UM12012

FRDM-MCXA153 Board User Manual

Rev. 1 — 25 January 2024 User manual

Document information

Information	Content
Keywords	UM12012, FRDM-MCXA153, MCXA1xx, Pmod, mikroBUS, Arduino, MCU-Link
Abstract	The FRDM-MCXA153 board is a design and evaluation platform based on the NXP MCXA1xx MCU.

1 Board overview

The FRDM-MCXA153 board is a design and evaluation platform based on the NXP MCXA1xx MCU. The MCXA1xx MCU is a low-power microcontroller for industrial and consumer Internet of Things (IoT) applications. It has one Arm Cortex-M33 core running at speeds of up to 96 MHz. It supports industrial communication protocol, brushless direct current (BLDC) motor / permanent magnet synchronous motor (PMSM) control, and integrated sensor interfaces (MIPI-I3C, I2C, and SPI).

The board is compatible with the Arduino UNO R3 and Mikroe click boards. It can be used with a wide range of development tools, including NXP MCUXpresso IDE, IAR Embedded Workbench, and Arm Keil MDK. The board is lead-free and RoHS-compliant.

For debugging the MCXA1xx MCU, the FRDM-MCXA153 board uses an onboard (OB) debug probe, MCU-Link OB, which is based on another MCU, LPC55S69. The MCXA1xx MCU and the LPC55S69 MCU are also referred to as "target MCU" and "debug MCU", respectively, in this document.

This document provides details about the FRDM-MCXA153 board interfaces, power supplies, clocks, connectors, jumpers, push buttons, and LEDs.

1.1 Block diagram

Figure 1 shows the FRDM-MCXA153 board block diagram.

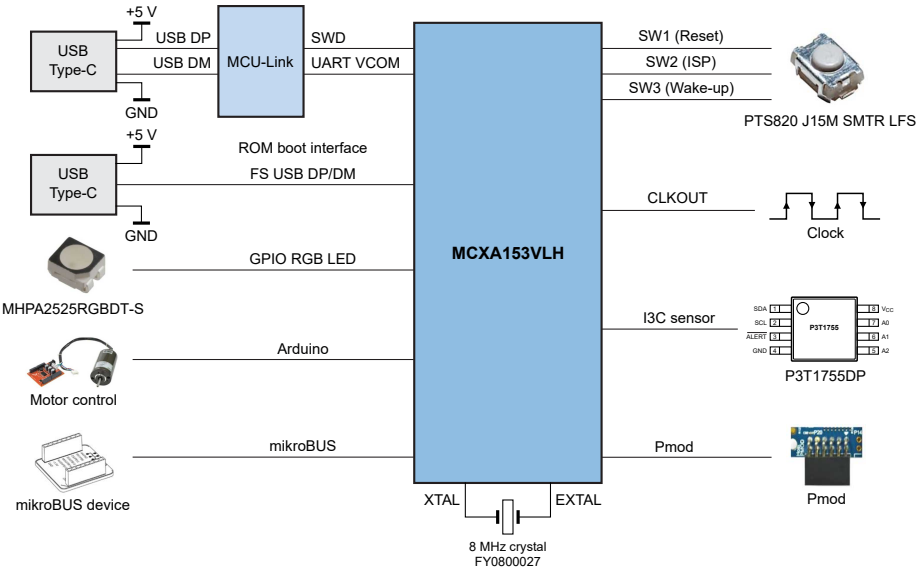

Figure 1. FRDM-MCXA153 block diagram

1.2 Board features

Table 1 lists the features of the FRDM-MCXA153 board.

