

AN14723

Establishing ISP Mode Communication with KW45B41Z Using KW45B41Z-LOC Board

Rev. 1.0 — 24 June 2025

Application note

Document information

Information	Content
Keywords	AN14723, KW45, KW45B41Z, KW45-LOC, ISP, UART, I2C, SPI, CAN, BusPal
Abstract	This application note describes the necessary steps to establish communication with a KW45B41Z microcontroller in ISP mode, referred to as target MCU, through each one of the supported interfaces, using KW45B41Z-LOC board.



1 Introduction

The KW45B41Z microcontroller contains a ROM bootloader, which is boot code resident in the read-only memory (ROM). The ROM bootloader begins its execution when the Cortex-M33 processor is released from reset, and can follow different paths. This document focuses on the in-system programming (ISP) path.

The ISP utility operates over a serial connection on the MCUs. Users can use host tools to upload/download application code via the bootloader.

This application note outlines the steps required to establish communication with the KW45B41Z microcontroller in ISP mode (referred to as the target MCU). The document demonstrates how to achieve the interface-based communication using the KW45B41Z-LOC board through each of the supported interfaces (UART, I2C, SPI, and CAN).

2 Entering ISP mode

For the ROM bootloader to follow the ISP path, BOOT_CONFIG pin (PTA4) must be active. To do so, perform the following steps:

1. Disconnect the board from all power sources.
2. Close JP16.
3. Keep the SW4 button pressed while connecting the board to the host USB port.
4. Reconnect any external power supply, if needed.
5. Release the SW4 button.

After following these steps, the KW45B41Z microcontroller enters the ISP mode.

3 Software and tools

In this document:

- The blhost utility of the SPSDK software is used when I2C or SPI protocols are selected as the communication interface.
- The standalone blhost application is used when a CAN interface is selected as the communication interface. SPSDK currently does not support CAN.

[Table 1](#) shows the versions of the tools used for the current document.

Table 1. Tool versions

Tool	Version
SPSDK	2.6.0
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 I2C, 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 [MCU Bootloader for NXP Microcontrollers](#).

4 Establishing communication

This section describes how to establish communication between the host computer and the target MCU using the UART, I2C, 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. To enable I2C, SPI, or CAN communication between the host computer and the target MCU, two components are required:

- A bridge, such as BusPal, created using an external device.
- A host-side command-line tool, such as blhost, to send commands from the host.

The user can use one of the following NXP MCUs to create a BusPal bridge:

- MKL25Z
- MKV46
- MK65F
- MCXW71
- MCXA156

To learn more about BusPal devices and how to program the BusPal firmware, refer to [BusPal Application for FRDM MCX Families](#).

Note: The current document only includes examples with MKL25Z, MCXW71, and MCXA156 MCUs used as BusPal bridge devices.

To make the MCU ready to receive ISP commands using the host-side tool, follow the steps described in [Section 2](#) and the following subsections.

4.1 Universal asynchronous receiver/transmitter (UART)

To communicate with the target MCU via UART, no external hardware or modifications are needed. Verify that the JP13 and JP14 jumpers are placed in their default 1-2 position.

