UM12330

FRDM-MCXE31B Board User Manual

Rev. 2.0 — 20 August 2025 **User manual**

Document information

Information	Content
Keywords	UM12330, MCXE31B MCU, FRDM-MCXE31B board, board interfaces, power supply, accelerometer sensor, Arduino, MCU-Link
Abstract	The FRDM-MCXE31B board is a design and evaluation platform based on the NXP MCXE31B MCU. This document describes the board features, jumpers, connectors, power supplies, clocks, interfaces, and debug support.

1 Board overview

The FRDM-MCXE31B board is a design and evaluation platform based on the NXP MCXE31B microcontroller (MCU). NXP MCXE31B MCU based on an Arm Cortex-M7 core, running at speeds of up to 160 MHz with a 2.70 - 5.5 V supply.

The FRDM-MCXE31B board consists of one MCXE31B device with a 64 Mbit external serial flash (provided by Winbond). The board also features the FXLS8974CFR3 I2C accelerometer sensor and one NMH1000 I2C magnetic switch. It also includes three TJA1057GTK/3Z CAN PHYs and one Ethernet PHY transceiver in addition to an RGB LED, push buttons, and MCU-Link debug probe circuit. The board is compatible with the Arduino shield modules, Pmod boards, and mikroBUS.

The FRDM-MCXE31B board uses an onboard (OB) debug probe, MCU-Link OB, based on another NXP MCU, LPC55S16 to provide debug support for the MCXE31B MCU.

Note: *This document also refers to the MCXE31B MCU and the LPC55S16 MCU as the `target MCU` and the `debug MCU` respectively.*

This document provides details about the FRDM-MCXE31B board interfaces, accelerometer, power supplies, clocks, connectors, jumpers, push buttons, LEDs, and MCU-Link OB.

1.1 Block diagram

Figure 1 shows the FRDM-MCXE31B board block diagram.

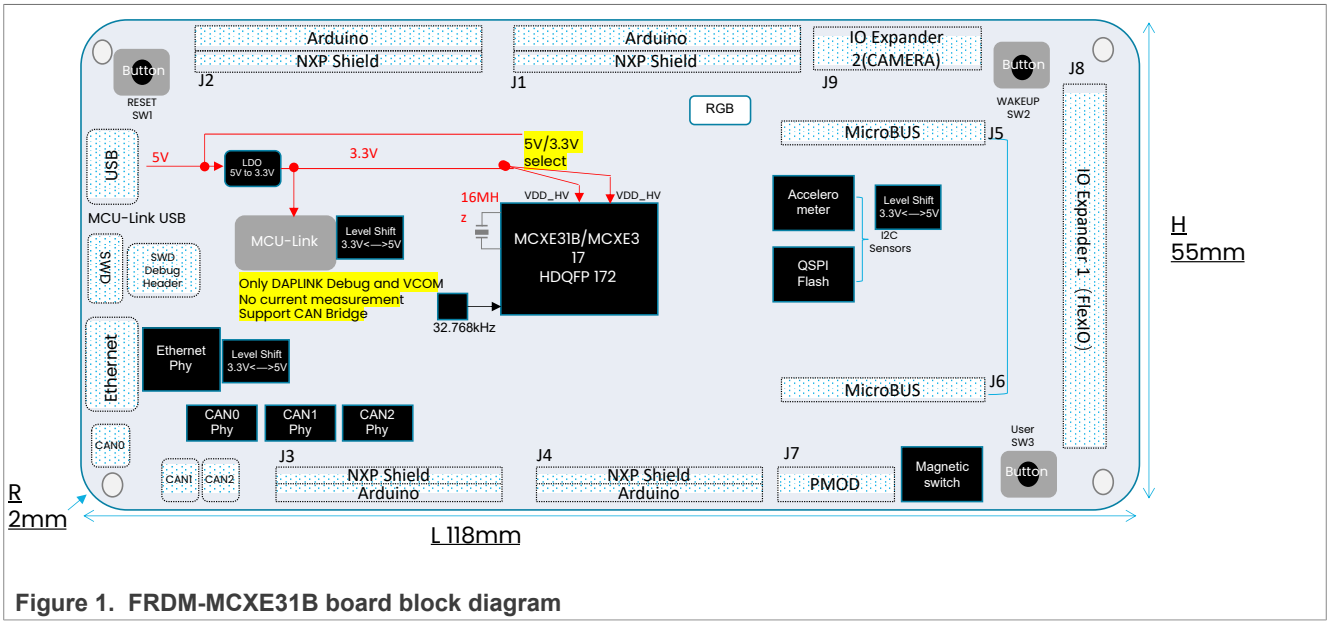

Figure 1. FRDM-MCXE31B board block diagram

1.2 Board features

Table 1 lists the features of the FRDM-MCXE31B board.

Table 1. Board features

Board feature	Target MCU features used	Description
MCU (target MCU)		The NXP MCXE31B MCUs are 32-bit general purpose microcontrollers based on the Arm Cortex-M7 core. They offer superior performance, large memories, and the most scalable peripherals in this class. This product series provides up to 160 MHz CPU performance with DSP and FPU support, with up to 4 MB Flash and up to 512 KB SRAM.
Power supply		P5V0 (5 V) input power supply using one of the following power sources: • MCU-Link USB2.0 Type-C connector • Arduino Shield compatible header • One LDO for 3.3 V power supply • Jumpers and resistors configuration for different power supplies
Clock		Crystal oscillators for: • 16 MHz system reference clock • 50 MHz Ethernet PHY clock input • 16 MHz clock input for MCU-Link • 32.768 kHz real-time clock (RTC)
Flash memory	QuadSPI	Winbond W25Q64JVSSIQ - 64 Mbit QSPI flash memory (populated)
Ethernet	Ethernet controller (ENET0)	10 / 100 Mbit/s (RMII) LAN8741 Ethernet PHY and RJ45 connectors
I/O headers		Headers compatible with: • Arduino shields (outer rows) and FRDM header (inner rows) • Mikroe click board • Peripheral module (Pmod)
FlexCAN interface	CAN0/CAN1/CAN2 module	• Provides three high-speed CAN transceivers that are accessible through 2x2-pin headers, J17/J18/J19
Debug		Onboard MCU-Link debug probe with CMSIS-DAP. It can connect to the target MCU through a USB-to-UART, or USB-to-I2C bridge. • 10-pin Arm JTAG/SWD connector for connecting an external debug probe
PCB		118 mm x 55 mm
Orderable part number		FRDM-MCXE31B

1.3 Kit contents

Table 2 lists the items included in the FRDM-MCXE31B board hardware kit.

Table 2. Kit contents

Item	Quantity
FRDM-MCXE31B board hardware assembly	1
USB 2.0 Type-A to Type-C cable, 1 meter	1
FRDM-MCXE31B Quick Start Guide	1

1.4 Board pictures

Figure 2 shows the top-side view of the FRDM-MCXE31B board with the MCXE31B MCU (target MCU), QSPI flash, accelerometer (I2C sensor), and Magnetic sensor highlighted. Figure 3 shows the bottom-side view of the FRDM-MCXE31B board.