Table 1. FRDM-MCXA153 features

Board feature	Target MCU features used	Description
MCU		NXP MCXA1xx MCU (part number: MCXA153VLH) based on an Arm Cortex-M33 core, running at speeds of up to 96 MHz. ***Note:*** *For details on the MCXA1xx MCU, see MCXA1xx Reference Manual and MCXA1xx Low-Power MCU sub-family Data Sheet.*

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Table 1. FRDM-MCXA153 features*...continued*

Board feature	Target MCU features used	Description
USB interface	USBFS0 module	USB Type-C connector J8
LPUART interface	LPUART0 module	MCU-Link (LPC55S69)
	LPUART2 module	mikroBUS socket connector J5 or Arduino socket connector J1
LPSPI interface	LPSPI0 module	mikroBUS socket connector J6 or Pmod connector J7 (DNP)
	LPSPI1 module	Arduino socket connector J2
LPI2C interface	LPI2C0 module	mikroBUS socket connector J5, Pmod connector J7 (DNP), and Arduino socket connector J2
I3C interface	I3C0 module	Digital temperature sensor (P3T1755DP)
Pmod connector		Pmod connector J7 (DNP)
mikroBUS socket		Two mikroBUS socket connectors J5 and J6
Arduino socket		Four Arduino socket connectors J1, J2, J3, and J4
Debug interface		MCU-Link onboard debug probe with a USB Type-C connector J15 for debugging the MCXA1xx MCU
Power supply		The following power supply options are available: • Two USB Type-C connectors, each can receive 5 V external power • 5-9 V input supply option from Arduino socket connector J3
Clocks		8 MHz clock for target MCU (MCXA1xx) and 16 MHz clock for debug MCU (LPC55S69)
Orderable part number		FRDM-MCXA153

1.3 Kit contents

Table 2 lists the items included in the FRDM-MCXA153 board hardware kit.

Table 2. Kit contents

Item	Quantity
FRDM-MCXA153 board hardware assembly	1
USB 3.0 Type-A to Type-C cable, 1 meter	1
FRDM-MCXA153 Quick Start Guide	1

1.4 Board pictures

Figure 2 shows the top-side view of the FRDM-MCXA153 board with MCXA1xx MCU highlighted.