[Figure 1](#) shows the response by the target MCU after receiving ISP command via UART interface.

```
(venv) C:\Users\nxf87131\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. Response from target MCU after ISP command via UART

4.2 Inter-integrated circuit (I2C)

To communicate with the target MCU using the I2C, JP24 should be placed in the 2-3 position, as shown in [Figure 2](#).

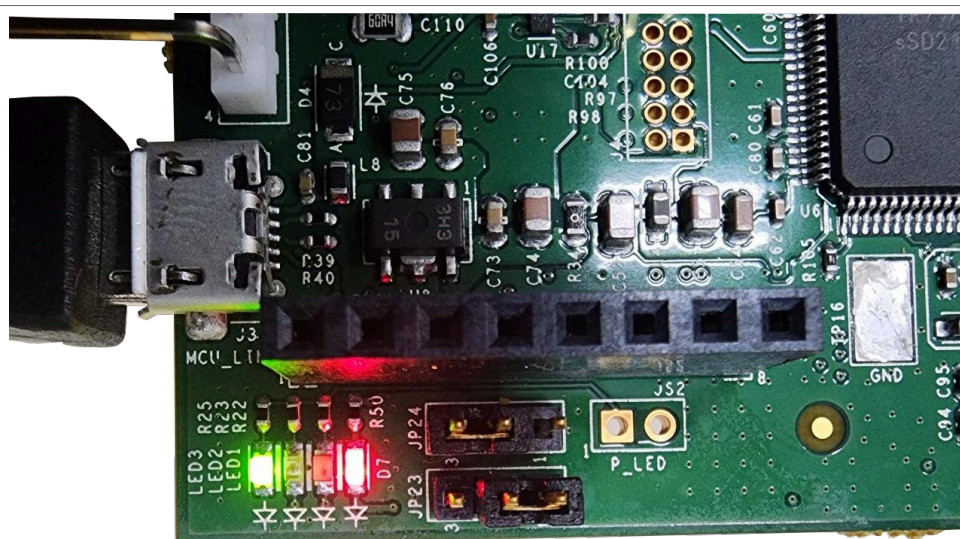


Figure 2. KW45B41Z-LOC board with JP24 in 2-3 position

For I2C interface, an external device is needed to act as a bridge between the host and the target MCU. The user should use the pins described in [Table 2](#), depending on the BusPal bridge device selected.

Table 2. I2C connection setup

Signal	Target MCU		MKL25Z BusPal	MCXW71 BusPal	MCXA156 BusPal
	MCU pin	KW45-LOC connector	FRDM-KL25Z connector	FRDM-MCXW71 connector	FRDM-MCXA156 connector
LPI2C_SCL	PTB5	J2, pin 5	J1, pin 14	J2, pin 1	J5, pin 5
LPI2C_SDA	PTB4	J2, pin 6	J1, pin 16	J2, pin 2	J5, pin 6

Figure 3 shows the response by the target MCU after receiving ISP command via I2C interface.

```
C:\npx>blhost -b i2c -p COM132 get-property 1
Response status = 0 (0x0) Success.
Response word 1 = 1258488064 (0x4b030100)
Current Version = K3.1.0
```

Figure 3. Response from target MCU after ISP command via I2C

4.3 Serial peripheral interface (SPI)

To communicate via SPI with the target MCU, no modifications in the KW45B41Z-LOC board are needed. However, an external device is needed to act as a bridge between the host and the target MCU. Use the pins described in [Table 3](#), depending on the BusPal bridge device selected.

Table 3. Connection setup for SPI communication.

Signal	Target MCU		MKL25Z BusPal	MCXW71 BusPal	MCXA156 BusPal
	MCU pin	KW45-LOC connector	FRDM-KL25Z connector	FRDM-MCXW71 connector	FRDM-MCXA156 connector
LPSP1_PCS0	PTB0	J1, pin 3	J2, pin 6	J2, pin 8	J6, pin 3

Establishing ISP Mode Communication with KW45B41Z Using KW45B41Z-LOC Board

Table 3. Connection setup for SPI communication....continued

Signal	Target MCU		MKL25Z BusPal	MCXW71 BusPal	MCXA156 BusPal
	MCU pin	KW45-LOC connector	FRDM-KL25Z connector	FRDM-MCXW71 connector	FRDM-MCXA156 connector
LPSPi_SIN	PTB1	J1, pin 5	J2, pin 8	J2, pin 7	J6, pin 6
LPSPi_SCK	PTB2	J1, pin 4	J2, pin 12	J2, pin 5	J6, pin 4
LPSPi_SOUT	PTB3	J1, pin 6	J2, pin 10	J2, pin 6	J6, pin 5

Figure 4 shows the response by the target MCU after receiving ISP command via SPI interface.