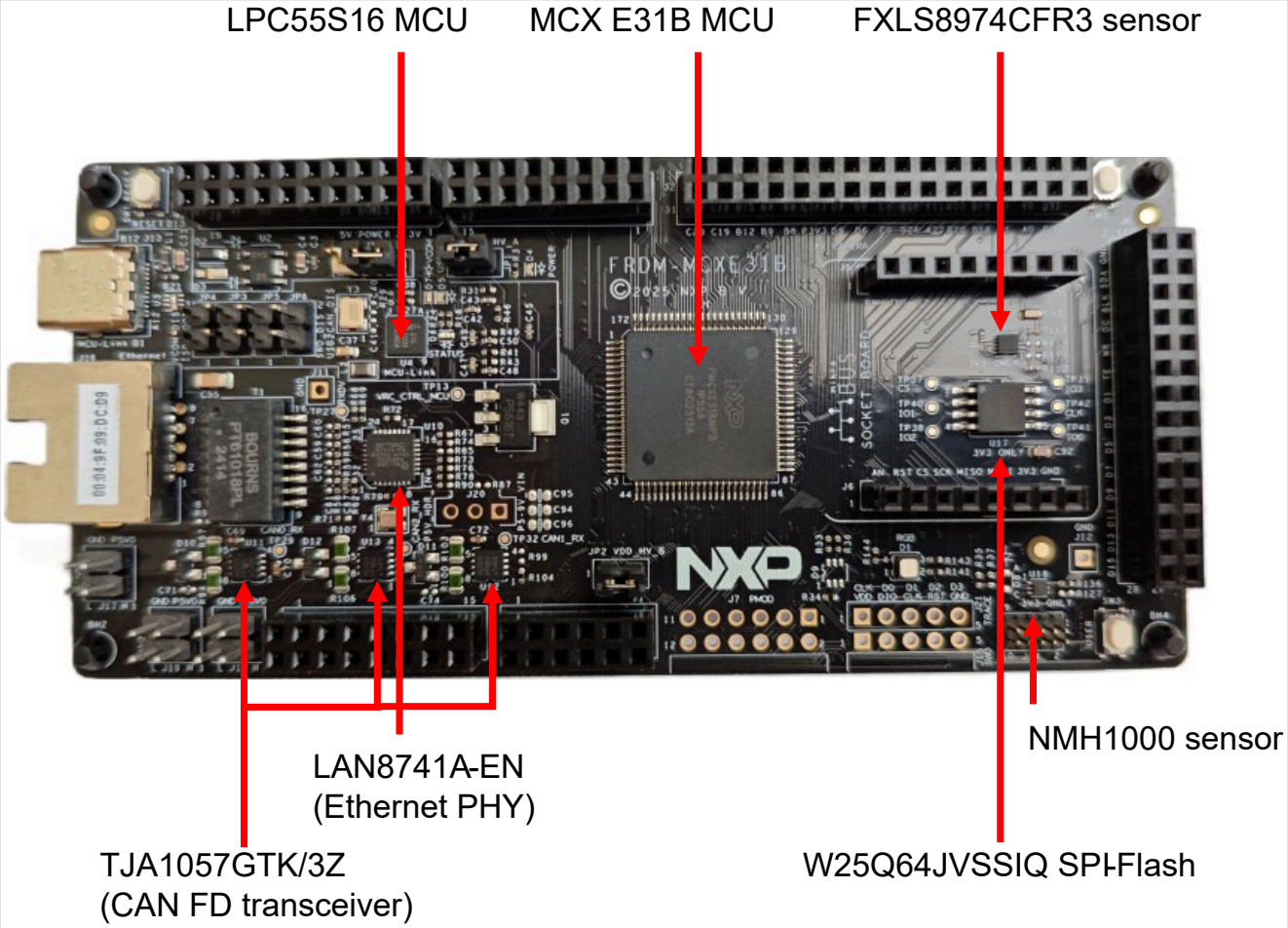

Figure 2. Top view of the FRDM-MCXE31B board

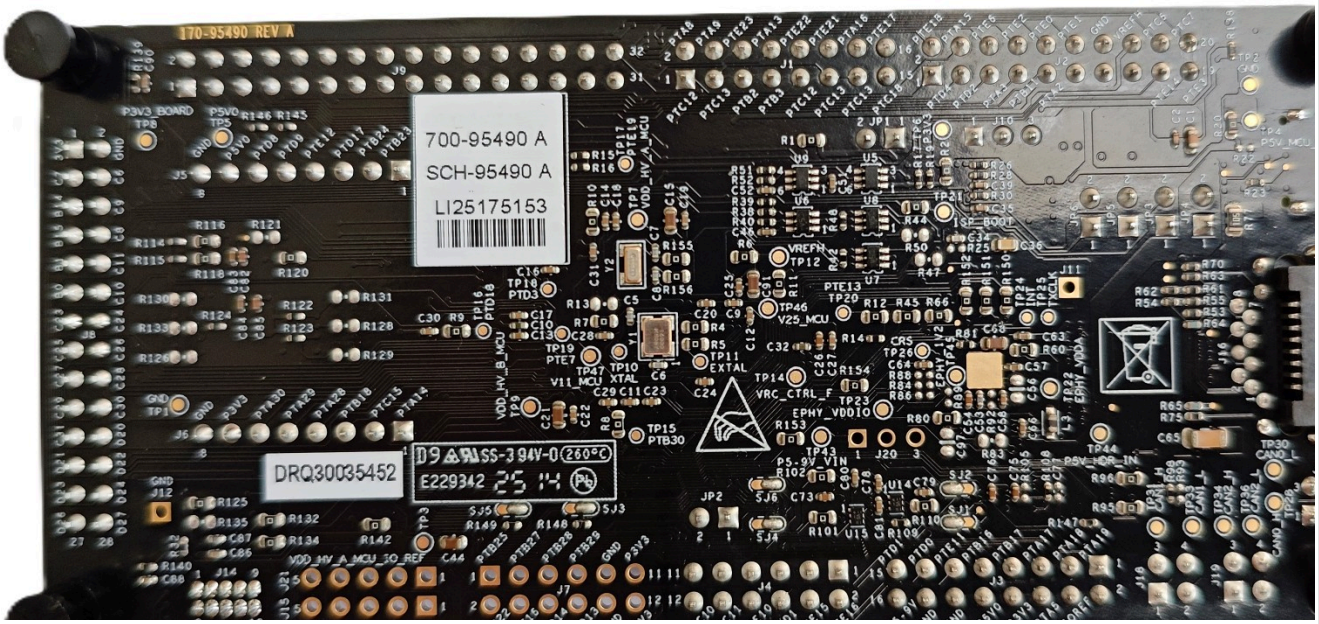

Figure 3. Bottom view of the FRDM-MCXE31B board

1.5 Connectors

Figure 4 shows the FRDM-MCXE31B board connectors.

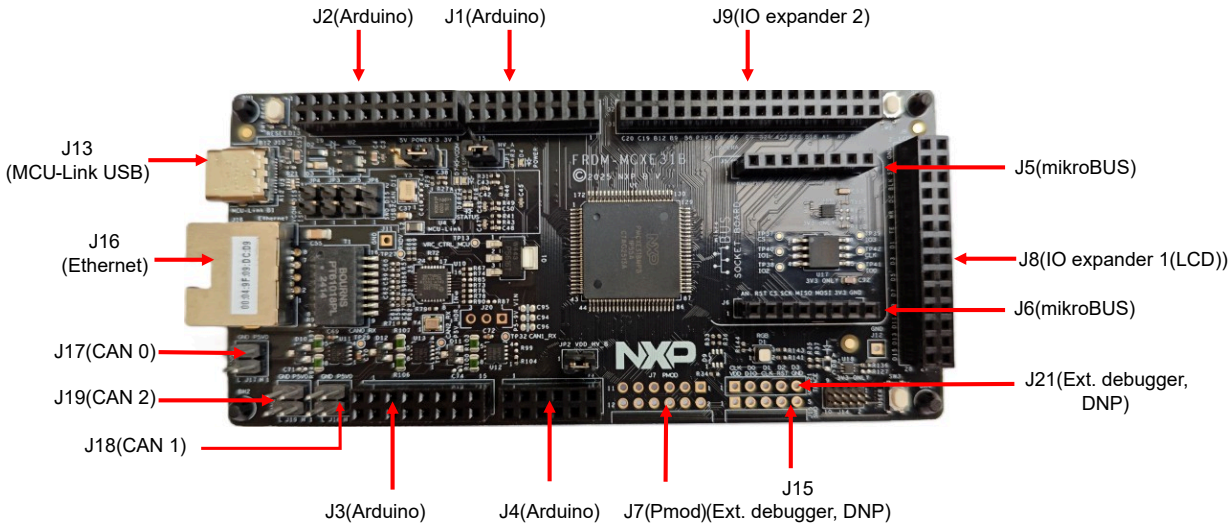

Figure 4. FRDM-MCXE31B board connectors

Table 3 describes the connectors available on the FRDM-MCXE31B board.

Table 3. FRDM-MCXE31B connectors

Part identifier	PCB label	Connector type	Description
J1	-	2 x 8-pin header	Arduino compatible I/O header (outer rows) and FRDM header (inner rows)
J2	-	2 x 10-pin header	
J3	-	2 x 8-pin header	
J4	-	2 x 6-pin header	
J5	-	1x 8-pin header	mikroBUS socket connectors
J6	-	1 x 8-pin header	
J7	Pmod	2 x 6-pin header	Pmod connector
J8	IO Expander 1	2 x 14-pin header (DNP)	IO Expander 1 (LCD)
J9	IO Expander 2	2 x 16-pin header (DNP)	IO Expander 2
J13	MCU-Link	USB Type-C connector	MCU-Link USB connector
J14	SWD/JTAG	2 x 5-pin header	Debug (JTAG / SWD) connector to connect an external debug probe
J21	Debug Trace	2 x 5-pin header	Debug trace connector
J15	SWD	1 x 5-pin header	Debug SWD connector that connects an external debug probe
J16	Ethernet	RJ45 connector	Shielded RJ45 connector jack.
J17	CAN0	2 x 2-pin header	Connects to the CAN0 bus and allows external connection with the bus
J18	CAN1	2 x 2-pin header	Connects to the CAN1 bus and allows external connection with the bus
J19	CAN2	2 x 2-pin header	Connects to the CAN2 bus and allows external connection with the bus

1.6 Jumpers

Figure 5 shows the FRDM-MCXE31B board jumpers.