Figure 2. Board top-side view

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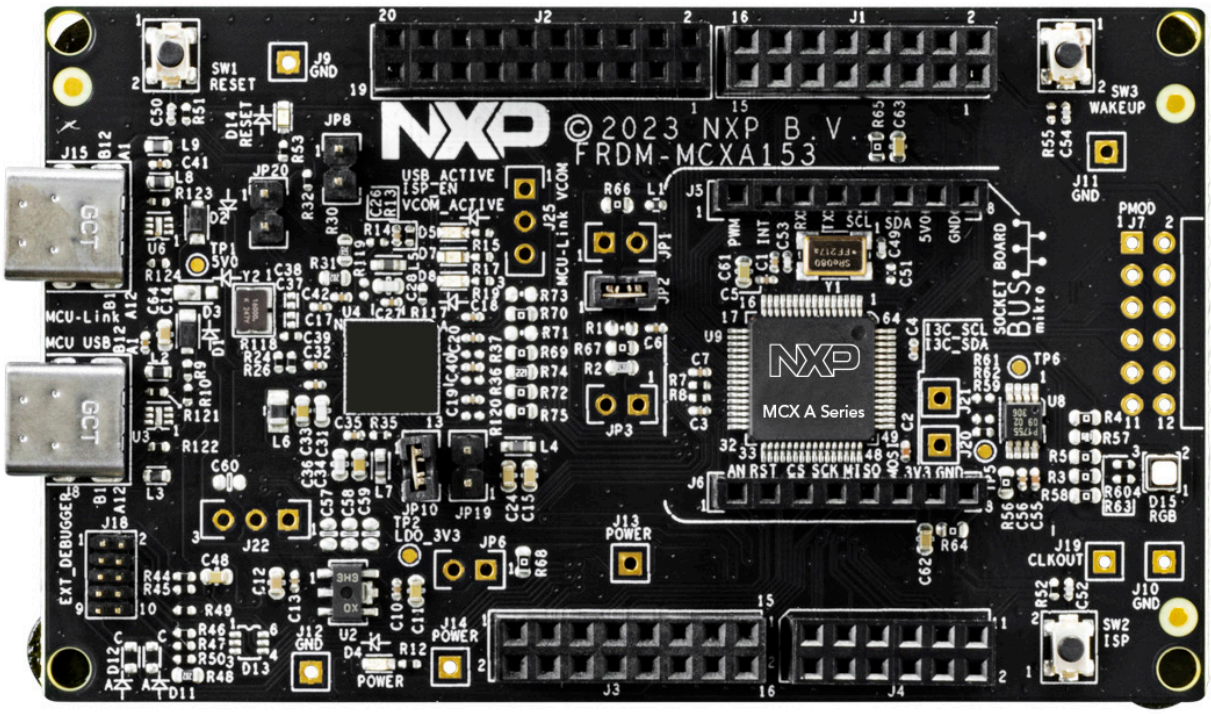
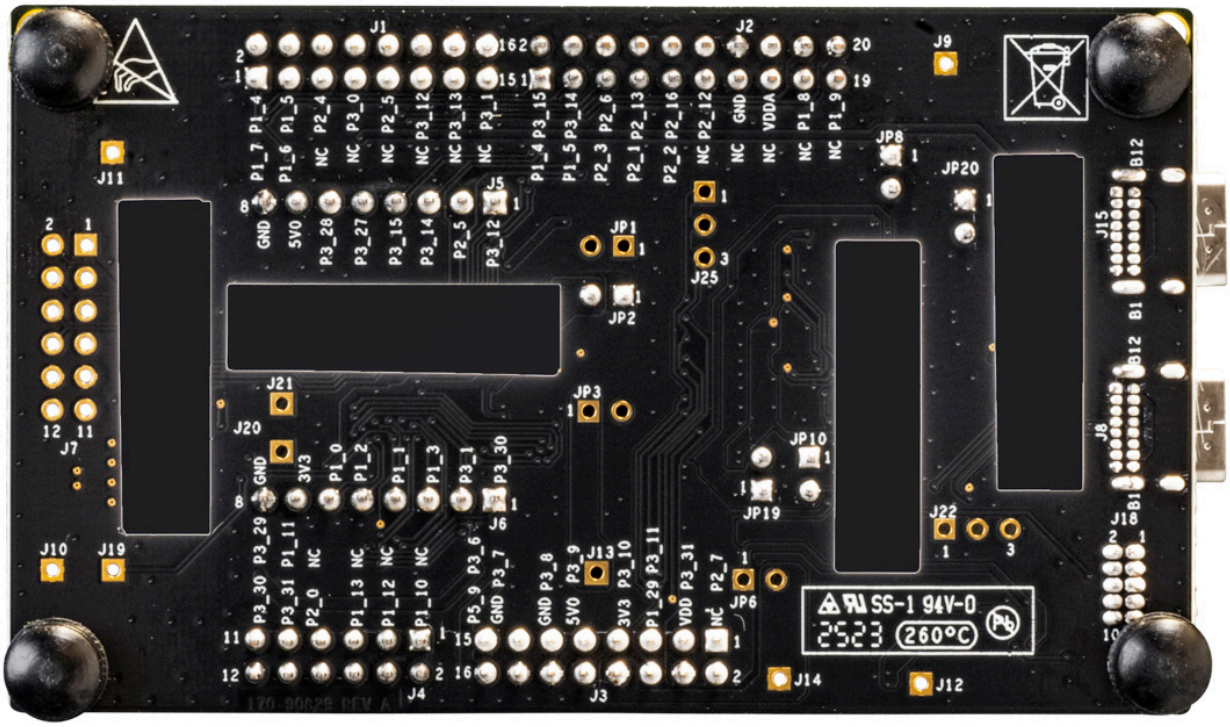


Figure 3 shows the bottom-side view of the FRDM-MCXA153 board.

