KW45B41Z-LOCUM

KW45B41Z-LOC Board User Manual

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Document information

Information	Content
Keywords	KW45B41Z-LOCUM, KW45B41Z-LOC, KW45B41Z, Bluetooth LE 5.3, CAN FD
Abstract	The KW45B41Z-LOC board is a highly configurable, low-power, cost-effective evaluation and development platform for NXPKW45B41Z MCU.

1 KW45B41Z-LOC Overview

The KW45B41Z-LOC board is a highly configurable, low-power, cost-effective evaluation and development platform for NXP KW45B41Z MCU, which is a low-power, highly secure, single chip wireless MCU based on Arm Cortex-M33 core. It offers an easy-to-use user interface with a virtual serial port and standard programming and run-control capabilities. This board provides the most suitable development and evaluation platform for the Bluetooth LE Channel Sounding feature, as it supports Antenna Switching by default.

The KW45B41Z MCU supports multiprotocol use cases with Matter, Thread, Zigbee, Bluetooth LE, and CAN FD for IoT, industrial, and automotive applications.

The KW45B41Z-LOC board provides RF circuitry (including two chip antennas and two u.FL connectors for the conducted measurements), high-speed CAN transceiver, 16 Mbit QSPI NOR flash memory, and 32 MHz crystal. It is compatible with Mikroe click boards. The board is a standalone PCB that supports application development with GFSK libraries from NXP. It can be used with a wide range of development tools, including NXP MCUXpresso IDE and IAR Embedded Workbench. The board is lead-free and RoHS-compliant.

For debugging the KW45B41Z MCU, the KW45B41Z-LOC board uses an onboard debug probe, known as MCU-Link OB (OB stands for "onboard"). This MCU-Link OB is based on another MCU, LPC55S69. For simplicity, MCU-Link OB is referred to as "MCU-Link debug probe" or just "MCU-Link", and the KW45B41Z MCU is referred to as "target MCU" in this document.

This document provides details about the KW45B41Z-LOC board interfaces, power supplies, clocks, push buttons, jumpers, and LEDs. In addition, it provides the steps to program the KW45B41Z-LOC board.

Note: *For more information on the operating temperature range for the board, see Section 2.11.*

1.1 Radio Equipment Directive compliance information

The following information is provided per Article 10.8 of the Radio Equipment Directive 2014/53/EU:

- Frequency bands in which the equipment operates
- The maximum RF power transmitted

Part number	RF technology	Frequency ranges (EU)	Maximum transmitted power
KW45B41Z-LOC	Bluetooth LE	2360 MHz – 2483 MHz	+10 dBm

EUROPEAN DECLARATION OF CONFORMITY (Simplified DoC per Article 10.9 of the Radio Equipment Directive 2014/53/EU)

This apparatus, namely KW45B41Z-LOC Development Platform, conforms to the Radio Equipment Directive 2014/53/EU. The full EU Declaration of Conformity for this apparatus is available at European Union Declaration of Conformity for KW45B41Z-LOC Evaluation Kit.

1.2 Device features

The KW45B41Z MCU includes a 96 MHz Arm Cortex-M33 CPU, a radio controller based on Arm Cortex-M3, called NBU (Narrow Band Unit), a radio transceiver operating in the 2.4 GHz frequency band (supporting GFSK modulations for Bluetooth Low Energy (LE) 5.3), Bluetooth LE controller stack, transceiver drivers, up to 1 MB flash, up to 128 KB SRAM, and peripherals optimized to meet the requirements of target applications.

1.3 Board kit contents

The KW45B41Z-LOC board kit contains the following items:

- KW45B41Z-LOC board
- A USB cable
- A bag with five jumpers

1.4 Block diagram

Figure 1 shows the block diagram of KW45B41Z-LOC board.

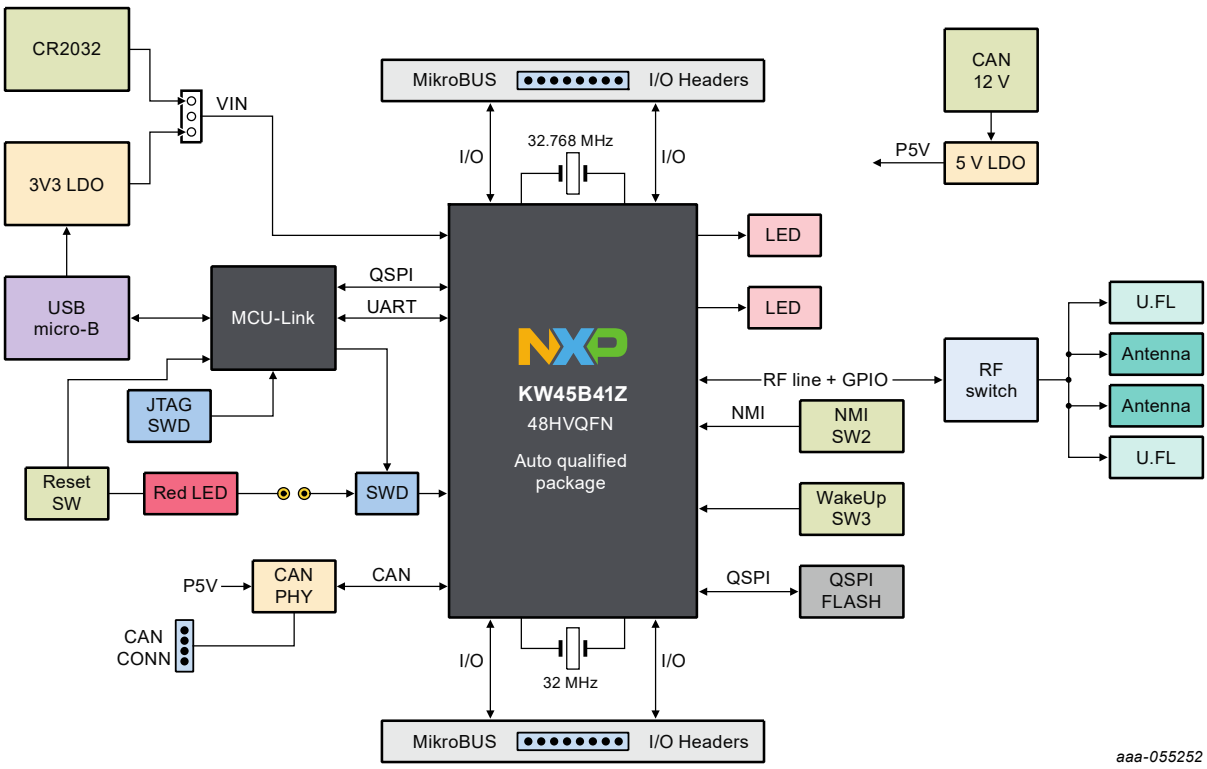

Figure 1. KW45B41Z-LOC block diagram

1.5 Board features

Table 1 describes the features of the KW45B41Z-LOC board.

Table 1. KW45B41Z-LOC features

Board feature	Target MCU feature used	Description
MCU (target MCU)		KW45B41Z MCU with Arm Cortex-M33 core running at a frequency of up to 96 MHz. ***Note:*** *For details on the KW45B41Z MCU features, see KW45 Product Family Data Sheet and KW45B41Z Reference Manual.*
CAN	FlexCAN module (CAN0)	A high-speed CAN transceiver for driving CAN signals between the target MCU and a 1x4 pin header
LPUART	Two LPUART modules (LPUART0 and LPUART1)	• LPUART0: Connects to one of the two mikroBUS socket connectors for an external UART connection • LPUART1: Supports a USB-to-UART bridge for connecting MCU-Link to the target MCU

Table 1. KW45B41Z-LOC features*...continued*

Board feature	Target MCU feature used	Description
LPSPI	One of the two LPSPI modules (LPSPI1) with PCS0 used for LPSPI connection	PCS0 connects to: • 16 Mbit SPI NOR flash memory, which supports over-the-air (OTA) programming • One of the two mikroBUS socket connectors
LPI2C	One of the two LPI2C modules (LPI2 C1)	LPI2C1 module connects to one of the two mikroBUS socket connectors
RF	2.4 GHz radio	Two U.FL connectors and two antennas for RF operation
mikroBUS		mikroBUS socket with two 1x8 position receptacles
MCU-Link USB		USB 2.0 micro-B connector for creating MCU-Link high-speed USB connection to the host computer, and providing 5 V power to the board
Power supply		• The board can be powered up through: – Coin cell battery (CR2032/CR2450) – 5 V USB micro-B connector – 12 V DC power jack – CAN header • The following power configuration modes are supported: – DC-DC Converter with Buck mode – DC-DC Converter with Bypass mode
Clock		The target MCU receives the following two clocks: • A 32 MHz clock from a crystal for Arm core and radio. Alternatively, the 32 MHz clock can be provided from a TCXO (not populated on the board). • A 32.768 kHz clock from another crystal as RTC and low-power RF clock
Debug		• Onboard MCU-Link debug probe with CMSIS-DAP and SEGGER J-Link protocol options. It can connect to the target MCU through a USB-to-UART bridge. • 10-pin Arm JTAG/SWD connector for connecting an external debug probe

1.6 Board pictures

This section shows the connectors, push buttons, LEDs, battery holders, and jumpers on the top-side and the bottom-side of the KW45B41Z-LOC board.

1.6.1 Top-side view of KW45B41Z-LOC board

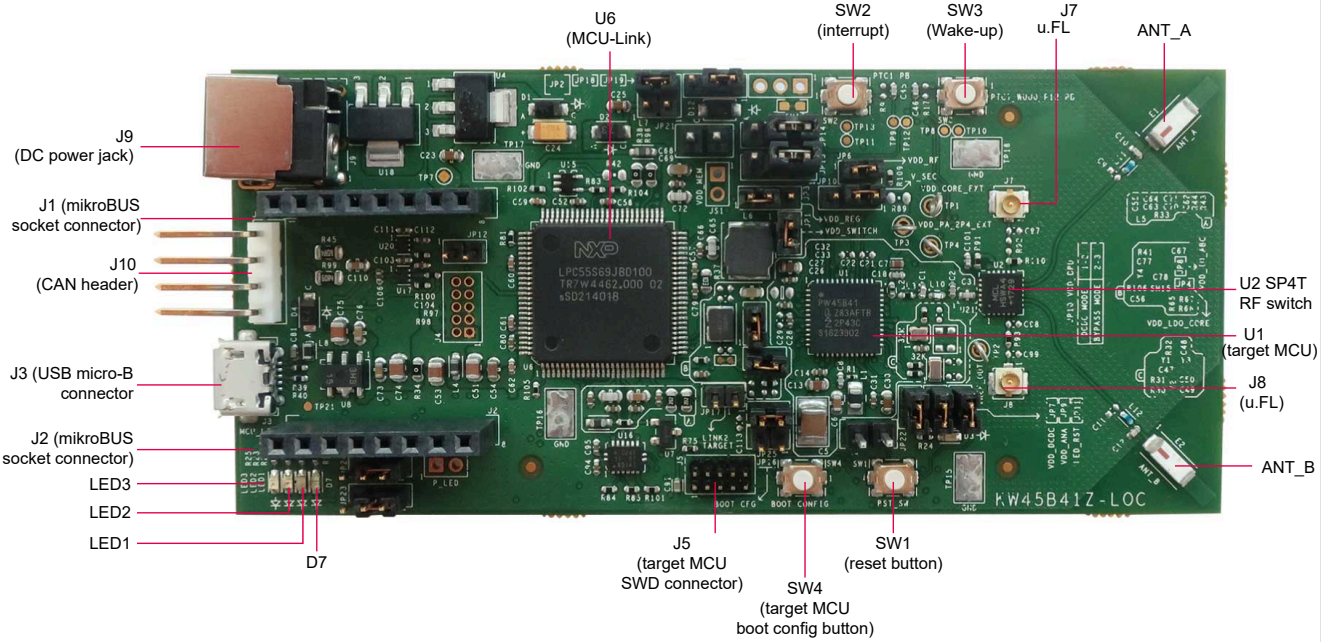

Figure 2. KW45B41Z-LOC connectors, push buttons, and LEDs (top-side view)

Figure 2 shows the top-side view of the KW45B41Z-LOC board with connectors, push buttons, and LEDs highlighted.