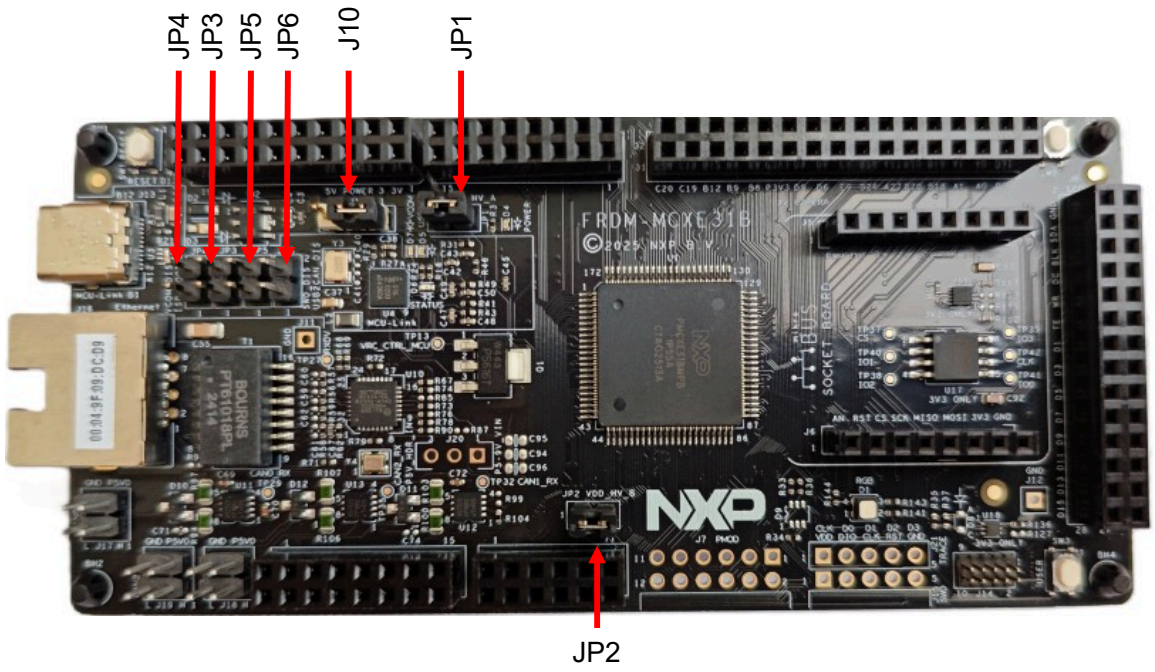

Figure 5. FRDM-MCXE31B board jumpers

Table 4 describes the FRDM-MCXE31B board jumpers.

Table 4. FRDM-MCXE31B jumpers

Part identifier	Jumper type	Description
JP3	1x2-pin header	MCU-Link (LPC55S16) ISP mode enable jumper: • **Open (default setting)**: MCU-Link (LPC55S16) follows the normal boot sequence (MCU-Link boots from its internal flash if a boot image is found). With the internal flash erased, the MCU-Link normal boot sequence falls through to In-System Programming (ISP) boot mode. • **Shorted**: MCU-Link is forced to ISP mode (USB1). Use this setting to reprogram the MCU-Link internal flash with a new image or use the MCUXpresso IDE with the CMSIS-DAP protocol. ***Note:*** *By default, the MCU-Link internal flash is preprogrammed with a version of the CMSIS-DAP firmware.*
JP4	1x2-pin header	MCU-Link VCOM port disable jumper: • **Open (default setting)**: MCU-Link VCOM port is enabled. • **Shorted**: Sends a low signal on LPC_HW_VER_6 to disable MCU-Link VCOM port
JP5	1x2-pin header	MCU-Link SWD disable jumper: • **Open (default setting):** Enables the MCU-Link SWD feature. • **Shorted**: Sends a low signal on LPC_HW_VER_7 to disable the onboard MCU-Link SWD feature. ***Note:*** *This configuration is required to enable target MCU debug through an external debug probe.*

Table 4. FRDM-MCXE31B jumpers*...continued*

Part identifier	Jumper type	Description
JP6	1x2-pin header	USB-to-CAN bridge disable jumper: • **Open (default setting)**: the MCU-Link acts as a USB-to-CAN bridge between the host computer and the target MCU. • **Shorted**: the USB-to-CAN bridge is disabled.
J10	1x3-pin header	MCU power selection • **Pin 1-2 shorted** (**default setting**): the target MCU is sourced from the P3V3 power supply. • **Pin 2-3 shorted**: the target MCU is sourced from the 5 V power supply.
JP1	1x2-pin header	MCU VDD_HV_A selection • **Pin 1-2 shorted** (**default setting**): VDD_HV_A is sourced from the 3.3 V or 5 V power supply. • **Pin 1-2 open**: VDD_HV_A is powered down.
JP2	1x2-pin header	MCU VDD_HV_B selection • **Pin 1-2 shorted** (**default setting**): VDD_HV_B is sourced from the 3.3 V power supply. • **Pin 1-2 open**: VDD_HV_B is powered down.

1.7 Push buttons

Figure 6 shows the FRDM-MCXE31B board push buttons.

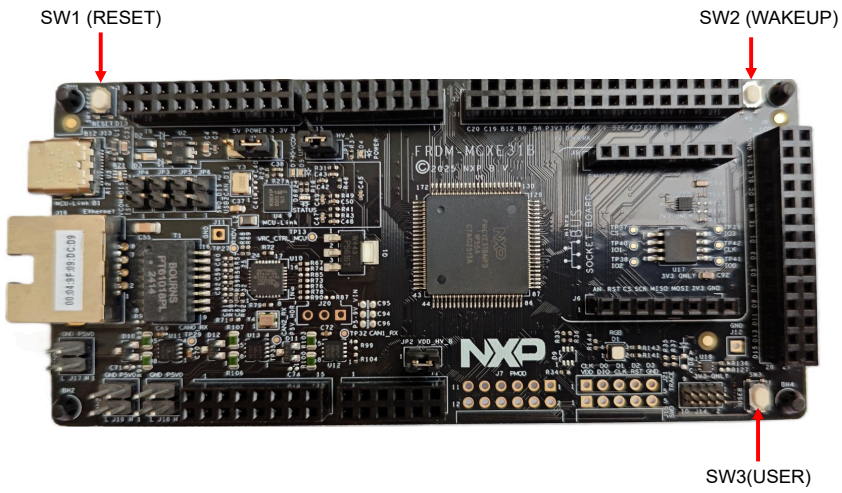

Figure 6. FRDM-MCXE31B board push buttons

Table 5 describes the FRDM-MCXE31B board push buttons.

Table 5. FRDM-MCXE31B push buttons

Part identifier	PCB label	Name/function	Description
SW1	RESET	Reset button	Pressing SW1 asserts the MCXE31B MCU pin PTA5 (RESET_b), which wakes up the MCU from any mode. When SW1 is pressed, the reset LED D13 turns ON.
SW2	WAKEUP	Power (wake-up) button	SW2 is a general-purpose input and a low-power wake-up unit pin. Pressing SW2 gives a low level on PTB23/WAKEUP_SW2. Otherwise, it is a high level on PTB23/WAKEUP_SW2.
SW3	USER	User button	Pressing SW3 asserts a low level on the MCXE31B MCU pin PTD5.

1.8 LEDs

The FRDM-MCXE31B board provides light-emitting diodes (LEDs) for monitoring system status. The information collected from the LEDs can be used for debugging purposes.

Figure 7 shows the FRDM-MCXE31B board LEDs.

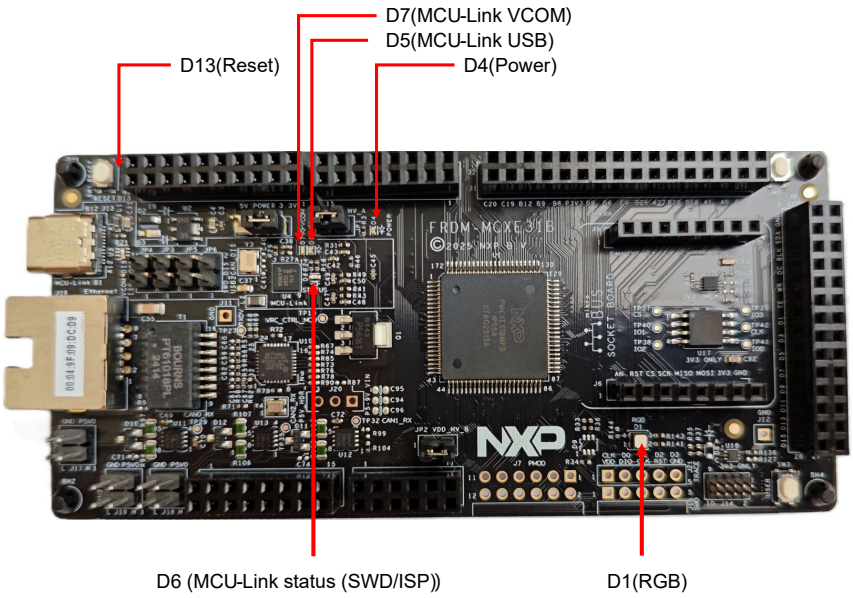

Figure 7. FRDM-MCXE31B board LEDs

Table 6 describes the FRDM-MCXE31B board LEDs. For information about the MCU-Link-specific LEDs, refer toSection 3.8.

Table 6. FRDM-MCXE31B LEDs

Part identifier	PCB label	LED color	LED name/function	Description (when LED is ON)
D4	POWER	Green	MCU power-on indicator LED	Indicates MCU power-on status. When the MCU is powered up, D4 turns ON.
D13	RESET	Red	Reset LED	Indicates system reset activity. When board reset is initiated, for example, by pressing the reset button (SW1), D13 turns ON.
D1	RGB	Red/green/blue	RGB LED	User-defined LEDs, which can be controlled through a user application.