Figure 3. Board bottom-side view



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1.5 Connectors

Figure 4 shows the FRDM-MCXA153 board connectors.

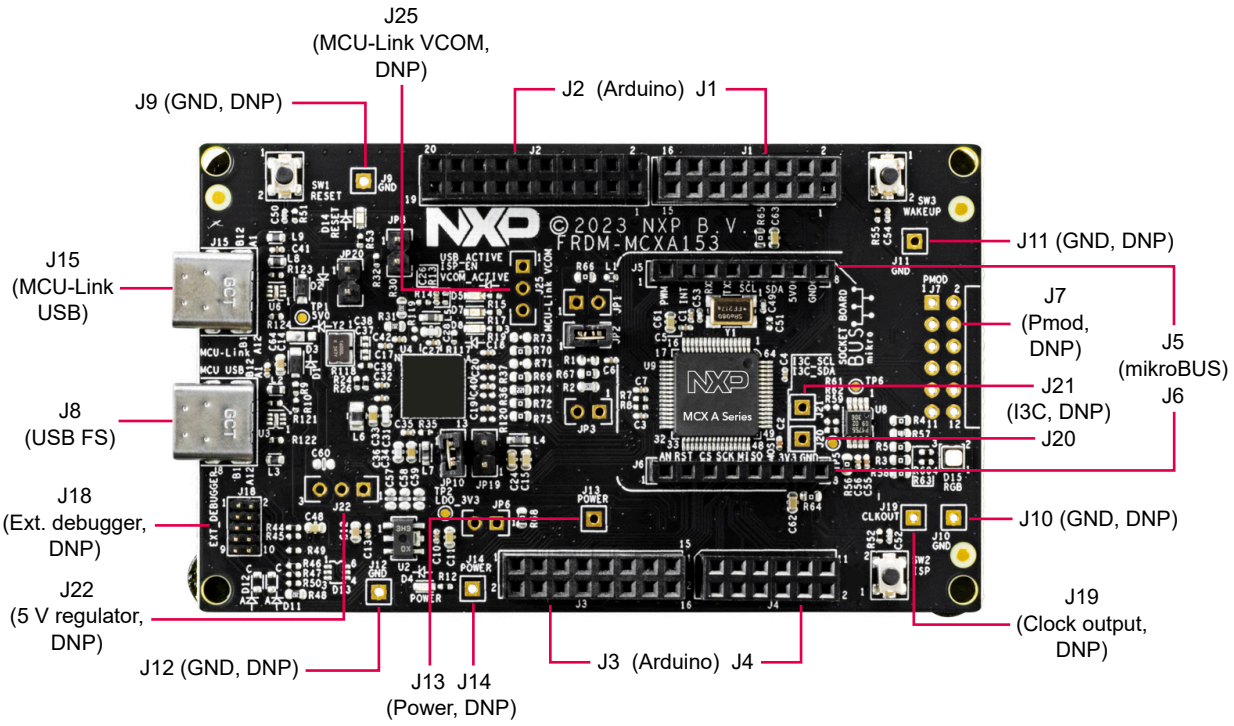

Figure 4. Connectors

Note: *External debugger connector (J18), which is shown populated in Figure 4, is not populated on the FRDM-MCXA153 boards shipped to customers.*

Table 3 describes the connectors available on the FRDM-MCXA153 board.

