or CAN interface. A host-side command-line tool (for example, blhost) can be used to communicate with the target MCU directly over a UART connection. However, to enable I^{2}C, SPI, or CAN communication between the host computer and the target MCU, you must create a bridge (for example, BusPal) using an external device, along with a host-side command-line tool (for example, blhost). You can use one of the following NXP MCUs to create a BusPal bridge:

- KW45B41Z
- MKL25Z
- MKV46
- MK65F

Note: *The current document only includes examples with the KW45B41Z and MKL25Z MCUs used as BusPal bridge devices.*

4.1 Using UART interface

To communicate with the target MCU using the Universal Asynchronous Receiver/Transmitter (UART) interface, no external hardware or modifications are needed. To establish a UART connection between the host computer and the MCXW71 MCU (FRDM-MCXW71 board), boot the MCU in ISP mode as explained in Section 2. The target MCU starts receiving ISP commands using the host-side tool.

Figure 1 shows the response from the target MCU after running the ISP command using the UART interface.

```
(venv) C:\Users\ \Documents\SPSDK\git\spsdk\venv>blhost -p COM17 get-property 1
Response status = 0 (0x0) Success.
Response word 1 = 1258488064 (0x4b030100)
Current Version = K3.1.0
```

Figure 1. Running ISP command using UART interface

4.2 Using I^{2}C interface

To communicate with the MCXW71 MCU using the Inter-Integrated Circuit (I^{2}C) interface, you must create a BusPal bridge (using an external device) between the host computer and the target MCU. Devices, such as an NXP MCU MKL25Z or KW45B41Z, can be used as a BusPal bridge device for I^{2}C communication.

To establish an I^{2}C connection between the host computer and the MCXW71 MCU (FRDM-MCXW71 board) while using an MKL25Z MCU (FRDM-KL25Z board) or a KW45B41Z MCU (KW45B41Z-EVK or KW45B41Z-LOC board) as a bridge device, follow these steps:

1. Boot the target MCU in ISP mode as explained in Section 2.
2. Set up an I^{2}C connection between the FRDM-MCXW71 board and the FRDM-KL25Z / KW45B41Z-EVK / KW45B41Z-LOC board, as described in Table 2.

Table 2. I^{2}C connection setup

Signal	Target MCU		MKL25Z BusPal	KW45B41Z BusPal	
	MCU pin	FRDM-MCXW71 connector	FRDM-KL25Z connector	KW45B41Z-EVK connector	KW45B41Z-LOC connector
LPI2C1_SCL	PTB5	J2, pin 1	J1, pin 14	J2, pin 10	J2, pin 5

Table 2. I²C connection setup...*continued*

Signal	Target MCU		MKL25Z BusPal	KW45B41Z BusPal	
	MCU pin	FRDM-MCXW71 connector	FRDM-KL25 Z connector	KW45B41Z-EVK connector	KW45B41Z-LOC connector
LPI2C1_SDA	PTB4	J2, pin 2	J1, pin 16	J2, pin 9	J2, pin 6

After following the above steps, the target MCU starts receiving ISP commands using the host-side tool. Figure 2 shows the response from the target MCU after running the ISP command using the I²C interface.

```
(venv) C:\Users\[redacted]\Documents\SPSDK\git\spsdk\venv>blhost -b i2c -p COM21 get-property 1
Response status = 0 (0x0) Success.
Response word 1 = 1258488064 (0x4b030100)
Current Version = K3.1.0
```

Figure 2. Running ISP command using I²C interface

4.3 Using SPI interface

To communicate with the MCXW71 MCU using the Serial Peripheral Interface (SPI) interface, you must create a BusPal bridge (using an external device) between the host computer and the target MCU. Devices, such as NXP MKL25Z or KW45B41Z MCU, can be used as a BusPal bridge device for SPI communication.

To establish an SPI connection between the host computer and the MCXW71 MCU (FRDM-MCXW71 board) while using an MKL25Z MCU (FRDM-KL25Z board) or a KW45B41Z MCU (KW45B41Z-EVK or KW45B41Z-LOC board) as a bridge device, follow these steps:

1. Boot the target MCU in ISP mode as explained in Section 2.
2. Set up an SPI connection between the FRDM-MCXW71 board and the FRDM-KL25Z / KW45B41Z-EVK / KW45B41Z-LOC board, as described in Table 3.