1.6.2 Top-side view of KW45B41Z-LOC board with jumpers

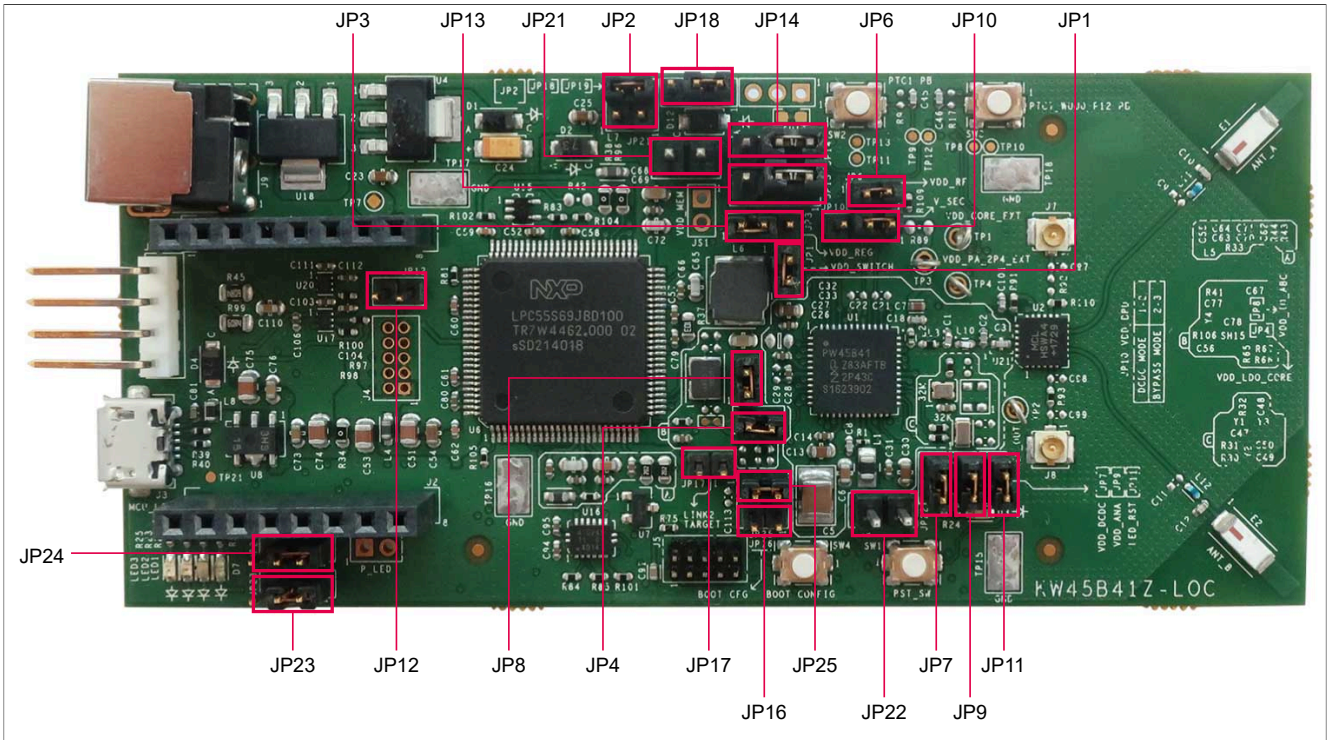

Figure 3. KW45B41Z-LOC jumpers

Figure 3 shows the top-side view of the KW45B41Z-LOC board with jumpers highlighted.

1.6.3 Bottom-side view of KW45B41Z-LOC board

Figure 4 shows the bottom-side view of the KW45B41Z-LOC board with battery holder (BT2) highlighted.

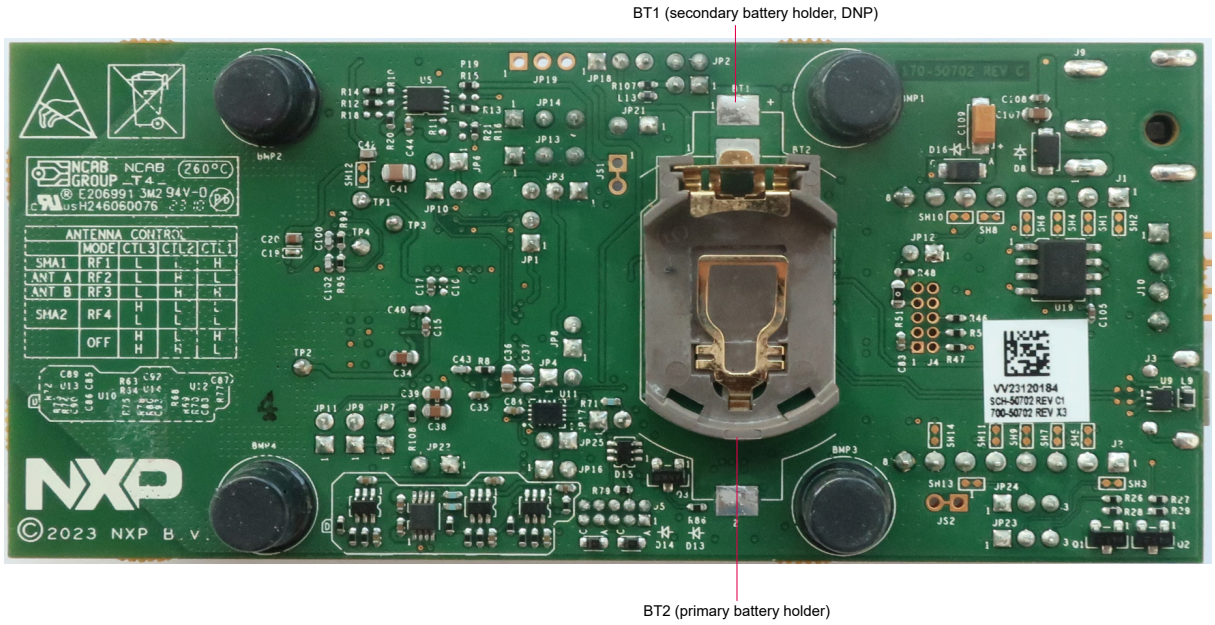

Figure 4. KW45B41Z-LOC bottom-side view

1.7 Connectors

Table 2 describes the connectors used in the KW45B41Z-LOC board.

Table 2. KW45B41Z-LOC connectors

Part identifiers	Connector type	Description	Reference section
BT1 (DNP) (secondary option)	Coin cell battery holders ***Note:*** • *BT1 and BT2 have overlapping footprints (BT2 is used by default).* • *CAN transceiver does not work when using coin cell battery.*	Holder for 3 V CR2450N lithium coin cell battery	Section 2.1
BT2 (primary option)		Holder for 3 V CR2032 lithium coin cell battery	
J9	DC power jack	Connector for 12 V power adapter	
J10	1x4 pin header	CAN expansion header and 12 V power source	
J7, J8	U.FL connectors	U.FL connectors	Section 2.7
ANT_A, ANT_B	Antennas	2400 MHz RF chip antennas	
J1, J2	1x8 position receptacles	mikroBUS socket connectors	Section 2.8
J3	USB 2.0 micro-B receptacle	MCU-Link USB connector	Section 2.10

Table 2. KW45B41Z-LOC connectors*...continued*

Part identifiers	Connector type	Description	Reference section
J5	2x5 pin header	Arm JTAG (SWD) connector to connect an external debug probe or external debug target	Section 3.2
J4 (DNP)	2x5 pin header	MCU-Link SWD connector	For more information on this connector, see KW45B41 Z-LOC board schematics.

1.8 Jumpers

Table 3 describes the jumpers used in the KW45B41Z-LOC board.

Table 3. KW45B41Z-LOC jumpers

Part identifier	Jumper type	Description	Reference section
JP11	1x2 pin header	LED reset button enable jumper: • Open: LED reset (D3) is disabled • Shorted (default setting): LED reset (D3) is enabled	Section 1.9
JP16	1x2 pin header	Target MCU boot configuration button (SW4) enable jumper: • Open (default setting): SW4 is disabled • Shorted: SW4 is enabled	
JP1	1x2 pin header	VDD_SWITCH power enable jumper: • Open: VDD_SWITCH power is OFF • Shorted (default setting): VDD_SWITCH power is supplied to the target MCU	Section 2.1
JP2	2x2 pin header	P_VDD_SWITCH supply power source selection jumper: • 2-4 shorted (default settings): P_VDD_SWITCH supply is produced from V_BRD supply • 1-3 shorted: P_VDD_SWITCH supply is produced from VBAT supply ***Note:*** *In the KW45B41Z-LOC board, P_VDD_SWITCH supply produces through jumper JP1 the target MCU supply VDD_SWITCH, which powers rest of the target MCU supplies.* *By populating the jumper JP2, you can operate KW45 board with the coincell power supply in the following two methods:* • *2-4 shorted and 1-3 shorted: In this configuration, the coincell supplies power to all the target board components. This makes functional some components on the board like the NOR SPI external flash.* ***Note:*** *This method is not recommended for power profiling with coincell.* • *1-3 shorted: In this configuration, the coincell supplies power to the KW45 chip only. While, the rest of the board is powered off.* *This method is preferred for power profiling with coincell. This configuration requires removal of the jumper JP25 from the board. When the board operates from coincell and JP2 is configured in 1-3 shorted mode (supplying KW45 chip only), the RF switch on*	

Table 3. KW45B41Z-LOC jumpers*...continued*

Part identifier	Jumper type	Description	Reference section
		the board is not functional since it is supplied from the V_BRD voltage node. Therefore RF section is disabled in this mode.	
JP3	1x3 pin header	VDD_REG supply power source selection jumper: • 1-2 shorted (default settings): VDD_REG supply is produced from P_VDD_SWITCH supply • 2-3 shorted: VDD_REG supply is produced from VOUT_SWITCH power of the target MCU	
JP10	1x3 pin header	V_SEC supply power source selection jumper. V_SEC jumper selects between KW45 DCDC or bypass power schemes. The jumper settings are: • 1-2 shorted (default settings): V_SEC supply is produced from 1 V8_DCDC supply • 2-3 shorted: V_SEC supply is produced from VDD_REG supply	
JP4	1x2 pin header	VDD_LDO_CORE supply enable jumper: • Open: VDD_LDO_CORE supply is OFF • Shorted (default setting): VDD_LDO_CORE supply is ON	
JP6	1x2 pin header	VDD_RF supply enable jumper: • Open: VDD_RF supply is OFF • Shorted (default setting): VDD_RF supply is ON	
JP7	1x2 pin header	VDD_DCDC supply enable jumper: • Open: VDD_DCDC supply is OFF • Shorted (default setting): VDD_DCDC supply is ON	
JP8	1x2 pin header	VDD_IO_ABC power enable jumper: • Open: VDD_IO_ABC power is OFF • Shorted (default setting): VDD_IO_ABC power is supplied to the target MCU	
JP9	1x2 pin header	VDD_ANA power enable jumper: • Open: VDD_ANA power is OFF • Shorted (default setting): VDD_ANA power is supplied to the target MCU	
JP25	1x2 pin header	Target MCU reset enable jumper: • Open: Target MCU reset is disabled • Shorted (default setting): Target MCU reset is enabled. ***Note:*** *In the KW45B41Z-LOC board, P_VDD_SWITCH supply produces through jumper JP1 the target MCU supply VDD_SWITCH, which powers rest of the target MCU supplies.* *Depending on the coincell operation mode, the JP25 is populated.* *The following are the two methods to configure JP25 in coincell operation mode:* • *JP25 is populated if the JP2 pins 2-4 and 1-3 are populated. The coincell supplies power to all the target board components in this configuration. This makes some component functional on the board , such as the NOR SPI flash.* • *JP25 is not populated if the JP2 pins 1-3 are shorted. The coincell supplies power to the KW45 chip only. While, the rest of the board is powered off in this configuration.*	

Table 3. KW45B41Z-LOC jumpers*...continued*

Part identifier	Jumper type	Description	Reference section
		The jumper needs to be populated when programming or debugging the board.	
JS1 (DNP)	1x2 pin header	VDD_MEM supply enable shunt. When populated, this shunt enables VDD_MEM supply for SPI NOR flash memory. ***Note:*** *You need to cut PCB trace on the bottom side of the board to enable/disable option.*	
JS2 (DNP)	1x2 pin header	P_LED supply enable jumper. JS2 is a PCB shunt, it is not a physical component on the board. If populated, it can be used to enable P_LED supply for LED1, LED2, and LED3. ***Note:*** *You need to cut the PCB trace on the bottom side of the board either to enable or disable the jumper.*	
JP13	1x3 pin header	Target MCU LPUART controller selection for MCU-Link: • 1-2 shorted (default setting): LPUART1 controller connects to MCU-Link • 2-3 shorted: LPUART0 controller connects to MCU-Link	Section 2.4
JP14	1x3 pin header		
JP21	1x2 pin header	USB-to-UART bridge disable jumper: • Open (default setting): MCU-Link is connected to the target MCU through a USB-to-UART bridge • Shorted: The USB-to-UART bridge between MCU-Link and the target MCU is disabled	
JP12	1x2 pin header	MCU-Link (LPC55S69) boot configuration jumper: • Open (default setting): MCU-Link follows normal boot sequence (MCU-Link boots from internal flash if a boot image is found). With the internal flash erased, MCU-Link normal boot sequence falls through to ISP boot mode. • Shorted: MCU-Link is forced to ISP mode (USB1). Use this setting to reprogram MCU-Link internal flash with a new image or use the MCUXpresso IDE with CMSIS-DAP protocol. ***Note:*** *By default, MCU-Link flash is preprogrammed with a version of CMSIS-DAP firmware.*	Section 3.3
JP17	1x2 pin header	Debug probe target selection jumper: • Open (default setting): The onboard target MCU is selected as the debug probe target and it can be debugged using the MCU-Link debug probe or an external debug probe. • Shorted: The MCU-Link debug probe can be used to debug an external target MCU.	Section 3.2
JP18	1x3 pin header	Target power selection jumper: • 1-2 shorted (default setting): Onboard target MCU or an external target MCU is used as the debug probe target and it uses board power to operate. • 2-3 shorted: An external target MCU is used as the debug probe target and it operates using its own power	
JP22	1x2 pin header	MCU-Link serial wire debug (SWD) disable jumper: • Open (default setting): MCU-Link SWD feature is enabled. MCU-Link drives SWD of target MCU or external target MCU. • Shorted: MCU-Link SWD feature is disabled. This setting of JP22 can be used when connecting an external debug probe for debugging the target MCU.	