Table 3. FRDM-MCXA153 connectors

Part identifier	PCB label	Connector type	Description	Reference section
J1		2x8-position receptacle	Arduino socket connectors	Section 2.10
J2		2x10-position receptacle		
J3		2x8-position receptacle		
J4		2x6-position receptacle		
J5	mikroBUS SOCKET BOARD	1x8-position receptacle	mikroBUS socket connectors	Section 2.9
J6		1x8-position receptacle		
J7 (DNP)	PMOD	2x6-pin/position connector	Pmod connector	Section 2.8
J8	MCU USB	USB Type-C connector	USB full-speed connector	Section 2.3
J9 (DNP)	GND	1-pin/position connector	GND test point connectors	For more information on these connectors, see FRDM-MCXA153 board schematics.
J10 (DNP)	GND	1-pin/position connector		
J11 (DNP)	GND	1-pin/position connector		
J12 (DNP)	GND	1-pin/position connector		

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Table 3. FRDM-MCXA153 connectors...*continued*

Part identifier	PCB label	Connector type	Description	Reference section
J13 (DNP)	POWER	1-pin/position connector	Power test point connectors	
J14 (DNP)	POWER	1-pin/position connector		
J15	MCU-Link	USB Type-C connector	MCU-Link USB connector	Section 3.6
J18 (DNP)	EXT_ DEBUGGER	2x5-pin/position connector	Target MCU external debugger connector	Section 3.2
J19	CLKOUT	1-position receptacle	Clock output test point connector	Section 2.2
J20	I3C_SDA	1-pin header	I3C data test point connector	Section 2.7
J21	I3C_SCL	1-pin header	I3C clock test point connector	
J22 (DNP)		1x3-pin/position connector	5 V DC voltage regulator	Section 2.1
J25 (DNP)	MCU-Link VCOM	1x3-pin/position connector	MCU-Link VCOM connector	Section 2.4

1.6 Jumpers

Figure 5 shows the FRDM-MCXA153 board jumpers.

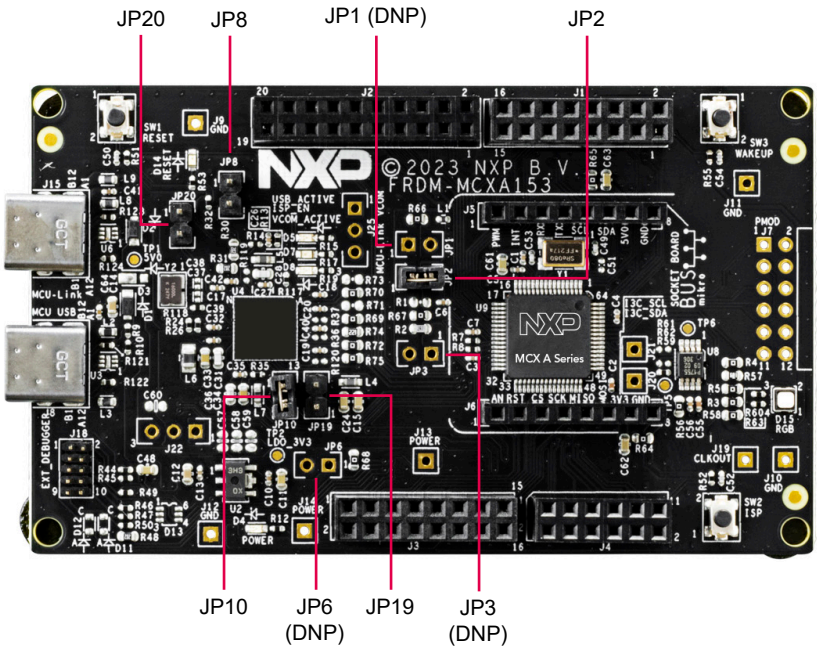

Figure 5. Jumpers

Table 4 describes the FRDM-MCXA153 board jumpers.