Note: *MCU-Link-specific LEDs D5, D6, and D7 are described in Section 3.9.*

2 Functional description

This section describes the power supplies, memories, clocks, sensors, expansion ports, and debug information. It also includes a description of the board interfaces (such as Ethernet, FlexCAN, Arduino, mikroBUS) and their connections.

2.1 Power supplies

The FRDM-MCXE31B board is powered up using one of the following primary power supply options:

- P5V_MCU_LINK supply from MCU-Link USB2.0 Type-C connector (J13)
- P5V0 supply from Arduino Shield compatible header, J3 (pin 10)
- P5V_HDR_IN supply from a 5 V regulator populated at 3-pin jumper J20, which is DNP by default). See Figure 13.

The power supplies provide power to board components, including the MCXE31B MCU, MCU-Link, QSPI flash memory, CAN transceiver, accelerometer, Arduino socket, mikroBUS socket, and Pmod connector.

A supply voltage ranging from 2.7 V to 5.5 V can be used to power up the MCXE31B MCU. The J10 jumper on the board can be used to power the MCU with either 3.3 V or 5 V supply. However, the MCU-Link debugger MCU LPC55S16JEV59 is always 3.3 V powered.

Note: *When powered by a 5 V supply, the onboard Ethernet PHY, sensors (FXLS8974CFR3 and NMH1000), and MCU-link, can all communicate normally with the MCXE31B MCU. This is because the VDD_HV_B is always powered by a 3.3 V supply.*

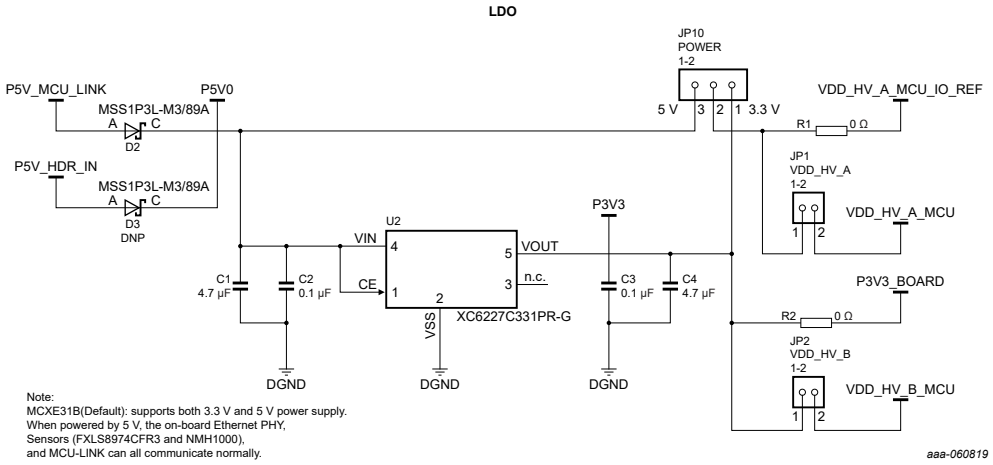

Figure 8. FRDM-MCXE31B board power sources and selection

Table 7 describes the 5 V input power sources and their output power supplies.

Table 7. 5 V power sources and selection

Part identifier	Device or power source	Output power supply	Description
J13	MCU-Link USB2.0 Type-C connector	P5V_MCU_LINK	• One of the sources of P5V0 (5 V) supply (default option) • USB regulator input power supply for MCU-Link microcontroller LPC55S16
J20 (DNP)	DC voltage regulator attached to connector	P5V_HDR_IN	One of the sources for P5V0 (5 V) supply

Table 7. 5 V power sources and selection*...continued*

Part identifier	Device or power source	Output power supply	Description
J3 (pin 10)	Arduino shield compatible header	P5V0	One of the sources for P5V0 (5 V) supply

3.3 V power sources and selection

Table 8 describes the 3.3 V input power sources and their output power supplies.

Table 8. 3.3 V power sources and selection

Part identifier	Device / power source	Output power supply	Description
U2	XC6227C331PR-G	P3V3	One of the sources for P3V3 supply (default selection)
J3 (pin 8)	Arduino shield compatible header	P3V3	One of the sources for P3V3 supply (default selection)

2.1.1 Power supply configuration

Once the main power configurations are set, the target MCU power configurations must be made using jumpers. See Figure 8. These jumpers provide access to insert ammeters in all the supplies connecting to the MCU device. They also provide a means of connecting external supplies to any of the MCX power pins.

Table 9 describes the power supply configurations for MCU analog, USB, and other operations.

Table 9. Power supply configurations

Power source	Zero-ohm resistor or Jumper used	Power supply rail	Description
P3V3	JP1	VDD_HV_A_MCU	Power supply for the MCU VDD_HV_A (for default 3.3 V)
	JP2	VDD_HV_B_MCU	Power supply for the MCU VDD_HV_B
	R2 resistor (installed)	P3V3_BOARD	Power supply for: • FXLS8974CFR3 I2C sensor • Magnetic switch • Level shifters. • QSPI flash memory • Crystal oscillator • CAN transceiver TJA1057 • RGB LED • mikroBUS connector • Pmod connector • IO Expander1 connector • IO Expander1 connector • MCU-Link LPC55S16

2.2 Clocks

Table 10 describes the clocks available on the FRDM-MCXE31B board.

Table 10. FRDM-MCXE31B board clocks

Clock generator	Clock frequency	Destination	Destination
Crystal oscillator, Y1	16MHZ	• XTAL of target MCU MCXE31B • EXTAL of target MCU MCXE31B	For high-frequency accurate time base
Crystal oscillator, Y2	32.768 kHz	• PTA24/OSC32K_XTAL of target MCU MCXE31B • PTA25/OSC32K_EXTAL of target MCU MCXE31B	MCXE31B MCU (RTC section)
Crystal oscillator, Y3	16 MHz	XTAL32M_N/P pins of LPC55S16 MCU-Link	Option for external clock input
Crystal oscillator, Y4	50 MHz	RMII 10/100 Mbit/s Ethernet transceiver LAN8741A-EN	Provides clock at XTAL1/CLKIN pin of Ethernet PHY. Also, it provides a provision to feed the clock back into the target MCU (MCXE31B) through (ENET_TXCLK)

2.3 Ethernet interface

The target MCU (MCXE31B) features one Ethernet controller (ENET) module. On the FRDM-MCXE31B board, the Ethernet controller connects to an RJ45 connector through an Ethernet PHY transceiver. The FRDM-MCXE31B board only supports RMII configuration.

Table 11 describes the onboard devices supporting the Ethernet interface.

Table 11. Ethernet interface devices

Part identifier	Part name and Manufacturer	Description
J16	Heling MJ88B-B011-RVL11-P	Shielded RJ45 connector jack with magnetic built-in to connect to an Ethernet cable
U10	Microchip Technology LAN8741 A-EN	Single-chip 10 / 100 Mbit/s RMII Ethernet PHY compliant with IEEE802.3/802.3u (Fast Ethernet), ISO 802-3/IEEE 802.3 (10 BASE-T), and Energy-Efficient Ethernet IEEE 802.3az
T1	Bourns PT61018PEL	Dual-channel 16-pin Ethernet transformer for LAN 10/100 Base-Tx

Input to the XTAL1/CLKIN pin of the Ethernet PHY is a 50 MHz clock from an external 50 MHz crystal oscillator (Y4). The oscillator is enabled by default. The clock circuit also provides a provision to feed the clock back into the target MCU (MCXE31B) through ENET_TXCLK.

2.4 FlexCAN interface

The MCXE31B MCU has six Flexible Controller Area Network (FlexCAN) modules: CAN0 to CAN5. The FRDM-MCXE31B board supports communication with the CAN0, CAN1, and CAN2 modules.

Table 12 describes the FRDM-MCXE31B FlexCAN connections.

Table 12. FlexCAN connections

FlexCAN module	Peripheral devices		
	Part identifier	Manufacturer and part number	Description
CAN0 / CAN1 / CAN2	U11 / U12 / U13	NXP TJA1057GTK/3Z	U11, U12, and U13 are high-speed CAN transceivers, which drive CAN signals between the CAN module of the MCXE31B MCU and a physical two-wire CAN bus. They perform the following functions: • Receive digital data from the MCU, converts it into analog data, and sends it to CAN bus lines. • Receive analog data from the CAN bus lines, converts it into digital data, and sends it to the MCU.
	J17 / J18 / J19		J17, J18, and J19 are 2x2-pin headers that allow external CAN connection with the CAN bus. Each has the following pinout: • Pin 1: High-level CAN bus line connection • Pin 2: Low-level CAN bus line connection • Pin 3: Power connection (P5V0) • Pin 4: GND

Figure 9 shows the FlexCAN0 interface schematic.