```
C:\nxp>blhost -b spi -p COM132 get-property 1
Response status = 0 (0x0) Success.
Response word 1 = 1258488064 (0x4b030100)
Current Version = K3.1.0
```

Figure 4. Response from target MCU after ISP command via SPI

4.4 Controller area network (CAN)

To communicate with the target MCU via CAN, no modifications are needed on the KW45B41Z-LOC board. However, an external 12 V power supply needs to be connected to J9, which provides power for the CAN transceiver.

For CAN interface, an external device is needed to act as a bridge between the host and the target MCU. Use the pins described in Table 4.

Table 4. Connection setup for CAN communication.

Signal	Target MCU		MCXW71 BusPal	MCXA156 BusPal
	MCU pin	KW45-LOC connector	FRDM-MCXW71 connector	FRDM-MCXA156 connector
CAN0_TX	PTC4	J10, pin 1	J21, pin 1	J22, pin 2
CAN0_RX	PTC5	J10, pin 2	J21, pin 2	J22, pin 4

Figure 5 shows the response by the target MCU after receiving ISP command via CAN interface.

```
C:\Users\nxf87131\Documents\blhost_2.6.7\bin\win>blhost.exe -b can -p COM5 get-property 1
Entering bit bang mode...
Entered BB mode
Ping responded in 1 attempt(s)
Inject command 'get-property'
Response status = 0 (0x0) Success.
Response word 1 = 1258488064 (0x4b030100)
Current Version = K3.1.0
```

Figure 5. Response from target MCU after ISP command via CAN

5 Revision history

[Table 5](#) summarizes the revisions to this document.

Table 5. Revision history

Document ID	Release date	Description
AN14723 v.1.0	24 June 2025	Initial public release

Legal information

Definitions

Draft — A draft status on a document indicates that the content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included in a draft version of a document and shall have no liability for the consequences of use of such information.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <https://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Suitability for use in non-automotive qualified products — Unless this document expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

HTML publications — An HTML version, if available, of this document is provided as a courtesy. Definitive information is contained in the applicable document in PDF format. If there is a discrepancy between the HTML document and the PDF document, the PDF document has priority.

Translations — A non-English (translated) version of a document, including the legal information in that document, is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Security — Customer understands that all NXP products may be subject to unidentified vulnerabilities or may support established security standards or specifications with known limitations. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately. Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP.

NXP has a Product Security Incident Response Team (PSIRT) (reachable at PSIRT@nxp.com) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

NXP B.V. — NXP B.V. is not an operating company and it does not distribute or sell products.

Trademarks

Notice: All referenced brands, product names, service names, and trademarks are the property of their respective owners.

NXP — wordmark and logo are trademarks of NXP B.V.

Establishing ISP Mode Communication with KW45B41Z Using KW45B41Z-LOC Board

AMBA, Arm, Arm7, Arm7TDMI, Arm9, Arm11, Artisan, big.LITTLE, Cordio, CoreLink, CoreSight, Cortex, DesignStart, DynamIQ, Jazelle, Keil, Mali, Mbed, Mbed Enabled, NEON, POP, RealView, SecurCore, Socrates, Thumb, TrustZone, ULINK, ULINK2, ULINK-ME, ULINK-PLUS, ULINKpro, μ Vision, Versatile — are trademarks and/or registered trademarks of Arm Limited (or its subsidiaries or affiliates) in the US and/or elsewhere. The related technology may be protected by any or all of patents, copyrights, designs and trade secrets. All rights reserved.

Kinetis — is a trademark of NXP B.V.

Contents

1	Introduction	2
2	Entering ISP mode	2
3	Software and tools	2
3.1	BusPal	2
4	Establishing communication	3
4.1	Universal asynchronous receiver/ transmitter (UART)	3
4.2	Inter-integrated circuit (I2C)	3
4.3	Serial peripheral interface (SPI)	4
4.4	Controller area network (CAN)	5
5	Revision history	6
	Legal information	7

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.