Table 4. FRDM-MCXA153 jumpers

Part identifier	Jumper type	Description	Reference section
JP1 (DNP)	1x2-pin header	Target MCU (MCXA1xx) analog power enable jumper. JP1 is not populated on the board. When populated	Section 2.1

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Table 4. FRDM-MCXA153 jumpers...*continued*

Part identifier	Jumper type	Description	Reference section
		(after removing resistor R66), it can be used to serve the following two purposes: • To produce the target MCU analog power supply, VDDA_MCU. • To measure the current consumption of analog IPs of the target MCU. For more details, see Section 2.1.1.	
JP2	1x2-pin header	Target MCU digital power enable jumper: • Open: The target MCU digital power supply, VDD_MCU, is OFF. • Shorted (default setting): The target MCU digital power supply, VDD_MCU, is produced. JP2 can also be used to measure current consumption of digital IPs of the target MCU. For more details, see Section 2.1.1.	
JP3 (DNP)	1x2-pin header	Target MCU total (analog + digital) power enable jumper. JP3 is not populated on the board. When populated (after removing resistor R2), it can be used to serve the following two purposes: • To produce the target MCU analog + digital power supply, MCU_VDD_P3V3. • To measure the total current consumption of the target MCU. For more details, see Section 2.1.1.	
JP6 (DNP)	1x2-pin header	Board (except target MCU) power enable jumper. JP6 is not populated on the board. When populated (after removing resistor R68), it can be used to serve the following two purposes: • To produce the board (except target MCU) power supply, VDD_BOARD. • To measure the current consumption of the board (except target MCU). For more details, see Section 2.1.1.	
JP20	1x2-pin header	MCU-Link SWD disable jumper: • Open (default setting): MCU-Link serial wire debug (SWD) feature is enabled. MCU-Link can be used to drive SWD of the target MCU. • Shorted: MCU-Link SWD feature is disabled. This setting of JP20 can be used when connecting an external debugger through connector J18 (not populated) for debugging the target MCU.	Section 3.2
JP8	1x2-pin header	MCU-Link (LPC55S69) ISP mode enable jumper: • Open (default setting): MCU-Link follows the normal boot sequence (MCU-Link boots from 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.	Section 3.4

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Table 4. FRDM-MCXA153 jumpers...*continued*

Part identifier	Jumper type	Description	Reference section
		Note: *By default, MCU-Link flash is preprogrammed with a version of CMSIS-DAP firmware.*	
JP19	1x2-pin header	MCU-Link VCOM port disable jumper: • Open (default setting): MCU-Link virtual communication (VCOM) port is enabled. • Shorted: MCU-Link VCOM port is disabled.	Section 3.7
JP10	1x2-pin header	MCU-Link SWD clock enable jumper: • Open: MCU-Link SWD clock is disabled. • Shorted (default setting): MCU-Link SWD clock is enabled. MCU-Link drives SWD of the target MCU.	For more information on these jumpers, see FRDM-MCXA153 board schematics.

1.7 Push buttons

Figure 6 shows the FRDM-MCXA153 board push buttons.

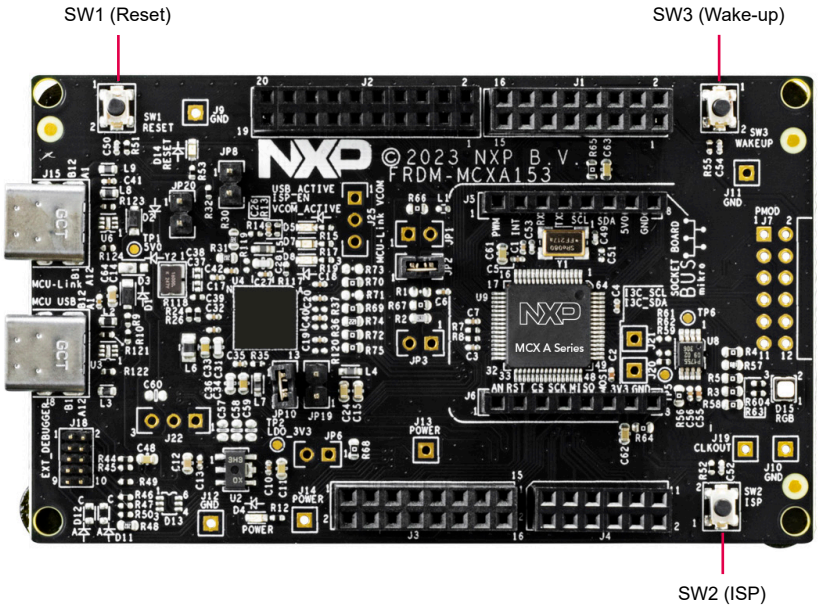

Figure 6. Push buttons

Table 5 describes the FRDM-MCXA153 board push buttons.