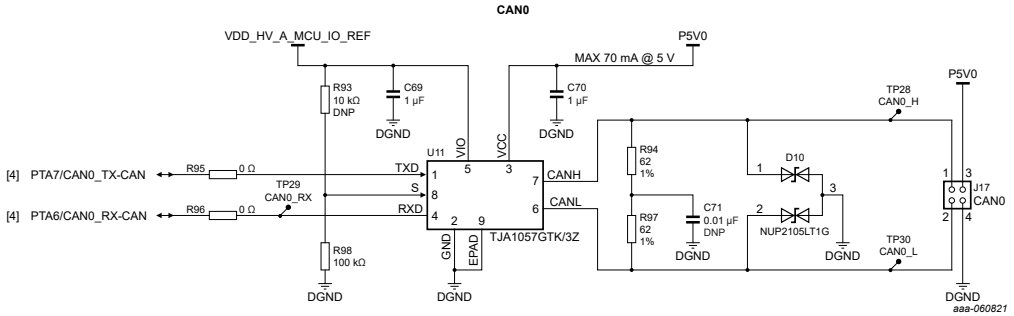

Figure 9. Schematic view of the FlexCAN0 interface

2.5 Accelerometer sensor

The FRDM-MCXE31B board has a 3-axis, compact digital accelerometer (NXP FXLS8974CFR3). This accelerometer sensor is designed for use in automotive remote keyless entry (key fob) applications that require ultra-low-power wake-up on motion.

The accelerometer supports:

- ±2/4/8/16 g user-selectable, full-scale measurement ranges.
- 12-bit acceleration data.
- 8-bit temperature sensor data.
- I2C interface supporting frequencies of up to 1 MHz.
- 3-wire or 4-wire SPI interface with clock frequencies of up to 4 MHz.

Figure 10 shows the accelerometer sensor on FRDM-MCXE31B board. For more information on the FXLS8974CFR3 sensor, visit nxp.com.

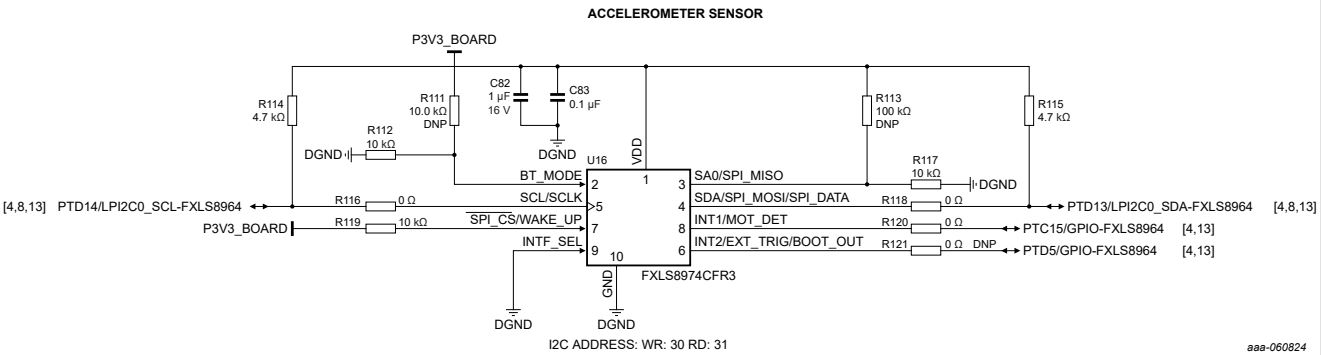

Figure 10. Accelerometer sensor on FRDM-MCXE31B board

2.6 Magnetic switch

The FRDM-MCXE31B board has a Hall effect magnetic field switch (NXP NMH1000). The switch is most sensitive to a vertical field passing through the top-to-bottom surfaces, orthogonal to the plane of the application printed-circuit board. It operates at low voltage, low current, low output data rate, and has a small physical size.

The switch supports:

- Threshold selection 3-state hardware pin.
- Threshold selection data bit (or bits) in an I2C accessible register.
- Sample rate selection 3-state hardware pin.
- Sample rate selection data bit (or bits) in an I2C accessible register.
- Mode selection hardware pin to select between standalone or I2C serial interface.
- Mode selection data bit (or bits) in an I2C accessible register.
- Two types of output indicate the absence of a magnetic field as compared to an internally set threshold:
  - Binary state hardware pin.
  - Binary state data bit (or bits), configurable as assert-high or assert-low, in an I2C accessible register.

For more information on NMH1000, visit https://www.nxp.com/.

Figure 11 shows the Magnetic switch schematic diagram.

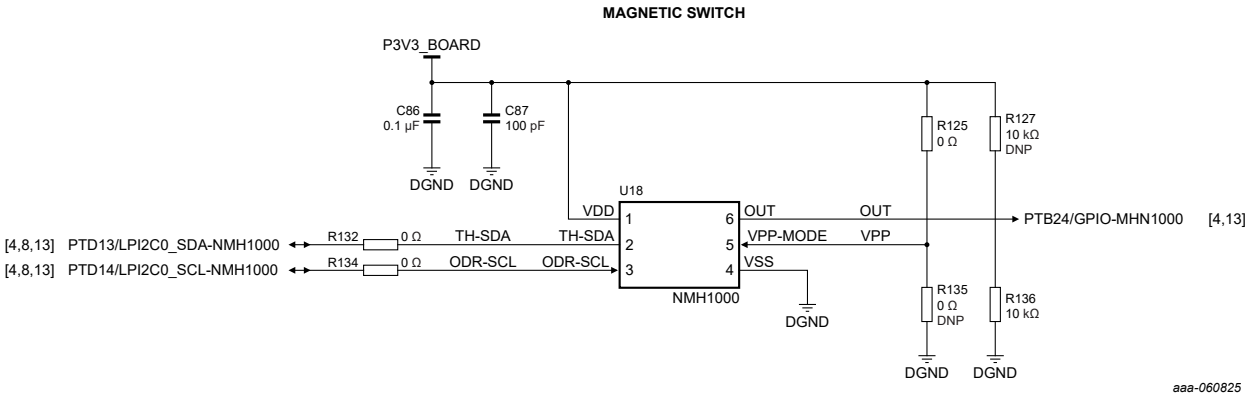

Figure 11. Magnetic switch schematic diagram

2.7 Flash memory interface

The target MCU (MCXE31B) features one Quad Serial Peripheral Interface (QuadSPI) controller, which can support an external memory. On the FRDM-MCXE31B board, the MCU MCXE31B QuadSPI controller can connect to an onboard QSPI flash memory.

The flash memory VCC is supplied by the P3V3 rail.

Note: *When MCXE31B is powered by a 5 V supply, the flash W25Q64JVSSIQ cannot be connected.*

Table 13 provides the details of the flash memory used on the board.

Table 13. Flash memory

Part identifier	Manufacturer and part name	Description
U17	Winbond W25Q64JVSSIQ	It is a 3 V 64-Mbit (8 MB) serial flash memory. For feature details, refer to the device data sheet.

Figure 12 shows the flash memory circuit diagram.

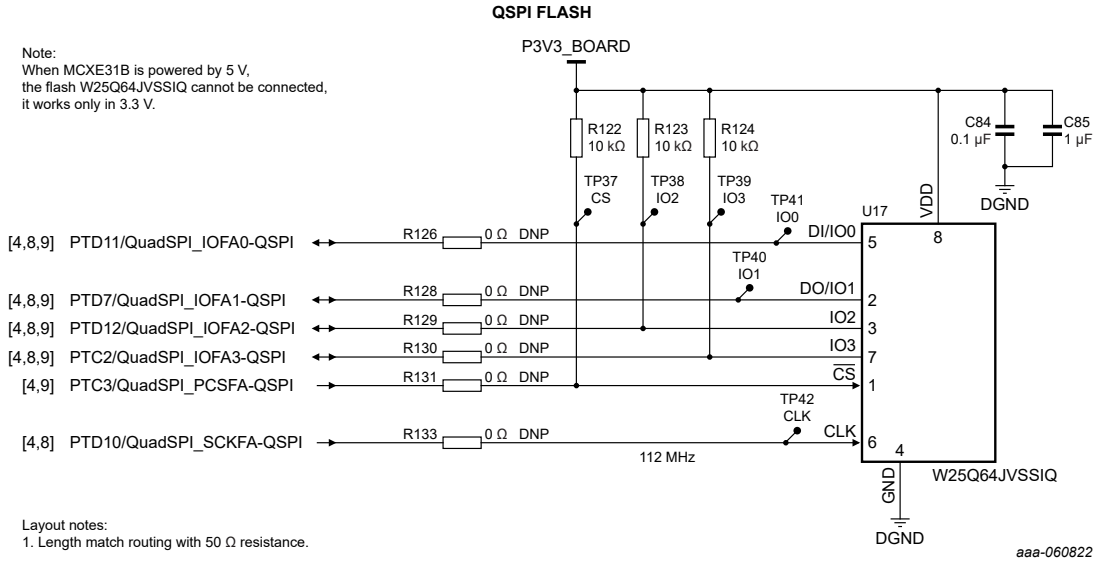

Figure 12. Flash memory circuit diagram

2.8 Arduino compatible I/O headers

The FRDM-MCXE31B board provides Arduino Uno compatible headers to support the Arduino and FRDM ecosystem shield modules. These headers are dual-row headers with the outer rows supporting the Arduino compatible shields and the inner rows supporting the various FRDM shields. These headers are designed to support the following shields:

- Sensor: FRDM-STBC-AGM01, FRDM-STBC-AGM04, FRDM-FXS-MULT2-B
- NFC: OM5577, OM5578
- USB Type C: OM13790 (Host)
- Motor control: FRDM-MC-LVBLDC, FRDM-MC-LVPMSM

Table 14 describes the connectors of the Arduino socket.