Table 3. KW45B41Z-LOC jumpers*...continued*

Part identifier	Jumper type	Description	Reference section
JP23	1x3 pin header	Target MCU pin selection jumper for mikroBUS socket connector J2 pin 1: • 1-2 shorted (default setting): J2 pin 1 (PWM output pin) connects to the target MCU pin PTD2. • 2-3 shorted: J2 pin 1 connects to the target MCU pin PTC0.	For more information on JP23 and JP24, see KW45B41Z-LOC board schematics.
JP24	1x3 pin header	Target MCU pin selection jumper for mikroBUS socket connector J2 pin 6: • 1-2 shorted (default setting): J2 pin 6 (I2C data pin) connects to the target MCU pin PTD3. • 2-3 shorted: J2 pin 6 connects to the target MCU pin PTB4.	

1.9 Push buttons

Table 4 describes the push buttons used in the KW45B41Z-LOC board.

Table 4. KW45B41Z-LOC push buttons

Part identifier	Name	Description
SW1	Reset button	Pressing SW1 resets the target MCU (KW45B41Z) which causes board peripherals to reset to their default states and executes the boot code. When SW1 is pressed, the LED D3 turns ON. If the target MCU is in Deep power down or power down mode, the MCU comes out of this mode. Jumper JP11 can be used to enable or disable LED D3.
SW2	Interrupt push buttons	Both of these switches support Wake-up unit (WUU) pins to wake up from low power.
SW3		
SW4	Target MCU boot configuration button	Helps the target MCU boot code to determine if the MCU should enter into In-System Programming (ISP) mode. The main purpose of this button is to force the target MCU into ISP mode at boot time; to do this, hold down this button while pressing and releasing the reset button, or while connecting power to the board. If an application in the target MCU internal flash is crashing or disabling the SWD port unintentionally, then ISP mode can be useful to recover control of the board. For more information on ISP mode, see *KW45B41Z Reference Manual*. By default, SW4 is disabled. It can be enabled by shorting jumper JP16.

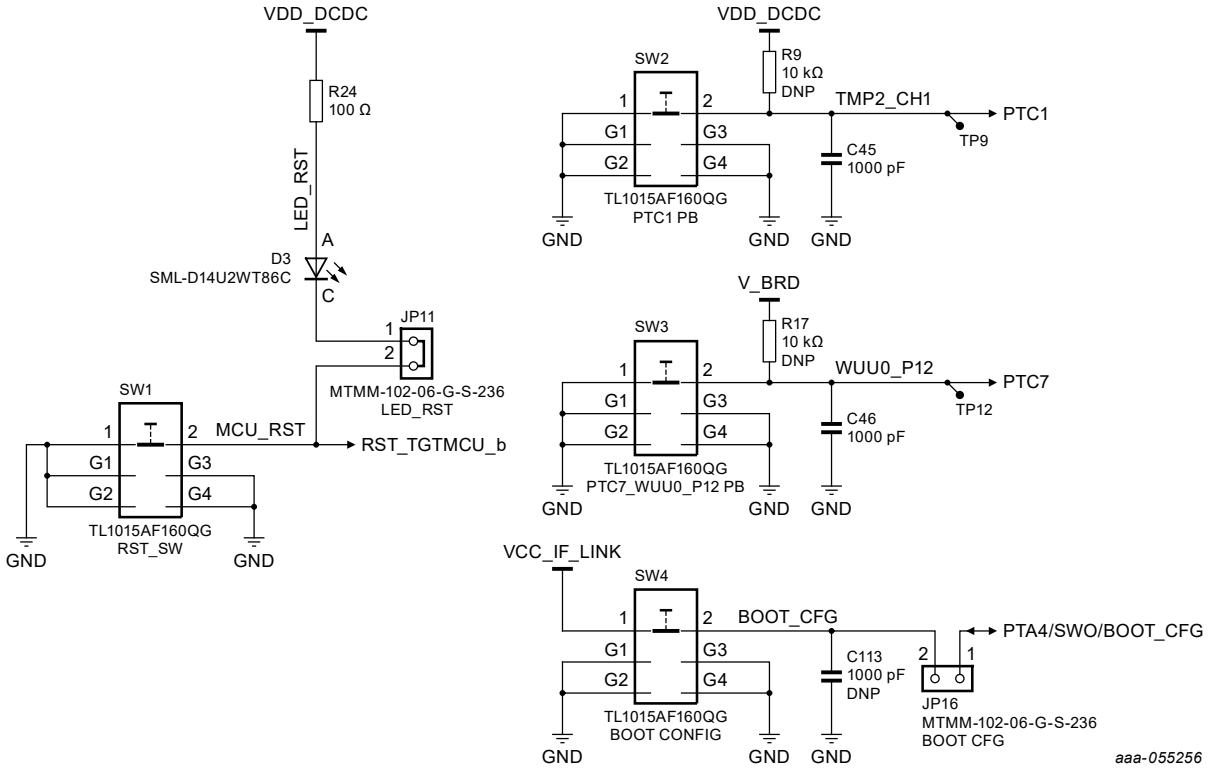

Figure 5. Push button circuit diagrams

Figure 5 shows the circuit diagrams of the push buttons used in the KW45B41Z-LOC board.

1.10 LEDs

Table 5 describes the light-emitting diodes (LEDs) that correspond to the target MCU in the KW45B41Z-LOC board. The board also has one more LED that is specific to MCU-Link. This LED is described in Section 3.8.

Table 5. KW45B41Z-LOC LEDs

Part identifier	Color	LED name/function	Description
LED1	Red	User LED	Controlled through a user application
LED2	Yellow	User LED	Controlled through a user application
LED3	Green	Power-on indicator LED	Indicates system power-on status. When the board is powered up, LED3 turns ON.
D3	Red	Reset button LED	Indicates system reset activity. When board reset is initiated, for example, by pressing the reset button, D3 turns ON.

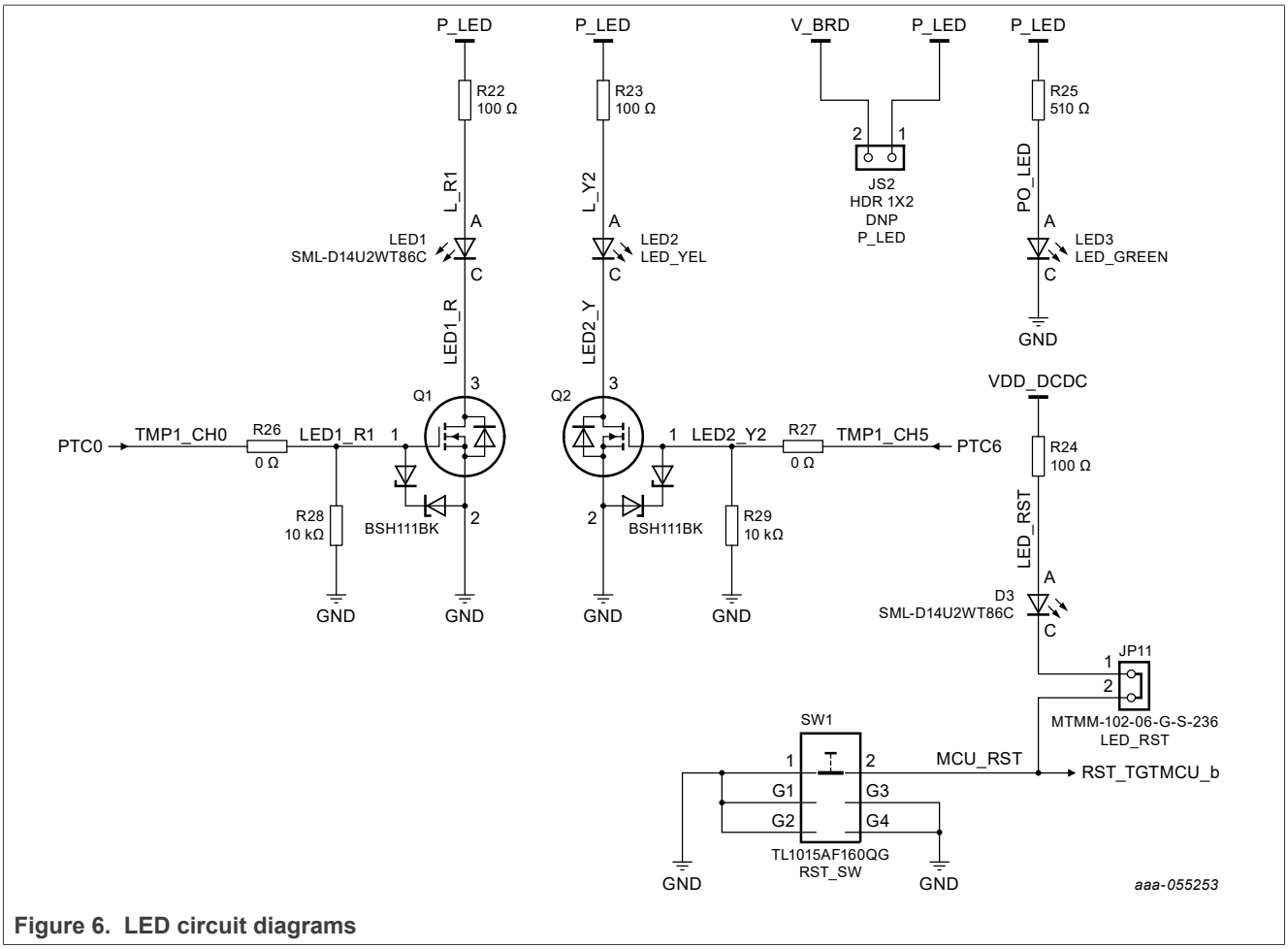

Figure 6. LED circuit diagrams

Figure 6 shows the circuit diagrams of the LEDs described in the Table 5.

2 KW45B41Z-LOC Functional Description

This chapter describes the features and functions of the KW45B41Z-LOC board. You can use the functionality described in this chapter as a reference while designing your own target board.

Note: *For details of the KW45B41Z MCU features, see KW45B41Z Reference Manual.*

The chapter is divided into the following sections:

2.1 Power supplies

The KW45B41Z-LOC board can be powered up using the following means:

- From an external battery (coin cell CR2032/CR2450). Two coin cell battery options are provided for more battery lifetime.
- Through the USB micro-B connector (J3), which produces 5 V power (FL_USB_5V0 supply). This supply powers the MCU-Link 3.3 V regulator U8.
- From external 12 V DC supply through connector J9. This option is used to power up CAN functionality in the board. Alternatively, 12 V external power can be supplied through pin 3 of CAN header J10.

The above primary power supplies are used to produce secondary power supplies for the board to power up other board components, including the target MCU, MCU-Link, SPI NOR flash memory, CAN transceiver, mikroBUS socket, push buttons, and LEDs.

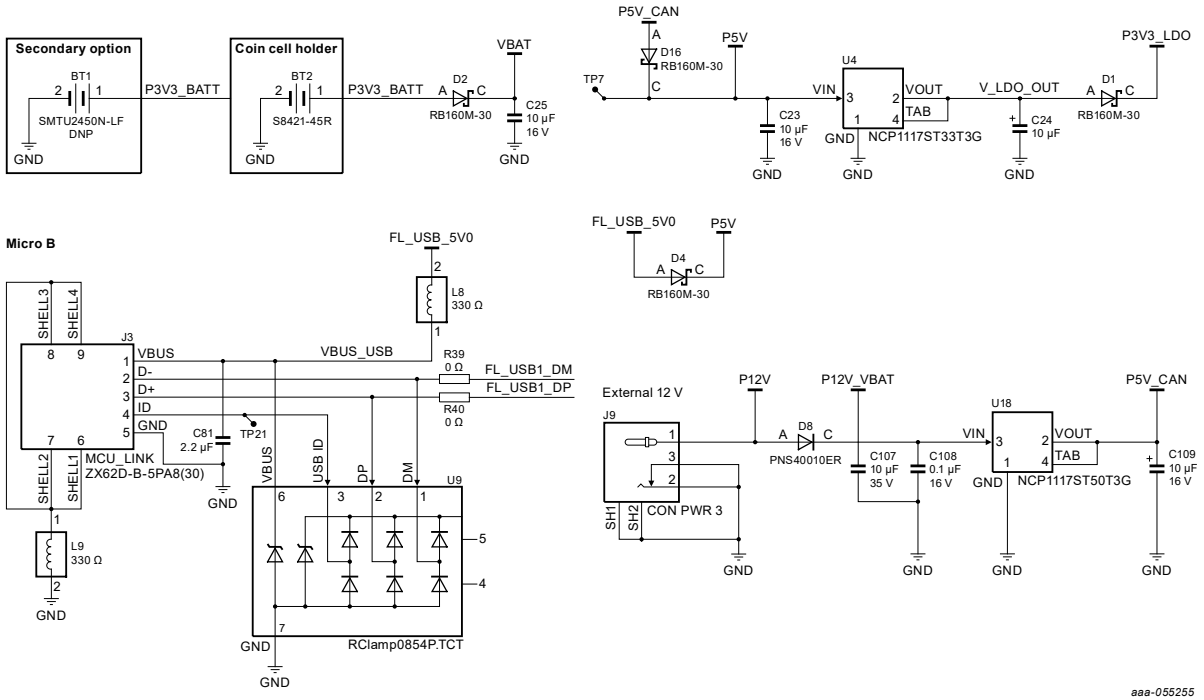

Figure 7. Power supply circuit diagrams

Figure 7 shows the circuit diagrams of major power supplies in the KW45B41Z-LOC board.