Table 5. FRDM-MCXA153 push buttons

Part identifier	PCB label	Name/function	Description
SW1	RESET	Reset button	Pressing SW1 asserts the MCXA1xx MCU pin P1_29 (RESET_b), which wakes up the target MCU from any mode. Keep SW1 pressed for a reasonable period of time to let the MCU perform a JTAG boundary scan.
SW2	ISP	ISP button	Helps the target MCU boot code to determine if the MCU should enter into the ISP mode. It connects to the target MCU pin P3_29.

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Table 5. FRDM-MCXA153 push buttons...*continued*

Part identifier	PCB label	Name/function	Description
			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, the ISP mode can be useful to recover control of the board.
SW3	WAKEUP	Wake-up button	Wakes up the target MCU from Deep Power-Down mode. It connects to the target MCU pin P1_7.

1.8 LEDs

The FRDM-MCXA153 board provides numerous 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-MCXA153 board LEDs.

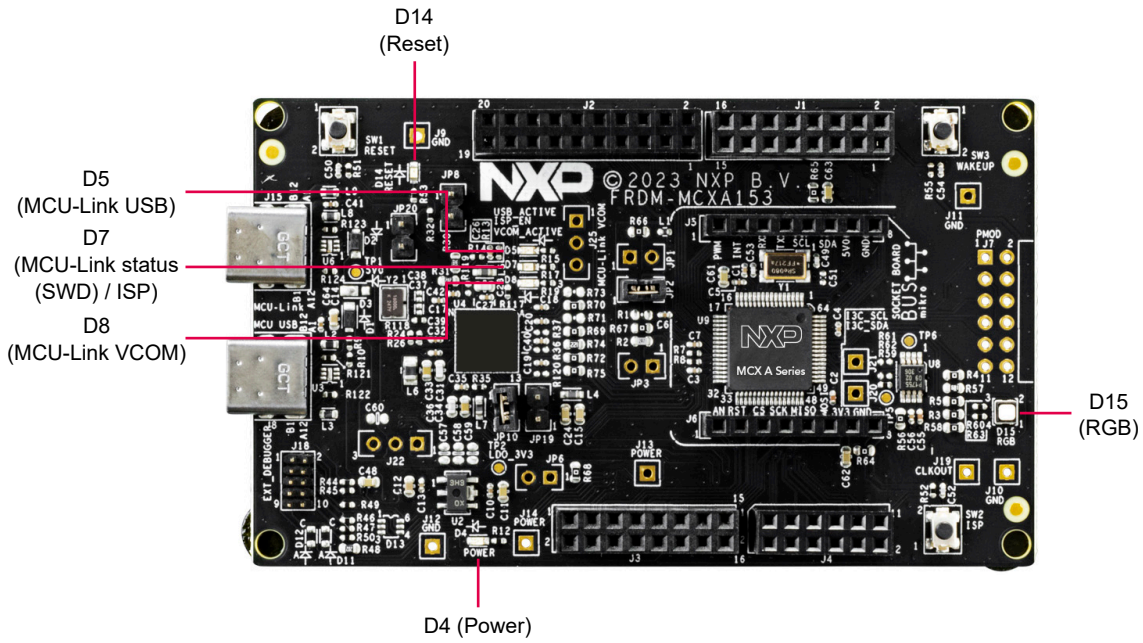

Figure 7. LEDs

Table 6 describes the FRDM-MCXA153 board LEDs that correspond to the target MCU. The board also has some MCU-Link specific LEDs, which are described in Section 3.8.