Table 3. SPI connection setup

Signal	Target MCU		MKL25Z BusPal	KW45B41Z BusPal	
	MCU pin	FRDM-MCXW71 connector	FRDM-KL25 Z connector	KW45B41Z-EVK connector	KW45B41Z-LOC connector
LPSPI_SCK	PTB2	J2, pin 5	J2, pin 12	J2, pin 6	J1, pin 4
LPSPI_SIN	PTB1	J2, pin 6	J2, pin 8	J2, pin 5	J1, pin 5
LPSPI_SOUT	PTB3	J2, pin 7	J2, pin 10	J2, pin 4	J1, pin 6
LPSPI_PCS0	PTB0	J2, pin 8	J2, pin 6	J2, pin 3	J1, pin 3

After following the above steps, the target MCU starts receiving ISP commands using the host-side tool. Figure 3 shows the response from the target MCU after running the ISP command using the SPI interface.

```
(venv) C:\Users\[redacted]\Documents\SPSDK\git\spsdk\venv>blhost -b spi -p COM21 get-property 1
Response status = 0 (0x0) Success.
Response word 1 = 1258488064 (0x4b030100)
Current Version = K3.1.0
```

Figure 3. Running ISP command using SPI interface

4.4 Using CAN interface

To communicate with the MCXW71 MCU using the controller area network (CAN) interface, only a KW45B41Z MCU can be used as a BusPal bridge device. The BusPal bridge enables communication between the host computer and the target MCU (MCXW71).

To establish a CAN connection between the host computer and the MCXW71 MCU (FRDM-MCXW71 board) while using a KW45B41Z MCU (KW45B41Z-EVK or KW45B41Z-LOC board) as a bridge device, follow these steps:

1. Boot the target MCU in ISP mode as explained in Section 2.
2. Set up a CAN connection between the FRDM-MCXW71 board and the KW45B41Z-EVK / KW45B41Z-LOC board, as described in Table 4.
   Note: *While establishing a CAN connection between the host computer and the MCXW71 MCU, only a KW45B41Z device can be used as a BusPal bridge device.*

Table 4. CAN connection setup

Signal	Target MCU		KW45B41Z BusPal	
	MCU pin	FRDM-MCXW71 connector	KW45B41Z-EVK connector	KW45B41Z-LOC connector
CAN0_TX	PTC4	J21, pin 1	J10, pin 1	J10, pin 1
CAN0_RX	PTC5	J21, pin 2	J10, pin 2	J10, pin 2

3. To supply power to the CAN transceiver in the KW45B41Z-EVK / KW45B41Z-LOC board, connect an external 12 V supply through the board power connector J9.

After following the above steps, the target MCU starts receiving ISP commands using the host-side tool. Figure 4 shows the response from the target MCU after running the ISP command using the CAN interface.

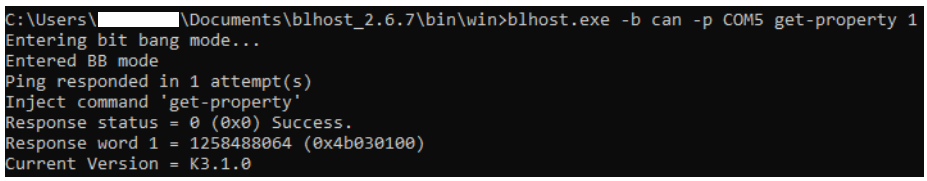

Figure 4. Running ISP command using CAN interface

5 References

The following are some additional documents that you can refer to for more information on the MCXW71 MCU:

- MCXW71x Reference Manual (MCXW71RM)
- MCXW71 Product Family Data Sheet (MCXW71)
- FRDM-MCXW71 Board User Manual (UM12063)
- MCXW71 Hardware Design Guide (UG10146)

Note: *Some of these documents may only be available under a non-disclosure agreement (NDA). To access such a document, contact a local NXP field applications engineer (FAE) or sales representative.*

6 Acronyms

Table 5 lists the acronyms used in this document.

Table 5. Acronyms

Acronym	Description
CAN	Controller area network
I^2C	Inter-Integrated Circuit
ISP	In-System Programming

Table 5. Acronyms...*continued*

Acronym	Description
MCU	Microcontroller unit
SPI	Serial Peripheral Interface
ROM	Read-only memory
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

7 Revision history

Table 6 summarizes the revisions to this document.

Table 6. Revision history

Document ID	Release date	Description
AN14427 v.1.0	10 September 2024	Initial public release

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