Table 6 describes the power supplies shown in Figure 7.

Table 6. KW45B41Z-LOC power supplies

Power source	Manufacturing part number	Power supply rail	Description
Coin cell battery holder BT2 (primary option)	S8421-45R	VBAT (3.3 V) ***Note:*** • *BT1 and BT2 have overlapping footprints (BT2 is used by default).* • *CAN transceiver does not work when using coin cell battery.*	One of the two supplies used to produce P_VDD_SWITCH supply
Coin cell battery holder BT1 (DNP) (secondary option)	SMTU2450N-LF		
MCU-Link USB connector J3	ZX62D-B-5PA8(30) (Hirose Electric)	FL_USB_5V0 (5 V)	• One of the two supplies used to produce P5V supply • Supplies USB1_VBUS power to MCU-Link (LPC55S69) • Supplies power to MCU-Link 3.3 V regulator U8
Alternative 12 V supply from power connector J9 or CAN header J10		P12V (12 V)	Supplies power to LDO voltage regulator U18
LDO voltage regulator U18	NCP1117ST50T3G (onsemi)	P5V_CAN (5 V)	• Another power supply used to produce P5V supply • Supplies power to CAN transceiver U19 (TJA1057GT/3)

Table 6. KW45B41Z-LOC power supplies*...continued*

Power source	Manufacturing part number	Power supply rail	Description
			• Supplies power to voltage translators U17 and U20
From FL_USB_5V0 or P5V_CAN supply		P5V (5 V)	• Supplies power to LDO voltage regulator U4 • Supplies power to mikroBUS socket connector J2
LDO voltage regulator U4	NCP1117ST33T3G (onsemi)	P3V3_LDO (3.3 V)	Produces V_BRD supply
From P3V3_LDO supply		V_BRD (3.3 V)	• Produces VCC_TGMCU supply • Another supply used to produce P_VDD_SWITCH supply • Supplies power to mikroBUS socket connector J1 • Supplies power to RF switch U2 • Supplies power to voltage translators U17 and U20 • Can be used to supply power to interrupt button SW3 • Can be used to produce VDD_MEM supply for SPI NOR flash memory through jumper JS1 (not populated) • Can be used to produce P_LED supply for the target MCU LEDs through jumper JS2 (not populated)
From VBAT or V_BRD supply through jumper JP2 ***Note:*** *When using VBAT supply at jumper JP2 to produce P_VDD_SWITCH supply, it is recommended to open jumper JP25 to avoid any damage to the target MCU chip, due to peak current limitations of the battery.*		P_VDD_SWITCH (3.3 V)	• Produces VDD_SWITCH power for the target MCU (KW45B41Z) through jumper JP1 • One of the two supplies used to produce VDD_REG supply
From P_VDD_SWITCH supply or VOUT_SWITCH power of the target MCU through jumper JP3		VDD_REG	• One of the two supplies used to produce V_SEC supply • Produces VDD_DCDC supply • Produces VDD_IO_ABC supply • Produces VDD_ANA power for the target MCU through jumper JP9
From VDD_REG or 1V8_DCDC supply through jumper JP10 (1V8_DCDC supply is produced in DC-DC inductor circuit)		V_SEC	• Produces VDD_LDO_CORE power for the target MCU through jumper JP4 • Produces VDD_RF power for the target MCU through jumper JP6
From VDD_REG supply through jumper JP7		VDD_DCDC	• Supplies VDD_DCDC power to the target MCU

Table 6. KW45B41Z-LOC power supplies*...continued*

Power source	Manufacturing part number	Power supply rail	Description
			• Supplies power to reset button SW1 and reset button LED D3 • Can be used to supply power to interrupt button SW2 • Supplies power to TCXO (not populated)
From VDD_REG supply through jumper JP8		VDD_IO_ABC	Supplies VDD_IO_ABC power to the target MCU
From V_BRD supply		VCC_TGMCU	• Produces VCC_IF_LINK supply • Supplies power to four-pole double-throw (4PDT) switch U11 • Supplies power to voltage translator U16
From VCC_TGMCU through shunt SH15		VCC_IF_LINK	• Supplies power to the target MCU JTAG / serial wire debug (SWD) connector J5 • Supplies power to boot configuration button SW4 • Supplies power to voltage translators U10, U12, U13, and U14 and buffer U15 • Supplies power to MCU-Link (LPC55S69)
MCU-Link regulator U8	XC6227C331 PR-G (Torex Semiconductor)	MLINK_3V3 (3.3 V)	• Supplies power to MCU-Link • Supplies power to MCU-Link LED D7 • Supplies power to MCU-Link SWD connector J4 (not populated) • Supplies power to voltage translators U10, U12, U13, U14, and U16

2.1.1 Power modes

Table 7 shows the power modes supported by the KW45B41Z-LOC board and how to select the power mode for the board.

Table 7. KW45B41Z-LOC power modes

Power mode	Description	Power mode selection
DC-DC Converter with Buck mode (default mode)	In this mode, the DC-DC converter of the target MCU is enabled.	Configure jumper JP10 as 1-2 shorted.
DC-DC Converter with Bypass mode	In this mode, the target MCU DC-DC converter is disabled.	Configure jumper JP10 as 2-3 shorted.

2.1.2 Current measurement

To measure the current when the board is supplied from the USB cable, connect an ammeter in between the jumper JP2 pins 2-4.

Note: *This jumper JP2 is used to measure the total power consumption of the chip.*

Table 8 shows the KW45B41Z-LOC board power supplies that support current measurement along with the jumpers that control these power supplies.

All the jumpers, except the jumper JP2 are 2-pin jumpers and an ammeter is connected to both 1 and 2 pins of the jumpers given in the Table 8 for the current measurement.

Table 8. Power supplies

Power supply	Jumper
VDD_LDO_CORE + VDD_RF + VDD_DCDC + VDD_IO_ABC	JP2 When the board is supplied with coincell battery, connect the ammeter between the jumper JP2 pins 1-3, and open the jumper JP25. ***Note:*** *The coincell current measurement is only supported when the coincell battery supplies power to the KW45 chip and the rest of the board is powered off.*
VDD_LDO_CORE	JP4
VDD_RF	JP6
VDD_DCDC	JP7
VDD_IO_ABC	JP8

2.1.3 DC-DC inductor options

The KW45B41Z-LOC board uses a 1 µH DC-DC inductor L1 (TDK MLZ2012A1R0WTD25). The inductor is enabled when the board is configured in DC-DC Buck mode.

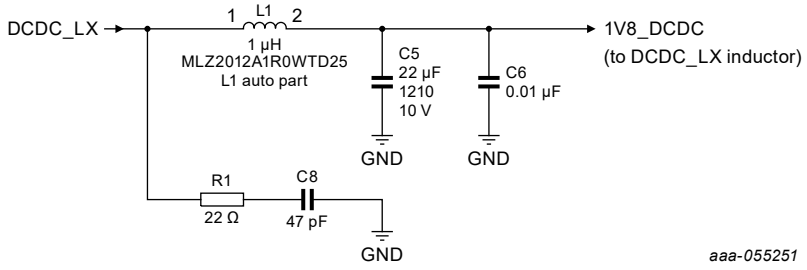

Figure 8. DC-DC inductor circuit diagram

Figure 8 shows the DC-DC inductor circuit diagram of the KW45B41Z-LOC board.

Choosing right DC-DC inductor for your target board is very important. While selecting a DC-DC inductor, look for the following specifications:

- Inductor value: 1 µH or 1.5 µH
- ESR: < 0.3 Ω
- Saturation current (Isat): > 300 mA
- Self-resonant frequency: > 50 MHz

The DC-DC inductor used in the KW45B41Z-LOC board is a good choice for general automotive applications (for example, car access) as it delivers good performance (low ESR, high saturation current). It is also a good choice for keyfob application based on LF technology. It prevents spurious from 100 kHz to 200 kHz that can interact with another reception device (that is, NXP LF device at 125 kHz) on the same board. Other recommended inductors are LQM18PH1R0MFRL from Murata and 78438336010 from Wurth.

Figure 9 shows other possible inductor options.

Inductor type	Value	Manufacturer	Part number	Automotive qualified AEC-Q200	ESR (Ω)	Isat (mA)	Maximum DC current (mA)	Temperature range (°C)	Size (LxWxH) mm
SMD shielded Multilayer ferrite	1 µH	TDK	MLZ2012A1R0WTD25	Yes	0.13	280	900	-55 to +125	2.2x1.45x1.05
SMD shielded Multilayer ferrite	1 µH	TDK	MLZ1608A1R0WTD25	Yes	0.15	190	600	-55 to +125	1.6x0.8x0.8
SMD shielded Thin film Metal core	1 µH	TDK	TFM2016ALMA1R0MTAA	Yes	0.05	3400	3700	-55 to +125	2x1.6x1
Wound (Metal)	1 µH	Murata	DFE322512F-1R0M	Yes	0.032	4800		-40 to +125	3.2x2.5x1.2
SMD shielded Multilayer ferrite	1 µH	Murata	LQM18PH1R0MFRL	Yes	0.29	600	950	-40 to +125	1.6x0.8x0.5
SMD shielded Multilayer ferrite	1 µH	Murata	LQM21PH1R0NGCD	Yes	0.1–0.13	200		-40 to +125	2x1.25x0.9
Chip coil	1 µH	Murata	LHQ3NPH1R0MM	Yes	0.03	2350	3000	-40 to +125	3x3x1.4
Chip coil	1 µH	Murata	LQW21FT1R0M0H	Yes	0.13	700	700	-40 to +125	2x1.2x1.6
SMD shielded Multilayer ferrite	1 µH	Chilisin	AKPB001608DZ1R0MA2	Yes	0.2	200	700	-40 to +125	1.6x0.8x0.8
SMD shielded Multilayer ferrite	1 µH	Chilisin	AKPB002012101R0MA2	Yes	0.12	650	1200	-40 to +125	2x1.25x1
SMD shielded Multilayer ferrite	1 µH	Chilisin	AKPB002016101R0MA6	Yes	0.085	850	1300	-40 to +125	2x1.6x1
T-core	1 µH	Cyntec	VCTA20161B-1R0MS6	Yes	0.041–0.048	3100	3800	-55 to +165	2x1.6x1.2
Wound shielded	1 µH	Wurth	78 438 336 010	Yes	0.032	4000	5000	-40 to +125	3x3x2

Figure 9. DC-DC inductor options

2.2 Clocks

Table 9 describes the clocks available on the KW45B41Z-LOC board.

Table 9. KW45B41Z-LOC clocks

Clock generator	Clock	Frequency	Destination
Y1: Crystal (NX1612SA 32MHZ EXS00A CS14160)	[XTAL, EXTAL]_32M	32 MHz	Target MCU (KW45B41Z)
Y2: Crystal (NX2012SE 32.768kHz EXS00A-MU01517)	XTAL32K / EXTAL32K	32.768 kHz	Target MCU
Y3: Temperature compensated crystal oscillator (TCXO) (NT2016SB-32MHZ-NSA3561B) (DNP)	EXTAL_RF	32 MHz	Target MCU
Y4: Crystal	MCU_LINK_[P, N]_16MHz	16 MHz	MCU-Link (LPC55S69)

In the KW45B41Z-LOC board, the target MCU requires the following two clocks:

- 32 MHz clock (with ±30 ppm accuracy): Provides clock inputs to the Arm Cortex-M33 core and 2.4 GHz radio
- 32.768 kHz clock: Provides an accurate low-power timebase and acts as real-time clock (RTC) and low-power RF clock

By default, the Y1 crystal provides a 32 MHz clock to the target MCU. Alternatively, Y3 TCXO (not populated) can be used to provide a 32 MHz clock to the target MCU.

Figure 10 shows the circuit diagram of the Y1 crystal that provides 32 MHz clock. Internal load capacitors provide the crystal load capacitance, and they can be adjusted to tune the center frequency of the crystal.

To measure the 32 MHz crystal frequency, program the XTAL (XTAL_RF) signal to provide buffered output clock signal.

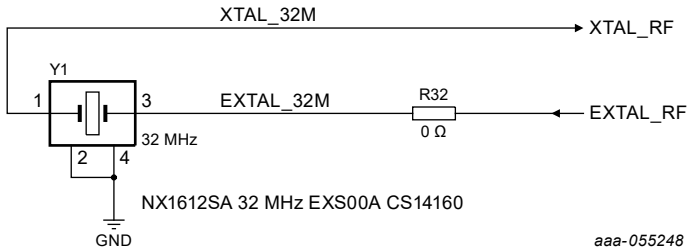

Figure 10. 32 MHz clock circuit diagram

Figure 11 shows the circuit diagram of the Y2 crystal that provides 32.768 kHz clock. Internal load capacitors provide the crystal load capacitance.