Table 14. Arduino socket connectors

Part identifier	Connector type
J1	2x8 position receptacle
J2	2x10 position receptacle
J3	2x8 position receptacle
J4	2x6 position receptacle

Figure 14 shows the pinouts of the Arduino socket connectors.

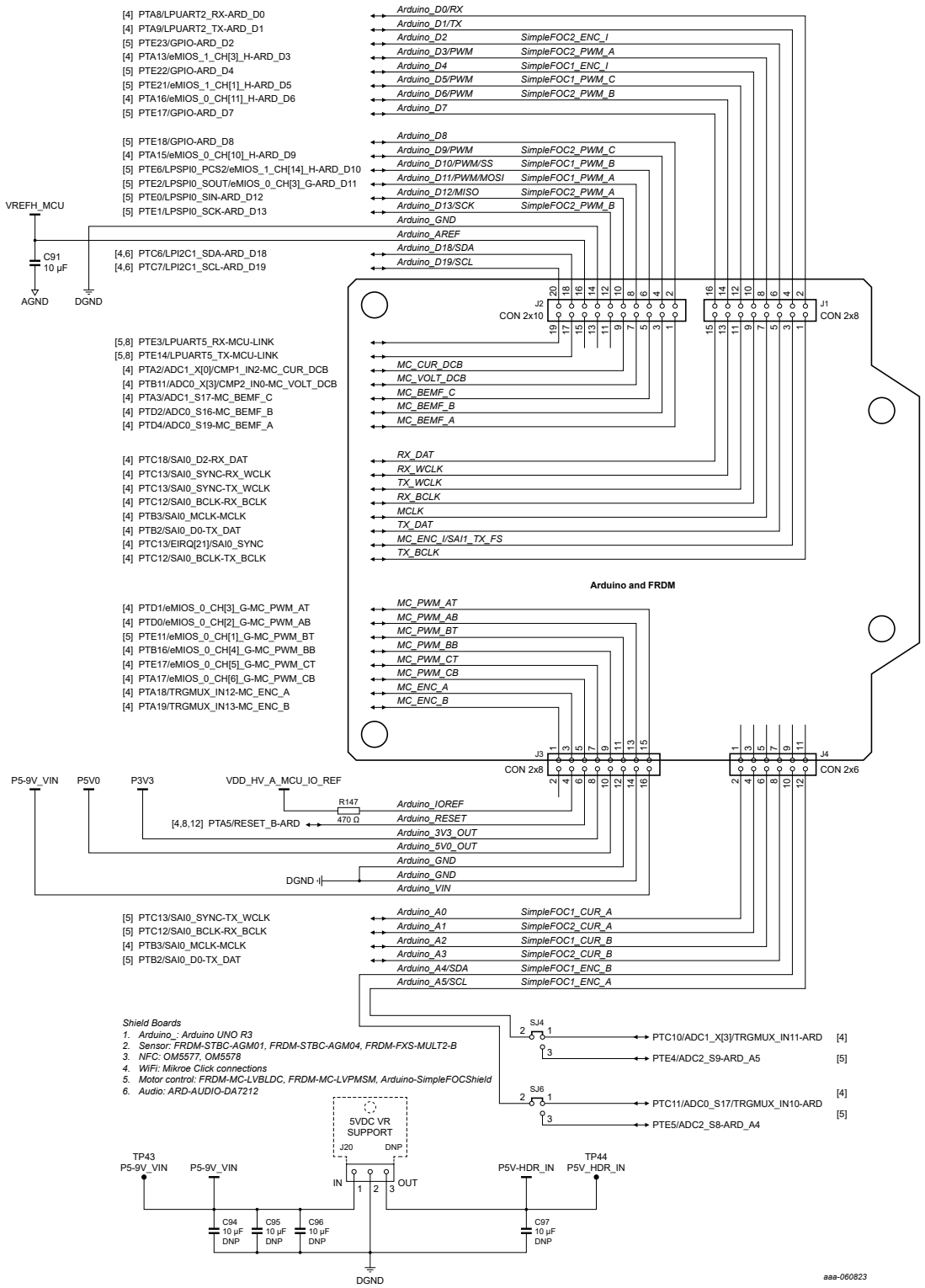

Figure 13. Arduino socket connector pinouts

2.9 mikroBUS header

A mikroBUS socket is a pair of 1x8-position receptacles (connectors) with a proprietary pin configuration and silkscreen markings. It provides the option of multiple hardware expansion using only a few pins.

The FRDM-MCXE31B board has a mikroBUS socket with a pair of 1x8-position receptacles, J5 and J6. Table 15 and Table 16 describe the pinouts of the mikroBUS headers (J5 and J6).

Table 15. J6 header pinout

Pin number	Net name	GPIO	Function / Signal name
1	AN	PTA14	ADC1_P4-MIKROE
2	RST	PTC15	GPIO_MIKROE
3	CS	PTB18	LPSPI1_PCS1_MIKROE
4	SCK	PTA28	LPSPI1_SCK_MIKROE
5	MISO	PTA29	LPSPI1_SIN_MIKROE
6	MOSI	PTA30	LPSPI1_SOUT_MIKROE
7	3V3	P3V3	3.3 V power line
8	GND	GND	Ground

Table 16. J5 header pinout

Pin number	Net name	GPIO	Function / Signal name
1	PWM	PTB23	eMIOS_1_CH[19]_Y-MIKROE
2	INT	PTB24	GPIO-MIKROE
3	RX	PTD17	LPUART2_RX-MIKROE
4	TX	PTE12	LPUART2_TX-MIKROE
5	SCL	PTD9	LPI2C1_SCL-MIKROE
6	SDA	PTD8	LPI2C1_SDA-MIKROE
7	5V0	P5V0	5 V power line
8	GND	GND	Ground

An add-on board, called *click board*, can be installed on a mikroBUS socket. A click board provides a plug-and-play solution for adding new functionality to a board design. A click board has a pair of 1x8-pin headers that connect to the pair of receptacles on a mikroBUS socket. Microelectronic (MIKROE) is one of the manufacturers of click boards. To find some click boards for the FRDM-MCXE31B mikroBUS socket, visit the MIKROE website.

2.10 Pmod header

Digilent Pmod (peripheral module) devices are small input/output interface boards that can be easily integrated with embedded control boards for expanding their capabilities.

The FRDM-MCXE31B board supports a Pmod connector J7 (Digilent PPPC062LJBN-RC) for expanding the capabilities of the board. It can be used to work with a remote host, or as an interface to a Pmod expansion board.

Table 17 describes the pinout of the Pmod header.

Table 17. Pmod header pinout

Pin number	GPIO	Function name / Signal name	Resistor setting
1	PTB25	LPSPI2_PCS0-PMOD	-
2	PTB22	GPIO-PMOD	-
3	PTB27	LPSPI2_SOUT-PMOD	-
4	PTC16	GPIO-PMOD	-
5	PTB28	LPSPI2_SIN-PMOD	-
6	PTD14	LPI2C0_SCL-PMOD	SJ5 pin 1-2 selection (default setting)
	PTA21	LPSPI2_PCS2-PMOD	SJ5 pin 2-3 selection
7	PTB29	LPSPI2_SCK-PMOD	-
8	PTD13	LPI2C0_SDA-PMOD	SJ3 pin 1-2 selection (default setting)
	PTA15	LPSPI2_PCS3-PMOD	SJ3 pin 2-3 selection
9	-	GND	-
10	-	GND	-
11	-	P3V3	-
12	-	P3V3	-

2.11 IO expander headers

IO expanders J8 and J9 bring out pin signals that are present in the 172-pin package. They also expose some trace signals from the board and include the FlexIO interface to connect to the LCD and camera as shown in Figure 14.