The 0 Ω resistors are provided to bypass the Y2 crystal which gives two additional GPIOs, PTD4 and PTD5, to the I/O headers.

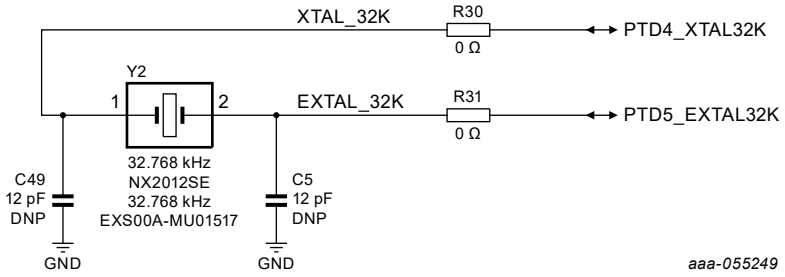

Figure 11. 32.768 kHz clock circuit diagram

2.3 CAN interface

The target MCU has a FlexCAN module (CAN0), which supports controller area network (CAN) and CAN flexible data rate (FD). The KW45B41Z-LOC board allows communication with CAN0 module through a high-speed CAN transceiver, which drives CAN signals between CAN0 module and a physical two-wire CAN bus that terminates at a 1x4 pin header.

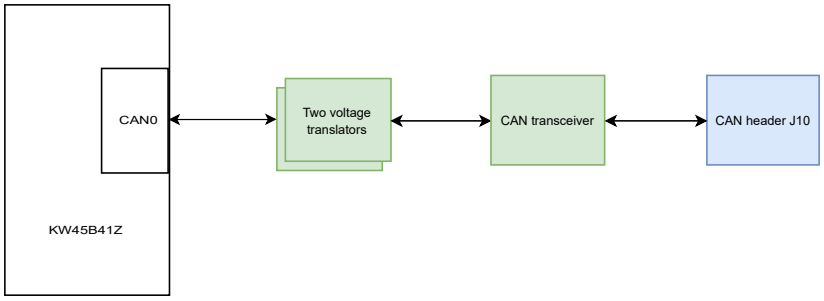

Figure 12. CAN diagram

Figure 12 shows the KW45B41Z-LOC CAN diagram.

Table 10 explains the KW45B41Z-LOC CAN connections.

Table 10. KW45B41Z-LOC CAN connections

CAN module	Voltage translators	Transceiver	Connector
CAN0	Two voltage translators U17 and U20 (74LVCH1T45). U17 and U20 shift voltage	High-speed CAN transceiver U19 (NXP TJA1057GT/3), which is designed for high-	1x4 pin CAN header J10. It allows external CAN connection and has the following pinout:

Table 10. KW45B41Z-LOC CAN connections

CAN module	Voltage translators	Transceiver	Connector
	levels of signals between the target MCU and CAN transceiver from V_BRD to P5V_CAN and vice versa.	speed CAN applications in the automotive industry, providing the differential transmit and receive capabilities to a CAN protocol controller. It converts and sends analog data from CAN bus lines to the target MCU as digital data, and converts and sends digital data from the target MCU to the CAN bus lines as analog data.	• 1: High-level CAN bus line connection • 2: Low-level CAN bus line connection • 3: Power connection (P12V) • 4: Ground (GND)

Figure 13 shows the CAN circuit diagram involving J10, U19, U17, and U20.

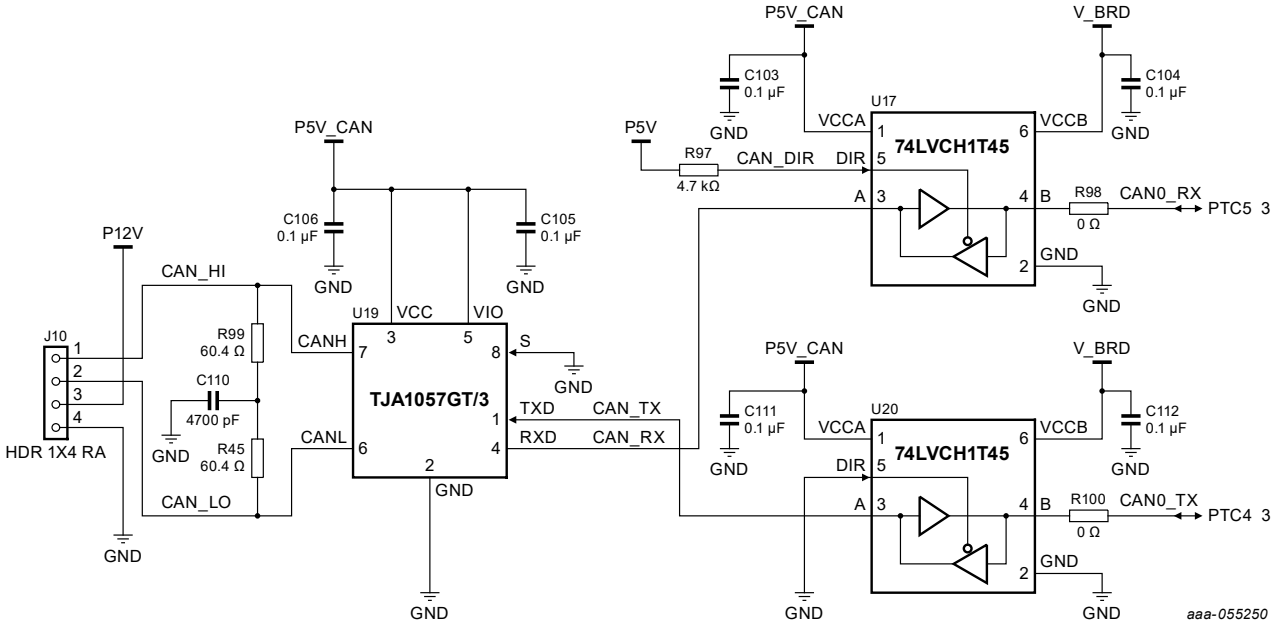

Figure 13. CAN circuit diagram

Figure 13 circuit diagram is explained below:

- The CAN interface of the board is only functional if the board is powered up using the P12V supply, which can be produced through connector J9 or pin 3 of CAN header J10
- U19 is powered up using the P5V_CAN supply, which is produced by the regulator U18
- J10 provides pins to interface with a CAN bus
- Pin 3 of J10 can be used to power up other KW45B41Z-LOC boards
- Pin 3 of the J10 can also be used as an input to power up the KW45B41Z-LOC board

2.4 LPUART interface

The target MCU (KW45B41Z) has two low-power universal asynchronous receiver/transmitter (LPUART) modules, LPUART0 and LPUART1. The KW45B41Z-LOC board supports connections to both LPUART modules.

Figure 14 shows the LPUART diagram of the KW45B41Z-LOC board.

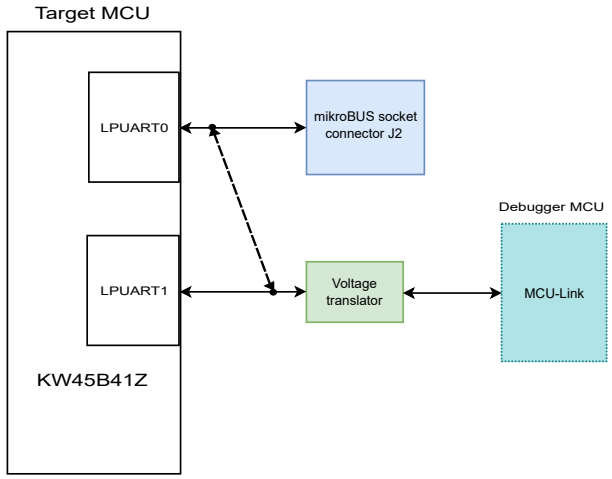

Figure 14. LPUART diagram

Table 11 explains the KW45B41Z-LOC LPUART connections.

Table 11. KW45B41Z-LOC LPUART connections

LPUART module	Voltage translator	Connector / MCU-Link
LPUART0		mikroBUS socket connector J2. It allows a UART connection between the target MCU and plugged-in click board.
LPUART1 (default) / LPUART0 (alternative)	Bidirectional voltage translator U16 (74AVC4TD245 BQ). It supports a USB-to-UART bridge between MCU-Link and the target MCU, by shifting voltage levels of signals between the two devices from 3.3 V to VCC_ TGMCU and vice versa. The USB-to-UART bridge can be disabled by shorting jumper JP21.	MCU-Link (LPC55S69). The USB-to-UART bridge between MCU-Link and the target MCU can be used for debugging the target MCU from MCU-Link.

A USB-to-UART bridge can be established between MCU-Link and the target MCU using either the LPUART1 module or the LPUART0 module of the target MCU based on the settings of jumpers JP13 and JP14:

- JP13 and JP14 are 1-2 shorted (default settings): LPUART1 module is used to create a USB-to-UART bridge. When LPUART1 is used, ISP programming is supported.
- JP13 and JP14 are 2-3 shorted: LPUART0 module is used to create a USB-to-UART bridge.
  Note: *ISP programming is not supported with LPUART0.*

2.5 LPSPI interface

The target MCU has two low-power serial peripheral interface (LPSPI) modules, LPSPI0 and LPSPI1. Each LPSPI module can act as a SPI master or slave, and supports four peripheral chip selects (PCSes), PCS0, PCS1, PCS2, and PCS3. The KW45B41Z-LOC board only supports LPSPI1 module, with PCS0 used for LPSPI connection.

Figure 15 shows the KW45B41Z-LOC LPSPI diagram.

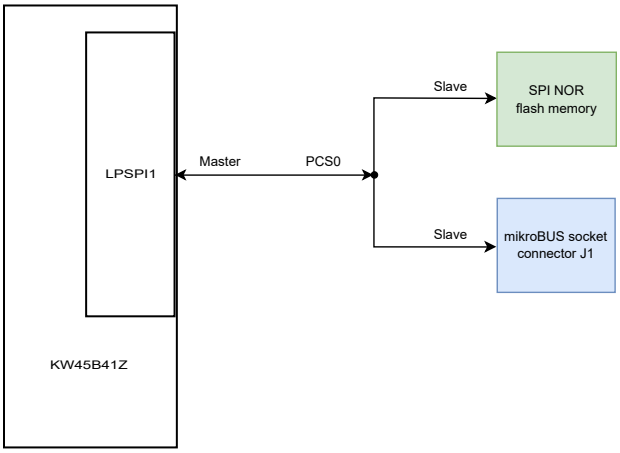

Figure 15. LPSPI diagram

Table 12 explains the KW45B41Z-LOC LPSPI connections.

Table 12. KW45B41Z-LOC LPSPI connections

PCS	Slave device
PCS0	16 Mbit (2 MB) SPI NOR flash memory U5 (AT25XE161D-MAHN-T) for over-the-air (OTA) programming or for storing non-volatile system data or parameters
	mikroBUS socket connector J1. It allows a SPI connection between the target MCU and plugged-in click board.

Figure 16 shows the circuit diagram of the SPI NOR flash memory.

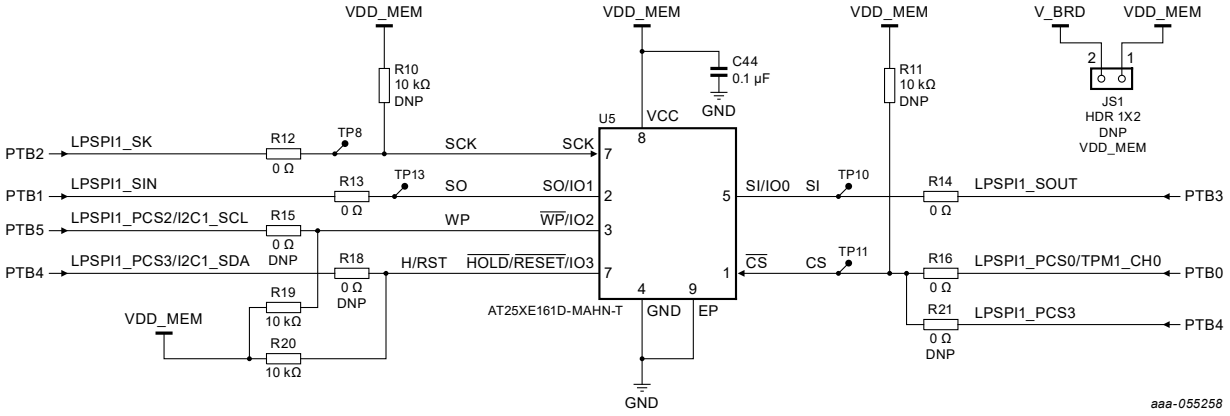

Figure 16. SPI NOR flash memory circuit diagram

Figure 16 circuit diagram is explained below:

- The SPI NOR flash memory (U5) is normally powered through JS1. JS1 is PCB short on the board, not a physical component, and it can be populated for enable/disable U5 power supply.
  Note: *You need to cut the PCB trace on the bottom side of the board to enable or disable option.*
- VDD_MEM is the power supply for U5 that is derived from the V_BRD supply through JS1
- Current drawn by U5 can be measured via JS1
- Discrete pull-up resistors are provided for SPI signals

2.6 LPI2C interface

The target MCU (KW45B41Z) has two low-power inter-integrated circuit (LPI2C) modules, LPI2C0 and LPI2C1. The KW45B41Z-LOC board only supports LPI2C1 module.

Figure 17 shows the KW45B41Z-LOC LPI2C diagram.

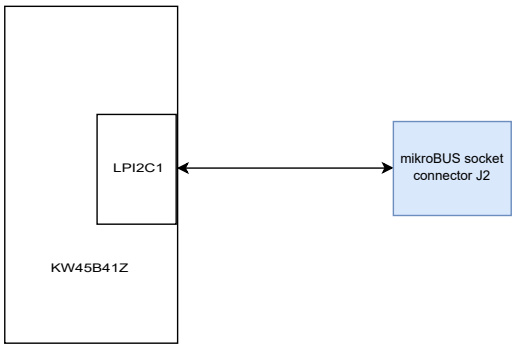

Figure 17. LPI2C diagram

Table 13 shows the KW45B41Z-LOC LPI2C bus device map.

Table 13. KW45B41Z-LOC LPI2C bus device map

LPI2C module	I2C address	Device	Description
		KW45B41Z (U1)	Target MCU. It acts as I2C master on the board.
LPI2C1	I2C address is defined by the plugged-in click board	mikroBUS socket connector J2	Allows an I2C connection between the target MCU and plugged-in click board

2.7 RF interface

The target MCU has a 2.4 GHz radio supporting concurrent operations in the 2.4 GHz bands. The radio supports the following protocols:

- Bluetooth Low Energy version 5.3
- Generic two-level FSK/GFSK/MSK/GMSK

The KW45B41Z-LOC board provides the following RF input/output (I/O) ports for communication with the 2.4 GHz radio of the target MCU:

- Two U.FL connectors (J7 and J8) (20279-001E)
- Two RF chip antennas (ANT_A and ANT_B)

Only one of these I/O ports is selected for communication at a time. The KW45B41Z-LOC board provides an SP4T RF switch U2 (HSWA4-63DR) to make this selection. This switch supports in enabling the Channel Sounding Antenna Switching feature. The KW45 supports 1x1 and 2x2 antenna paths.

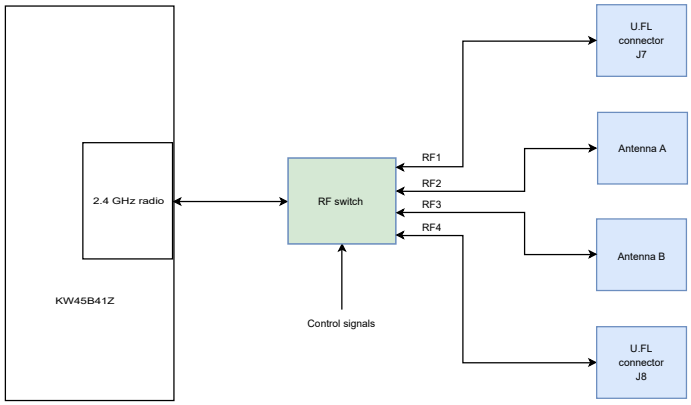

Figure 18. RF diagram

Figure 18 shows the KW45B41Z-LOC RF diagram.

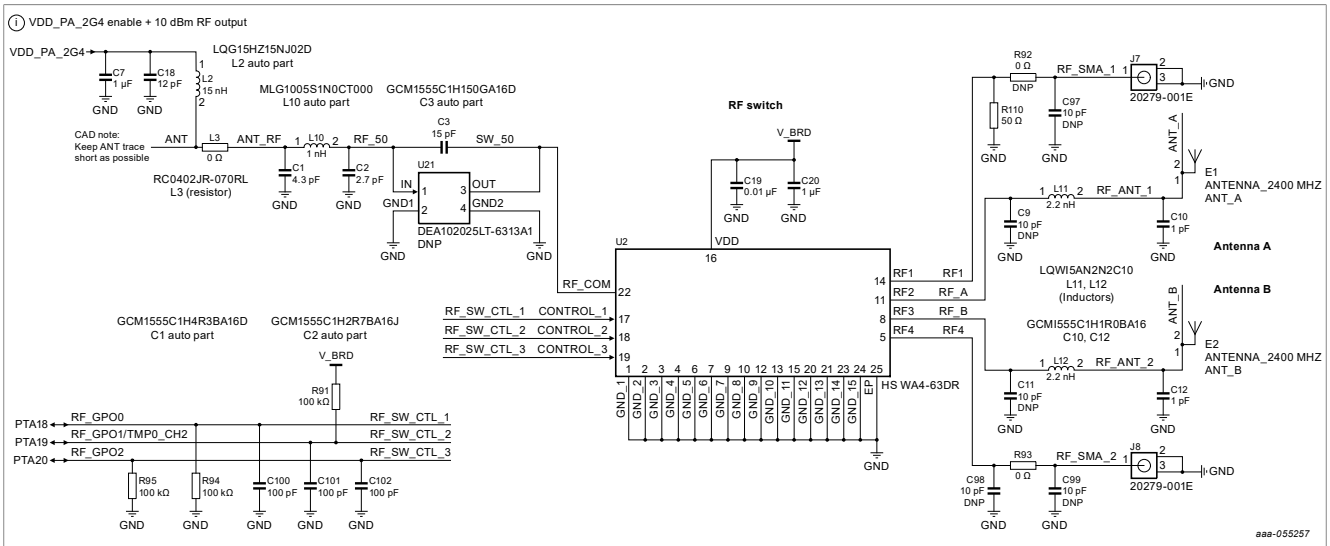

Figure 19. RF circuit diagram

Figure 19 shows the KW45B41Z-LOC RF circuit diagram.

The RF switch selects the I/O port for RF communication using three control signals (CTRL1, CTRL2, and CTRL3) as mentioned in the Table 14 below.

Table 14. RF I/O port selection

Control signals			RF mode	RF I/O port
CTRL3	CTRL2	CTRL1		
Low	Low	High	RF1	U.FL connector J7, which is disconnected from the RF switch. The RF1 output is terminated by a 50 Ω resistor, R110.
Low	High	Low	RF2 (default mode)	Antenna A
Low	High	High	RF3	Antenna B

Table 14. RF I/O port selection*...continued*

Control signals			RF mode	RF I/O port
CTRL3	CTRL2	CTRL1		
High	Low	Low	RF4	U.FL connector J8
Low	Low	Low		
High	Low	High	All OFF	None
High	High	Low		

The KW45B41Z-LOC board supports programmable output power from -30 dBm to +10 dBm at the U.FL connectors. In addition, typical receiver sensitivity at the U.FL connectors is given below (with packet error rate (PER) 30.1% for 37-byte payload packet):

- -105.4 dBm for Gaussian frequency-shift keying (GFSK) applications (250 kbit/s, BT = 0.5, h = 0.5)
- -96 dBm for BLE applications (1 Mbit/s)

2.8 mikroBUS socket

A mikroBUS socket is a pair of 1x8 position receptacles (connectors) with a proprietary pin configuration. It allows maximum hardware expandability with smallest number of pins.

The KW45B41Z-LOC board has a mikroBUS socket with two 1x8 position receptacles, J1 and J2.

Table 15 shows the pinouts of the mikroBUS socket connectors.

Table 15. mikroBUS socket connector pinouts

Pin number	Pin name (description)	Signal name
J1 connector		
1	AN (Analog)	ADC0_A13
2	RST (Reset)	RST_TGTMCU_b
3	CS (SPI chip select)	LPSPI1_PCS0
4	SCK (SPI clock)	LPSPI1_SK
5	MISO (SPI master input slave output)	LPSPI1_SIN
6	MOSI (SPI master output slave input)	LPSPI1_SOUT
7	VDD_TARGET (3.3 V power)	V_BRD
8	GND (Reference ground)	GND
J2 connector		
1	PWM (PWM output)	PTD2/TMP1_CH0
2	INT (Hardware interrupt)	WUU0_P12
3	RX (UART receive)	UART0_RX
4	TX (UART transmit)	UART0_TX
5	SCL (I2C clock)	I2C1_SCL
6	SDA (I2C data)	PTD3/I2C1_SDA
7	+5V (5 V power)	P5V
8	GND (Reference ground)	GND

The KW45B41Z-LOC mikroBUS socket supports different types of add-on boards, called *click boards*, which are plug and play solutions to add new functionality to the board design. A click board has a pair of 1x8 pin headers that connect to the two receptacles of a mikroBUS socket.

MikroElektronika (MIKROE) is one of the manufactures of click boards. The details of few example click boards for KW45B41Z-LOC mikroBUS socket are available at MIKROE website.

2.9 GPOs

Table 16 describes the target MCU pins that are used as general-purpose outputs (GPOs) on the KW45B41Z-LOC board.

Table 16. Target MCU GPOs

Target MCU pin	GPO function (device)
PTA18	RF_GPO0 (RF switch)
PTA19	RF_GPO1 (RF switch)
PTA20	RF_GPO2 (RF switch)

2.10 MCU-Link USB

The KW45B41Z-LOC board has a USB 2.0 micro-B connector J3 (Hirose Electric ZX62D-B-5PA8(30)). This connector is used to supply 5 V power to the board. It can also be used to create MCU-Link high-speed USB connection to the host computer.

2.11 Board operating conditions

The operating temperature range for the KW45B41Z-LOC board is -40 ℃ to +85 ℃. See *KW45 Product Family Data Sheet* for more details on device operating conditions.

3 MCU-Link Debug Probe

MCU-Link is a debug probe architecture jointly developed by NXP and Embedded Artists. The MCU-Link architecture is based on the LPC55S69 MCU, and it includes several mandatory and optional features. NXP uses MCU-Link on its evaluation kits (EVK boards). For example, KW45B41Z-LOC.

MCU-Link is also available as a standalone probe (MCU-Link probe, MCU-Link Pro probe). All these MCU-Link probes use the same firmware.

NXP EVK boards have the configuration strap pins HW_VER_6 and HW_VER_7. These pins are read by the MCU-Link firmware during the boot process. These configuration strap pins determine the availability of the type of MCU-Link board and its corresponding supported features. The different types of MCU-Link boards include:

- Onboard (OB)
- MCU-Link base model
- MCU-Link Pro

3.1 Supported MCU-Link features

Table 17 summarizes the MCU-Link features supported on the KW45B41Z-LOC board.

Table 17. Supported MCU-Link features

Feature	Description
Serial wire debug (SWD) / serial wire debug trace output (SWO)	Allows SWD-based debugging with SWO for profiling and/or low overhead debug standard I/O communication
Virtual communication (VCOM) serial port	Adds a serial COM port on the host computer, and connects it to the target MCU by using MCU-Link as a USB-to-UART bridge
External debug probe support	Allows debugging the target MCU (KW45B41Z) using an external debug probe, instead of MCU-Link. Support for external debug probe is enabled by disabling SWD feature. While using external debug probe, VCOM feature can be enabled
External target support[1]	Allows debugging an external target MCU using MCU-Link

[1] J-Link firmware does not support this feature.

3.2 Supported debug scenarios

Table 18 describes the debug scenarios supported on the KW45B41Z-LOC board.

Table 18. Supported debug scenarios

Debug scenario	Feature support
Use MCU-Link as debugger for the target MCU (KW45B41Z)	• Serial wire debug (SWD): – MCU-Link SWD feature is enabled (MCU-Link SWD disable jumper JP22 is open) – The target MCU SWD interface is connected to MCU-Link – The target MCU SWD connector J5 is not used for external connection • Virtual communication (VCOM): MCU-Link VCOM feature is enabled • Target selection: Target selection jumper JP17 is open • Target power selection: Target power selection jumper JP18 is set to 1-2 shorted
Use an external debugger to debug the target MCU (KW45B41Z)	• SWD: – Disable MCU-Link SWD feature by shorting MCU-Link SWD disable jumper JP22

Table 18. Supported debug scenarios*...continued*

Debug scenario	Feature support
	– Connect the external debugger to the target MCU SWD connector J5. The target MCU SWD interface is connected to the external debugger. • VCOM: MCU-Link VCOM feature can be used • Target selection: Target selection jumper JP17 is open • Target power selection: Target power selection jumper JP18 is set to 1-2 shorted
Use MCU-Link as debugger for an external target MCU	• SWD: – MCU-Link SWD feature is enabled (MCU-Link SWD disable jumper JP22 is open) – Connect the external target MCU to the target MCU SWD connector J5 • VCOM: MCU-Link VCOM feature is not supported • Target selection: Short target selection jumper JP17 • Target power selection: – If the external target MCU has to get power from the board, then set target power selection jumper JP18 to 1-2 shorted – If the external target MCU has to use its own power, then set jumper JP18 to 2-3 shorted

3.3 MCU-Link host driver and utility installation

MCU-Link is supported on host computers running on Windows 10, MacOS X, and Ubuntu Linux operating systems (OSs). For each of these OSs, an MCU-Link firmware package is available that includes the host device drivers, MCU-Link firmware, and scripts to program CMSIS-DAP and J-Link firmware. The host device drivers are included in the firmware package to configure the host so that it displays user-friendly device names.