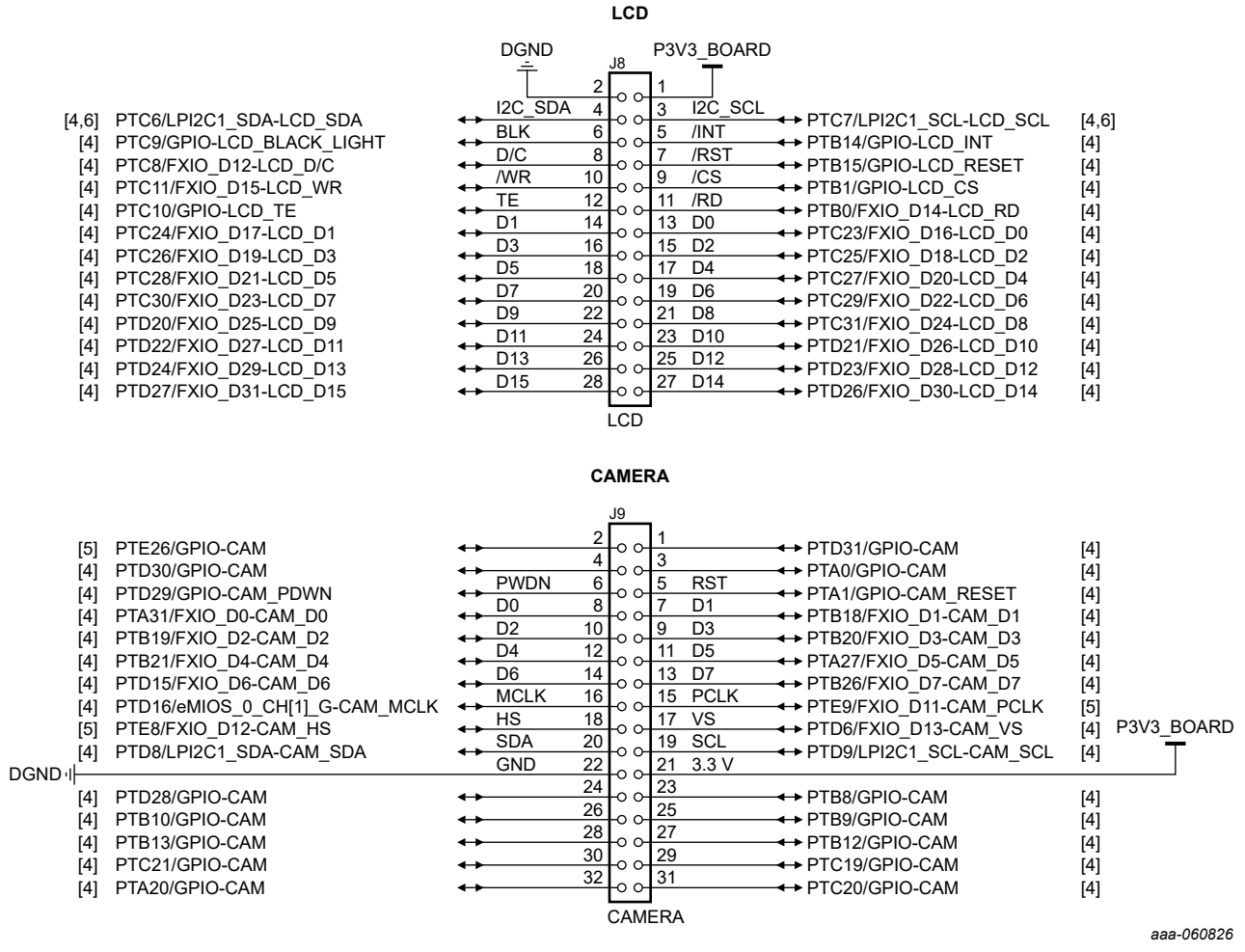

Figure 14. IO expanders J8 and J9

3 MCU-Link OB debug probe

MCU-Link is a debug probe architecture jointly developed by NXP and Embedded Artists. The MCU-Link architecture is based on the NXP LPC55S16 MCU, which is based on an Arm Cortex-M33 core. It can be configured to support different debug feature options.

The MCU-Link architecture is used in:

• Standalone debug probes, such as MCU-Link Pro

• Onboard debug probes implemented on NXP evaluation boards, such as FRDM-MCXE31B. The onboard implementation of MCU-Link is referred to as MCU-Link OB.

The FRDM-MCXE31B board implements a subset of the MCU-Link architecture features, as mentioned in Section 3.1 For more details on the MCU-Link architecture, visit the MCU-Link Debug Probe Architecture page.

The MCU-Link OB on the FRDM-MCXE31B board is factory-programmed with the firmware based on the NXP CMSIS-DAP protocol. The firmware also supports all other features supported in the hardware. A custom version of the J-Link firmware to make MCU-Link OB compatible with J-Link LITE is also available. However, this firmware version only supports limited features, including debug/SWO and VCOM. For more information, refer to the URL:

https://www.nxp.com/design/design-center/software/development-software/mcuxpresso-software-and-tools-/mcu-link-debug-probe:MCU-LINK.

3.1 Supported MCU-Link features

MCU-Link includes several mandatory and optional features. Table 18 summarizes the MCU-Link features supported on the FRDM-MCXE31B board.

Table 18. Supported MCU-Link features

Feature	Description
Serial wire debug (SWD) / serial wire debug trace output (SWO)	MCU-Link allows SWD-based debugging with SWO for profiling and/or low overhead debug standard I/O communication.
Virtual communication (VCOM) serial port	MCU-Link adds a serial COM port on the host computer and connects it to the target MCU, while acting as a USB-to-UART bridge.
USB serial input/output (USBSIO[1]) port	MCU-Link adds a USB serial I/O port on the host computer and connects it to the target MCU, while acting as a USB-to-I2C bridge.
External debug probe support	The MCU-Link interface supports debugging the target MCU (MCX E31B) using an external debug probe, instead of MCU-Link. Support for an external debug probe is enabled by disabling the SWD feature.

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

3.2 Supported debug scenarios

Table 19 describes the debug scenarios supported on the FRDM-MCXE31B board.

Table 19. Supported debug scenarios

Debug scenario	Feature support	Required jumper/connector settings
Use MCU-Link for debugging the MCX E31B MCU	SWD: Enabled	MCU-Link SWD enabled if jumper JP5 is open.
		Target MCU external debugger connector J14 is not used for external connection.
	VCOM: Enabled	MCU-Link VCOM port enable if jumper JP4 is open.
Use an external debugger for debugging the MCX E31B MCU	SWD: Not supported	Short JP5
	-	Connect the external debugger to J14.
	VCOM: Not supported	JP4 is shorted.

3.3 MCU-Link firmware update utility installation

The MCU-Link debug probe is supported on a host computer running a Windows 10/11, MacOS X, or Ubuntu Linux operating system (OS). The debug probe works with standard OS drivers. For Windows, the MCU-Link firmware installation program also includes information files to provide user-friendly device names.

Support for MCU-Link can be enabled using the LinkServer utility, which is an NXP GDB server and flash utility that supports many NXP debug probes. For more details on this utility, visit the https://nxp.com/linkserver page.

Running the LinkServer installer also installs a firmware update utility and the drivers (information files) required for MCU-Link. NXP recommends using the LinkServer installer for installing the MCU-Link firmware update utility.

Note: *If the MCU-Link firmware version is 3.155 or later, an automatic firmware update can be done using LinkServer installer version 24.12.15 or later. For more details on automatic firmware update, refer to the Readme mark-down file in the LinkServer installation package. However, if the current firmware version is earlier than 3.155, you require to run manually the MCU-Link firmware update utility, which is included in the LinkServer installation package.*

To download and update the firmware for the MCU-Link debug probe, refer to the URL:

https://www.nxp.com/design/design-center/software/development-software/mcuxpresso-software-and-tools-/mcu-link-debug-probe:MCU-LINK

To work with MCU-Link, NXP recommends using the latest MCU-Link firmware. If you are using the tools MCUXpresso IDE and LIBUSBIO, check their versions before updating the MCU-Link firmware on your host computer. Refer Table 20 to check the compatibility of these tools with the MCU-Link firmware. If you are using the MCUXpresso for Visual Studio Code extension or a third-party IDE from IAR or Keil, NXP recommends using the latest MCU-Link firmware version.

Table 20. Compatibility check between MCUXpresso IDE and MCU-Link firmware

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

Table 20. Compatibility check between MCUXpresso IDE and MCU-Link firmware*...continued*

MCUXpresso IDE version	Supported MCU-Link firmware version	USB driver type	CMSIS-SWO support	FreeMASTER support via	
				SWD / JTAG	USB bridge
MCUXpresso 11.7.1 or later	V3.117 and later	WinUSB	Yes	Yes	FreeMASTER V3.2.2 or later
MCUXpresso 24.12.100 or later	V3.155 and later	WinUSB	YES	Yes	FreeMASTER V3.2.2 or later

3.4 Using MCU-Link with development tools

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

- MCUXpresso IDE
- MCUXpresso for Visual Studio Code
- IAR Embedded Workbench
- Arm Keil MDK

3.4.1 Using MCU-Link with MCUXpresso IDE

The MCUXpresso IDE recognizes any type of MCU-Link probe that uses either the 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 a 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 download and update the firmware for the MCU-Link debug probe, refer to the URL:

https://www.nxp.com/design/design-center/software/development-software/mcuxpresso-software-and-tools-/mcu-link-debug-probe:MCU-LINK.

It is recommended to use the latest MCU-Link firmware to utilize the latest functionality. However, the MCU-Link firmware version that you can use depends on the MCUXpresso IDE installed on your host computer. To check the MCU-Link firmware version that is compatible with your MCUXpresso IDE, refer to Table 20.