To download and install the host device drivers and update the MCU-Link firmware, follow these steps:

1. From the NXP website. navigate to the MCU-Link page.
2. Navigate to **Design Resources** > **SOFTWARE** section.
   Under the Development Software category, MCU-Link installation packages for Windows, MacOS, and Linux platforms are available.
3. Download the MCU-Link installation package applicable to your host OS.
4. Run the installer program (for Windows) or install the firmware package (for MacOS or Linux).

You are recommended to update the MCU-Link firmware on your board to the latest firmware version to get the latest functionality. Steps to update the firmware are provided in Section 3.4. Before updating the firmware, check if the MCU-Link firmware you want to use is compatible with the MCUXpresso IDE installed on your host computer. For details, see Table 19.

Table 19. Compatibility between MCU-Link firmware and MCUXpresso IDE

MCU-Link firmware version	USB driver type	CMSIS-SWO support	FreeMASTER support via		Supported MCUXpresso IDE versions
			SWD / JTAG	USB bridge	
V1.xxx and V2.xxx	HID	No	Yes	Yes	MCUXpresso 11.3 or later
V3.xxx (up to and including V3.108)	WinUSB	No	Yes	FreeMASTER V3.2.2 or later	MCUXpresso 11.7.0 or later
V3.117 and later	WinUSB	Yes	Yes	FreeMASTER V3.2.2 or later	MCUXpresso 11.7.1 or later

The KW45B41Z-LOC board is now ready for the usage. If you use the board with MCUXpresso IDE version 11.3 or higher, you are notified in case a more recent firmware version is available for MCU-Link. If you use the board with a different IDE, ensure that the latest MCU-Link firmware version is installed on the board.

3.4 Updating MCU-Link firmware

MCU-Link is supported by the Linkserver utility, which is a GDB server and flash utility from NXP with support for many NXP debug probes. Running the Linkserver installer automatically installs the drivers and firmware update utilities required for MCU-Link. You are recommended to use the Linkserver utility to update the MCU-Link firmware, unless you are using MCUXpresso IDE version 11.6.1 or earlier. For more details on this utility, see Linkserver.

Note: *Before updating the MCU-Link firmware, check the compatibility between the MCU-Link firmware and the MCUXpresso IDE For more information, see Section 3.6.1.*

MCU-Link debug probe is supported on Windows 10/11, MacOS X, and Ubuntu Linux platforms. MCU-Link probe uses standard OS drivers. For Windows, the installation program also includes information files to provide user-friendly device names.

If you do not want to use the entire Linkserver installer package, you can install only the information files and the MCU-Link firmware update utility using the MCU-Link Pro Debug Probe link.

After OS drivers are set up, your host computer is ready to use MCU-Link. Before updating the firmware, the onboard MCU-Link must be powered up in the ISP mode.

Follow the steps given below to configure MCU-Link in the ISP mode and update the MCU-Link firmware:

1. Disconnect the board from the host computer, short jumper JP12, and reconnect the board. The board enumerates on the host computer as a WinUSB or HID device (depending on the firmware version). The red MCU-Link status LED D7 lights up and stays on. For more details, see Section 3.8.
2. Navigate to the `MCU-LINK_installer_Vx_xxx` directory, where `Vx_xxx` indicates the version number, for example, V3.108.
3. Follow the instructions in the `readme.txt` to find and run the firmware update utilities for CMSIS-DAP or J-Link versions.
4. Disconnect the board from the host computer, open jumper JP12, and reconnect the board.

Note: *It is recommended to use the latest firmware version. The older versions of MCUXpresso does not support KW45. For details, contact your local field applications engineer (FAE) or sales representative.*

3.5 Supported firmware options

Supported firmware options for the KW45B41Z-LOC MCU-Link debug probe are described below:

- By default, the KW45B41Z-LOC MCU-Link debug probe is programmed with firmware based on CMSIS-DAP protocol from NXP. This firmware also supports all other features supported in hardware. For information on updating the MCU-Link firmware, see Section 3.3.
- A custom version of J-Link is also available but this firmware is limited to debug and VCOM features.
- Other firmware options available for MCU-Link OB may not provide the buffer enable / direction control support that is required to correctly configure the KW45B41Z-LOC hardware. Therefore, care should be taken while using such firmware.

3.6 Using MCU-Link with development tools

The MCU-Link debug probe can be used with the following supported IDEs within the MCUXpresso ecosystem:

- MCUXpresso IDE (see Section 3.6.1)
- IAR Embedded Workbench

Note: *Other IDEs that support CMSIS-DAP or J-Link protocol can also use the MCU-Link debug probe; refer to the documentation for these IDEs for more information.*

3.6.1 Using MCU-Link with MCUXpresso IDE

The MCU-Link debug probe can be used with IDEs supported within the MCUXpresso ecosystem, such as MCUXpresso IDE, IAR Embedded Workbench, and MCUXpresso for Visual Studio Code (starting July 2023).

The MCUXpresso IDE recognizes any type of MCU-Link probe that uses either CMSIS-DAP or J-Link firmware. When you start a new debug session, the IDE checks for all the available debug probes. For all the probes it finds, the IDE displays the probe types and unique identifiers in the **Probes discovered** dialog box.

If a debug probe requires firmware update, the probe is displayed with a warning in the **Probes discovered** dialog box. For each such probe, the latest firmware version is indicated and a link to download the latest firmware package is provided.

To update the firmware for MCU-Link debug probe, see the instructions provided in Section 3.4. You are advised to use the latest MCU-Link firmware to take the benefit of the latest functionality.

3.7 Connecting to a target through a USB-to-UART bridge

MCU-Link supports the VCOM serial port feature, which adds a serial COM port on the host computer, and connects it to the target MCU by using MCU-Link as a USB-to-UART bridge.

In the KW45B41Z-LOC board, MCU-Link is connected to the the LPUART1 port (default) or the LPUART0 port (alternative) of the target MCU through a voltage translator U16, which enables communication between MCU-Link and the target MCU, by shifting voltage levels of signals between the two devices from 3.3 V to VCC_TGMCU and vice versa.

To use MCU-Link as a USB-to-UART bridge, verify the following jumper settings and connect the J3 connector on the board to the USB port of the host computer:

- Jumper JP12 is open (MCU-Link is in Normal mode)
- Jumper JP21 is open (USB-to-UART bridge is enabled)

When you boot the KW45B41Z-LOC board, a VCOM port with the name MCU-Link Vcom Port (COMxx) is enumerated on the host computer, where “xx” may vary from one computer to another. Each MCU-Link based board has a unique VCOM number associated with it.

The USB-to-UART bridge (VCOM feature) can be disabled by disabling voltage translator U16 (setting it to high-impedance).

To disable U16, unpower the KW45B41Z-LOC board and short jumper JP21. Shorting/opening JP21 after powering up the board has no impact on the functions/features of the MCU-Link firmware.

3.8 MCU-Link status LED

To indicate MCU-Link status, the KW45B41Z-LOC board provides one red color LED D7.

Table 18 describes how LED D7 behaves in different MCU-Link modes.

Table 20. LED D7 behavior

MCU-Link mode	LED D7 behavior
Normal mode (with CMSIS-DAP firmware)	• Indicates heartbeat (fades in/out repeatedly), with SWD activity overlaid • The LED blinks rapidly at startup, if an error occurs
Normal mode (with J-Link firmware)	Remains OFF

Table 20. LED D7 behavior*...continued*

MCU-Link mode	LED D7 behavior
Firmware Update (ISP) mode	Lights up when MCU-Link (LPC55S69) boots in ISP mode

Figure 20 shows the MCU-Link circuit diagram of the LED described in the Table 20.

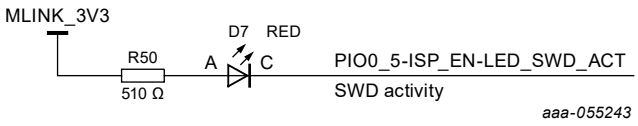

Figure 20. MCU-Link status LED

4 Software support

This section describes the software support for the KW45B41Z-LOC board. NXP provides a software development kit (SDK) for KW45B41Z-LOC board with several application examples.

Additional information on KW45B41Z-LOC software support can be found in *KW45B41Z-LOC RF Test Report* (AN14098) and *Channel Sounding Wireless Ranging Demo Application User Guide* (CSWRDAUG).

4.1 Downloading SDK with wireless ranging application

This section explains how to create the SDK ZIP package for the KW45B41Z-LOC board.

To create the SDK ZIP package, perform the following steps:

1. Navigate to the https://mcuxpresso.nxp.com/en/welcome page.
   The web pages enable you to create your own SDK ZIP package.
2. To search for any specific board, you can use the corresponding board name as the keyword. For example, **KW45**.

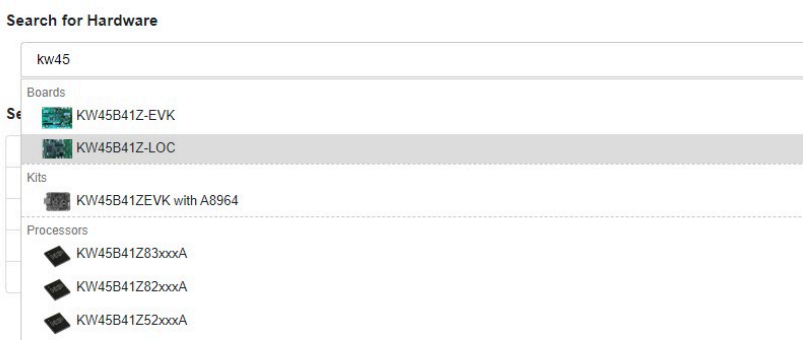

Figure 21. NXP SDK board selection

3. Click **Select Development Board** and enter your login credentials. The **Select Development Board** page is displayed.
4. To search the KW45B41Z-LOC board, use a keyword, such as, board name.
5. Select the software release tag version. For example, `REL_2.12.0_K4W1_MR3` with SDK 2.12.6.