3.4.2 Using MCU-Link with MCUXpresso for Visual Studio Code

The MCU-Link debug probe can be used with the MCUXpresso for Visual Studio Code extension from NXP. This extension uses the LinkServer debug server. To work with MCUXpresso for Visual Studio Code, install the LinkServer utility using the MCUXpresso Installer tool or as described in Section 3.3. For more details on MCUXpresso for Visual Studio Code, visit the MCUXpresso for Visual Studio Code page.

3.4.3 Using MCU-Link with third-party IDEs

The MCU-Link debug probe can be used with third-party IDEs, such as IAR Embedded Workbench and Arm Keil MDK. For more details, refer to the third-party tool documentation, covering the use of generic CMSIS-DAP probes or J-Link probes (depending on the firmware image you are using).

3.5 MCU-Link USB connector

The FRDM-MCXE31B board has a USB Type-C connector J13, which allows you to connect MCU-Link with your host computer. It can also be used to supply 5 V power to the board.

3.6 VCOM port (USB to target UART bridge)

MCU-Link supports a feature, known as *virtual communication (VCOM) serial port*. This feature allows MCU-Link to add a serial COM port on the host computer and connect it to the target MCU. In this setup, MCU-Link acts as a USB-to-UART bridge.

In the FRDM-MCXE31B board, MCU-Link is connected to the LPUART2 module of the target MCU.

To use MCU-Link as a USB-to-UART bridge, follow these steps:

1. Ensure that jumper JP2 is open (MCU-Link boots normally).
2. Ensure that jumper JP3 is open (MCU-Link VCOM port is enabled).
3. Connect the MCU-Link USB connector J13 to the USB port of the host computer.

When you boot the FRDM-MCXE31B 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 VCOM function can be disabled by shorting jumper JP3, before powering up the board. Changing the JP3 setting (open/short) after powering up the board has no impact on the MCU-Link VCOM function.

3.7 USBSIO port (USB to target I2C bridge)

MCU-Link supports a feature known as *USB serial input/output (USBSIO) port*. This feature allows MCU-Link to add a USB serial I/O port on the host computer and connect it to the target MCU. In this setup, MCU-Link acts as a USB-to-I2C bridge.

USBSIO feature support can be enabled on the host computer by using the `libusbsio` library, which is a free host library from NXP for Windows/Linux/MacOS systems. For more details on the libusbsio library, see https://www.nxp.com/libusbsio.

The FRDM-MCXE31B board supports connecting MCU-Link to the LPI2C0 module of the target MCU. By default, this I2C connection is disabled. It can be enabled by populating the following resistors:

- 0 Ω resistors R47 and R50

To use MCU-Link as a USB-to-I2C bridge, connect the board to the host computer by using a USB cable at J13 connector. A USB-to-I2C bridge can be used to emulate the host system / board peripherals.

By default, the USBSIO feature is disabled for I2C on the FRDM-MCXE31B board, allowing the target MCU I2C port to be used for other purposes. Disabling the USBSIO feature instructs the firmware not to enumerate the USB endpoint for USBSIO (which is called “MCU-Link LPCSIO” for backward compatibility reasons). Disabling the USBSIO feature also frees more USB bandwidth for the SWO profiling feature and energy measurement feature of MCU-Link.

Note: *The energy measurement feature of MCU-Link is not supported on the FRDM-MCXE31B board.*

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3.8 MCU-Link status LEDs

The FRDM-MCXE31B board has three status indicator LEDs for MCU-Link. Table 21 lists these LEDs and describes how each LED behaves in different MCU-Link modes. These LEDs are shown in Figure 15.

Table 21. MCU-Link LEDs

Part identifier	PCB label	LED color	LED function		
			Normal operation (with CMSIS-DAP)	Normal operation (with J-Link)	ISP (firmware update) mode
D5	USB_ACT	Green	Indicates USB communication. The LED lights up after successful USB enumeration at startup, and then stays ON.	The LED remains OFF.	The LED remains OFF.
D6	ISP_EN	Red	Indicates MCU-Link status / SWD activity. It acts as a heartbeat LED (fades in/ out repeatedly), with SWD activity overlaid. If an error occurs at startup, the D7 LED blinks rapidly.	The LED remains OFF.	The LED lights up when MCU-Link (LPC55S16) boots in ISP mode.
D7	VCOM_ ACT	Green	Indicates if the VCOM port is receiving/sending data. The LED lights up when MCU-Link boots, and then blinks when debug activity happens.	Indicates if the VCOM port is receiving/sending data. The LED lights up when MCU-Link boots, and then blinks when debug activity happens.	The LED remains OFF.

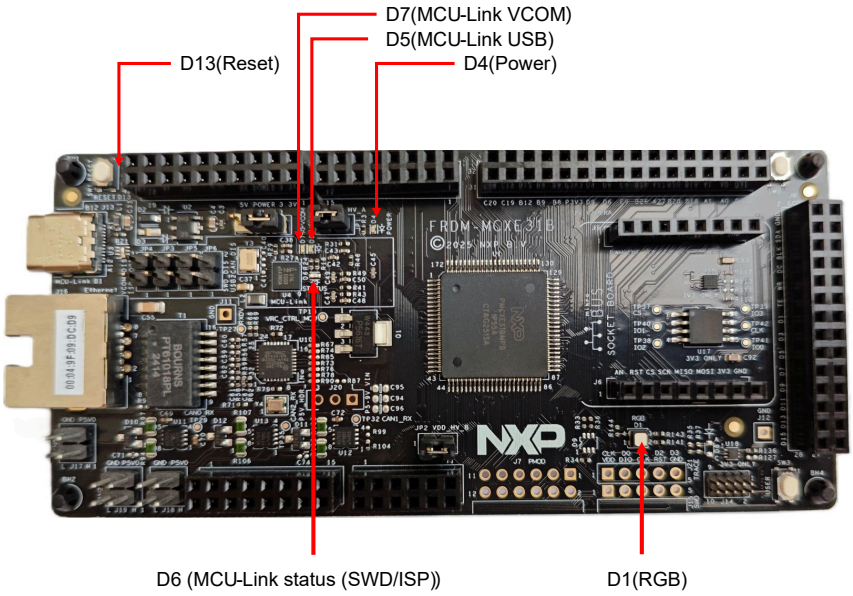

Figure 15. MCU-link LEDs

4 Board errata

Board errata is not applicable for the current board revision.

5 Acronyms

Table 22 lists the acronyms used in this document.

Table 22. Acronyms and abbreviations

Acronym	Description
ADC	Analog-to-digital converter
CAN	Controller area network
DNP	Do not populate / do not place
DUT	Device under test
FlexCAN	Flexible Controller Area Network
HID	Human interface device
I2C or I^2C	Inter-Integrated Circuit
IoT	Internet of Things
ISP	In-System Programming
LCD	Liquid-crystal display
LDO	Low-dropout regulator
LE	Low Energy
LED	Light-emitting diode
LPI2C	Low-Power Inter-Integrated Circuit
LPSPI	Low-Power Serial Peripheral Interface
LPUART	Low-Power Universal Asynchronous Receiver/Transmitter
MCU	Microcontroller unit
MISO	Multiple Input, Single Output
MOSI	Controller Output Target Input
MSK	Minimum shift keying
NMI	Non-maskable interrupt
OB	Onboard
OS	Operating system
PCS	Peripheral chip select
PDA	Personal digital assistant
PWM	Pulse Width Modulator
RF	Radio frequency
RTC	Real-time clock
RX	Receive
SPI	Serial Peripheral Interface
SWD	Serial wire debug
SWO	Serial wire debug trace output
TFT	Thin-film transistor

Table 22. Acronyms and abbreviations...*continued*

Acronym	Description
TPM	Timer/PWM Module
TX	Transmit
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
USBSIO	USB serial input/output
VCOM	Virtual communication

6 Related documentation

Table 23 lists some additional documents and resources that you can refer to for more information on the FRDM-MCXE31B board.

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

Table 23. Related documentation

Document	Description	Link / how to obtain
MCXE31B Reference Manual	Provides a detailed description about the MCXE31B MCU and its features, including memory maps, power supplies, and clocks.	Contact your NXP FAE / sales representative
MCXE31B Product Family Data Sheet	Provides information about the MCXE31B electrical characteristics, hardware design considerations, and ordering information.	
FRDM-MCXE31B board schematics	Provides a circuit representation showing the functionality and connectivity of the FRDM-MCXE31B board components.	
MCXE31B Chip Errata	Lists the details of all known silicon errata for the MCXE31B device.	Contact your NXP FAE / sales representative
LPC55S1x User manual (UM11295)	Intended for system software and hardware developers and application programmers who want to develop products with LPC55 S1x MCU	UM11295 download URL

For more information, refer to the URL: https://www.nxp.com/products/processors-and-microcontrollers/arm-microcontrollers/general-purpose-mcus/mcx-arm-cortex-m/mcx-e-series-microcontrollers:MCX-E-SERIES.

7 Revision history

Table 24 summarizes the revisions to this document.

Table 24. Document revision history

Document ID	Release date	Description
UM12330 v.2.0	20 August 2025	First public release
UM12330 v.1.0	21 July 2025	Preliminary internal release

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