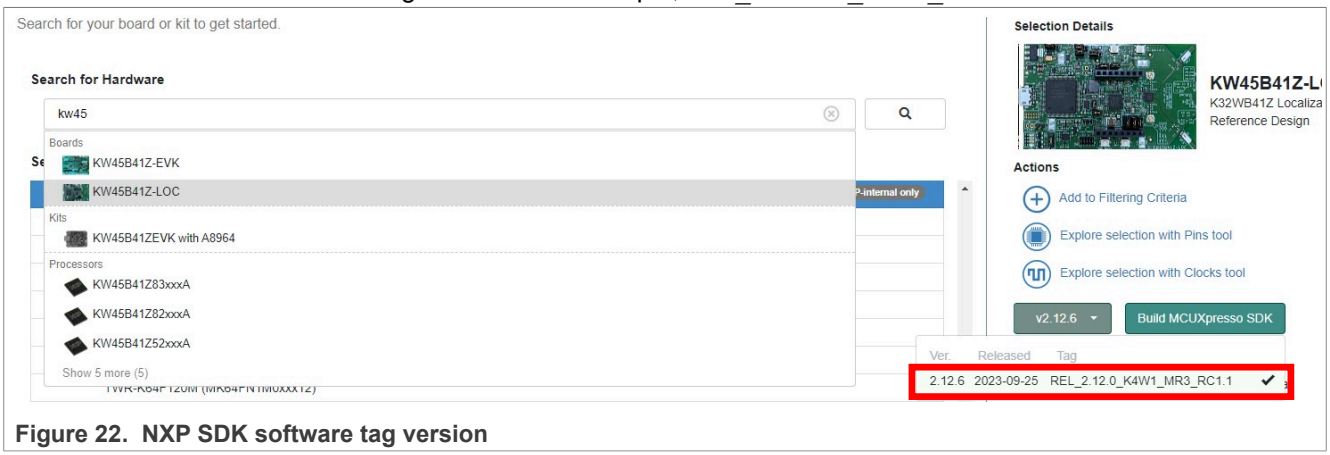

Figure 22. NXP SDK software tag version

6. Press the **Build MCUXpresso SDK** button.

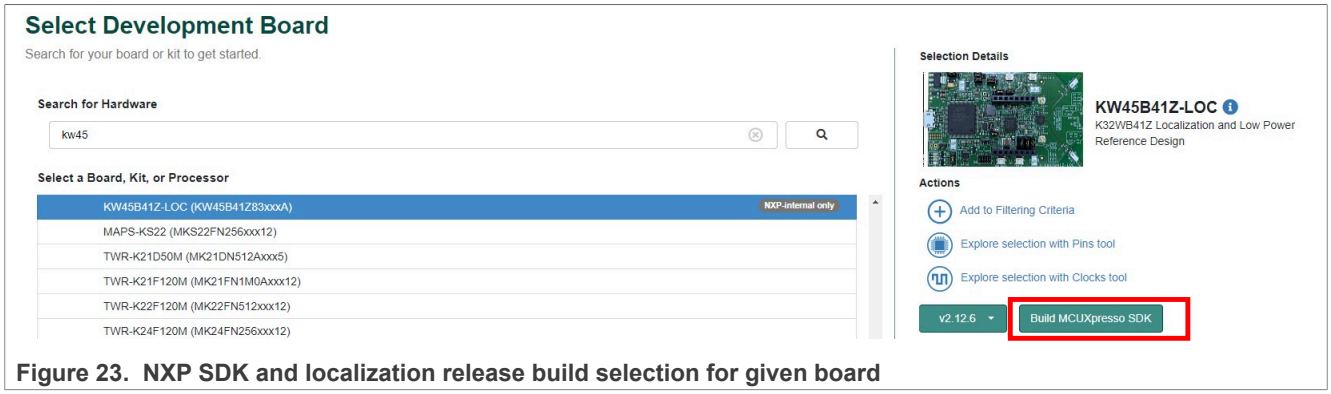

Figure 23. NXP SDK and localization release build selection for given board

7. Select the highlighted preferences as shown in Figure 24.

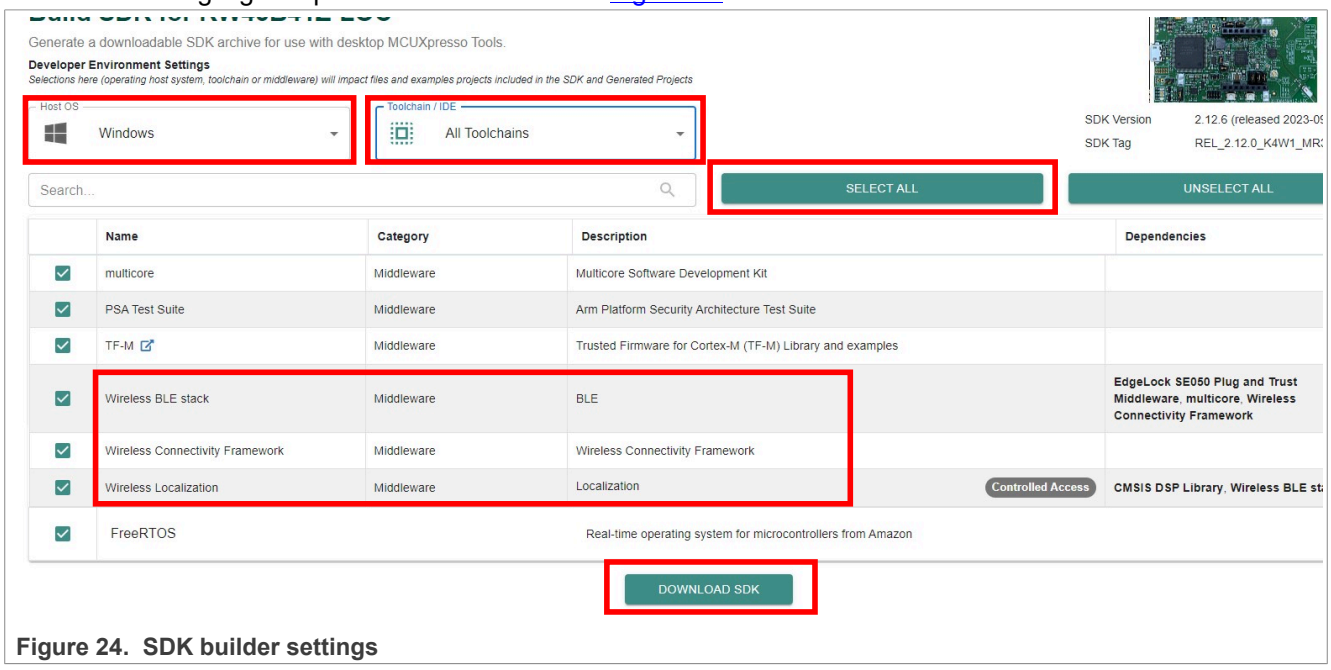

Figure 24. SDK builder settings

8. To run the wireless applications, you must configure the category as **Middleware** for the following settings:
   - Wireless Localization
   - Wireless Connectivity Framework
   - Wireless BLE stack
9. Press the **Download SDK** button. The SDK package is now downloaded to your local machine.

4.2 KW45B41Z-LOC SDK application ZIP package structure

Figure 25 shows the folder structure of the SDK ZIP package.

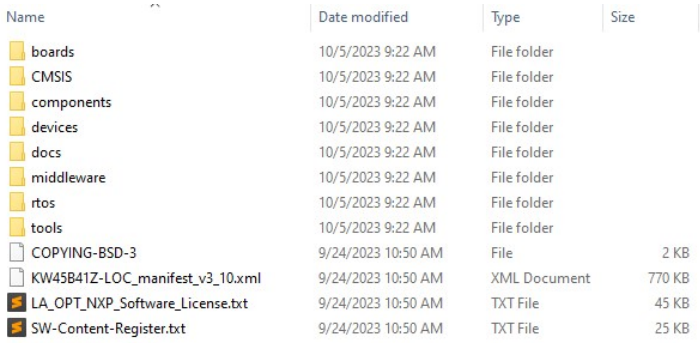

Figure 25. SDK zip package folder structure

Application related files are located at *boards\kw45b41zloc\wireless_examples*.

Figure 26 shows the folder structure of wireless examples.

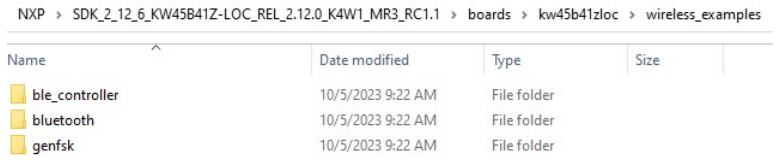

Figure 26. Wireless examples folder structure

The most important application for the KW45B41Z-LOC board testing is the wireless ranging application under the Bluetooth examples. This application fully supports the antenna diversity feature.

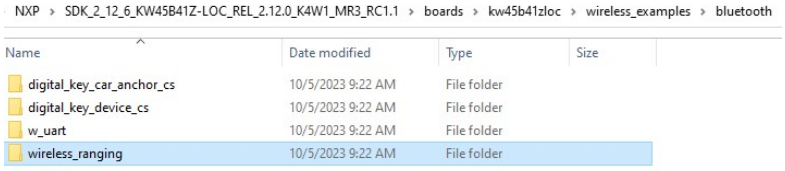

Figure 27. Bluetooth example applications

The Wireless connectivity test application is located under the *genfsk* directory.

4.3 Hardware and software requirements

Table 20 shows the hardware and software tools required to set up the KW45B41Z-LOC board.

Table 21. Required tools

Tool	Description
KW45B41Z-LOC development boards	Required units: 2
Micro-USB cables	Required units: 2 Used for PC and KW45B41Z-LOC board connection.
MCUXpresso IDE	Download the MCUXpresso Integrated Development Environment software from NXP website.

4.4 Programing Wireless Ranging demo application to KW45B41Z-LOC board

To program the Wireless Ranging demo application to the KW45B41Z-LOC board, perform the following steps:

1. Download the MCUXpresso IDE package from the NXP website link MCUXpresso Integrated Development Environment.
   Alternatively, you can use IAR Embedded Workbench.
2. Download the KW45B41Z-LOC SDK package. For more information, see Section 4.3.
3. Install the Secure Provisioning Command Line Tool (SPSDK). For more information, refer to the chapter 2.5 of the Getting Started with the KW45B41Z Evaluation Kit page.
4. Program the NBU firmware. To update the NBU firmware, the KW45 MCU needs to enter Bootloader ISP mode by putting the jumper JP16. Power cycle the board while keeping the button SW4 pressed. Release SW4 after power cycling. For more information, refer to the chapter 3.3 of the Getting Started with the KW45B41Z Evaluation Kit page.
   To run the wireless ranging demo application, `kw45b41_nbu_ble_hadm_xxx.sb3/.xip` is the firmware image that needs to be programmed to the NBU. It can be located in the SDK folder path *../middleware/wireless/ble-controller/bin*.
5. Remove the jumper JP16 after the NBU firmware update, and reset the board.
6. Prepare the whole hardware setup, which consists of two KW45B41Z-LOC boards.
7. Program the KW45B41Z-LOC boards over the MCU-Link interface.
8. Build the example application under the directory *<KW45B41Z-LOC software root>\boards\kw45b41zloc\wireless_examples\bluetooth\wireless_ranging*
9. Run the example application and test the wireless ranging application.
   For more information on the instructions, see *Channel Sounding Wireless Ranging Demo Application User Guide* (CSWRDAUG).

5 Board errata

Table 22 summarizes all the known errata for the KW45B41B LOC board.

Table 22. KW45B41Z LOC board errata summary

Erratum	Workaround	Applicable board revision	Applicable schematics revision
mikroBUS header connectors J1 and J2 on the KW45B41Z LOC board are mirrored	Desolder the header connectors J1 and J2 from top-side of the KW45B41Z LOC board and solder them on the bottom-side of the KW45B41Z LOC board and then plug the mikroBUS.	C1, C2	SCH-50702 PDF: SPF-50702_C1 and SPF-50702_C2

5.1 mikroBUS header connectors J1 and J2 on the KW45B41Z LOC board are mirrored

5.1.1 Description

mikroBUS header connectors J1 and J2 present on the top-side of the KW45B41Z LOC board are mirrored.

5.1.2 Impact

Difficulty in plugging the mikroBUS.

5.1.3 Workaround

Desolder the header connectors J1 and J2 from top-side of the KW45B41Z LOC board and solder them on the bottom-side of the KW45B41Z LOC board and then plug the mikroBUS.

5.1.4 Fix plan

The connectors J1 and J2 will be moved to the bottom-side of the KW45B41Z LOC board in the next revision.

6 KW45B41Z-LOC board limitation

The output power of the KW45B41Z radio has to be limited to comply with FCC requirements. The end user must determine the optimal radio output power needed to comply with the FCC requirements, based on their final circuit design.

7 Related documentation

Table 23 provides additional documents and resources that you can refer to for more information on the KW45B41Z-LOC board.

Some of the documents listed below may be available only under a non-disclosure agreement (NDA). To request access to these documents, contact your local field applications engineer (FAE) or sales representative.

Table 23. Related documentation

Document	Description	Link / how to access
KW45 Reference Manual	Provides a detailed description about the KW45 processor and its features, including memory maps, power supplies, and clocks.	KW45RM.pdf
KW45 Product Family Data Sheet	Provides information about electrical characteristics, hardware design considerations, and ordering information	KW45.pdf
KW45B41Z-LOC RF Test Report	Describes the KW45B41Z-LOC board RF performance	AN14098.pdf
Antenna Diversity Board User's Guide	Provides information about enabling the antenna diversity feature in the antenna diversity shield board for the widely available NXP KWxx development kits	Contact NXP FAE / sales representative
LPC55S6x/LPC55S2x/LPC552x User manual (UM11126)	Intended for system software and hardware developers and application programmers who want to develop products with LPC55S6x/LPC55S2x/ LPC552x MCU	UM11126.pdf

8 Acronyms

Table 24 lists the acronyms used in this document.

Table 24. Acronyms

Acronym	Description
4PDT	Four-pole double-throw
BLE	Bluetooth low energy
CAN	Controller area network
DNP	Do not populate
FSK	Frequency-shift keying
GFSK	Gaussian frequency-shift keying
GMSK	Gaussian minimum-shift keying
GPO	General-purpose output
GPIO	General-purpose input/output
HID	Human interface device
HMI	Human–machine interaction
I2C	Inter-integrated circuit
IDE	Integrated development environment
ISP	In-System Programming
LPI2C	Low-power inter-integrated circuit
LPSPI	Low-power serial peripheral interface
LPUART	Low-power universal asynchronous receiver/transmitter
MSK	Minimum-shift keying
NFC	Near field communication
OTA	Over-the-air
PCS	Peripheral chip select
PER	Packet error rate
ppm	Parts per million
RTC	Real-time clock
SP4T	Single-pole four-throw
SPI	Serial peripheral interface
SWD	Serial wire debug
SWO	Serial wire debug trace output
TCXO	Temperature compensated crystal oscillator
UART	Universal asynchronous receiver/transmitter
USB	Universal serial bus
VCOM	Virtual communication
WUU	Wake-up unit

Table 24. Acronyms*...continued*

Acronym	Description
NBU	Narrow band unit

9 Revision history

Table 25 summarizes the revisions done to this document.

Table 25. Revision history

Document ID	Release date	Description
KW45B41Z-LOCUM v.2	21 March 2024	The following changes are made in this release: • Added the following sections: – Radio Equipment Directive compliance information – Device features – MCU-Link host driver and utility installation – Board errata – KW45B41Z-LOC board limitation • Updated the following sections: – Power supply – Bottom-side view of KW45B41Z-LOC board – Related documentation • Updated the following figures: – KW45B41Z-LOC block diagram – Push button circuit diagrams – LED circuit diagrams – Power supply circuit diagrams – DC-DC inductor circuit diagram – 32 MHz clock circuit diagram – 32.768 kHz clock circuit diagram – CAN circuit diagram – SPI NOR flash memory circuit diagram – RF circuit diagram – MCU-Link status LED
KW45B41Z-LOCUM v.1	23 November 2023	Initial public release

Contents

For more information, please visit: https://www.nxp.com

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Document identifier: KW45B41Z-LOCUM
Document number: Agile number: 924-10008