Table 6. FRDM-MCXA153 LEDs

Part identifier	PCB label	LED color	Description (when LED is ON)
D4	POWER	Green	LDO_3V3 supply is available.
D14	RESET	Red	Indicates system reset activity. When board reset is initiated, for example, by pressing the reset button (SW1), D14 turns ON.
D15	RGB	Red/green/blue	User application LED. It can be controlled through a user application.

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2 Functional description

This section contains the following subsections:

2.1 Power supplies

The FRDM-MCXA153 board is powered up using the following primary power supplies:

- External 5 V power through USB Type-C connector J8
- External 5 V power through USB Type-C connector J15
- 5-9 V power from Arduino socket connector J3, pin 16

The primary power supplies are used to produce secondary power supplies for the board to power up other board components, including the MCXA1xx MCU, MCU-Link, I3C sensor, push buttons, and LEDs.

Table 7 describes the FRDM-MCXA153 board power supplies.

Table 7. FRDM-MCXA153 power supplies

Power source	Manufacturer and part number	Power supply	Description
External supply through USB Type-C connector J8		P5V_USB_FS (5 V)	One of the three power source options for SYS_5V0 supply
External supply through USB Type-C connector J15		P5V_MCU_LINK_USB (5 V)	• Second power source option for SYS_5V0 supply • Provides USB1_VBUS power to the LPC55S69 MCU (MCU-Link)
Arduino socket connector J3, pin 16		P5-9V_VIN (5-9 V)	Supplies power to 5 V DC voltage regulator J22 (not populated)
Voltage regulator J22 (DNP)		P5V_HDR_IN (5 V)	Third power source option for SYS_5V0 supply
From P5V_USB_FS / P5V_MCU_LINK_USB / P5V_HDR_IN supply ***Note:*** *By default, the option to produce SYS_5V0 supply from P5V_HDR_IN supply is disabled.*		SYS_5V0 (5 V)	Supplies power to: • LDO voltage regulator U2 • mikroBUS socket connector J5 • Arduino socket connector J3
LDO voltage regulator U2	Torex Semiconductor XC6227C331PR-G	LDO_3V3 (3.3 V)	• Produces MCU_VDD_P3V3 supply through either 2.7 Ω resistor R2 or jumper JP3 (not populated)

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Table 7. FRDM-MCXA153 power supplies*...continued*

Power source	Manufacturer and part number	Power supply	Description
			• Produces VDD_BOARD supply through either 0 Ω resistor R68 or jumper JP6 (not populated) • Supplies power to: – Power LED D4 – Arduino socket connector J3
From LDO_3V3 supply through resistor R2 or jumper JP3 (DNP)		MCU_VDD_P3V3 (3.3 V)	• Produces VDD_MCU supply through either 0 Ω resistor R1 (not populated) or jumper JP2 • Produces VDDA_MCU supply through either 0 Ω resistor R66 or jumper JP1 (not populated) • Produces VDD_USB supply
From MCU_VDD_P3V3 supply through resistor R1 (DNP) or jumper JP2		VDD_MCU	Supplies digital power (VDD) to the MCXA1xx MCU
From MCU_VDD_P3V3 supply through resistor R66 or jumper JP1 (DNP)		VDDA_MCU	• Supplies analog power (VDD_ANA/VREFH) to the MCXA1xx MCU • Supplies power to Arduino socket connector J2
From MCU_VDD_P3V3 supply		VDD_USB	Supplies VDD_USB power to the MCXA1xx MCU
From LDO_3V3 supply through resistor R68 or jumper JP6 (DNP)		VDD_BOARD (3.3 V)	• Produces the following power supplies: – VDD_P3T – MCU_LINK_3V3 – VREF_MCULINK • Provides VDDA power to the LPC55S69 MCU (MCU-Link) • Supplies power to: – Push buttons SW1, SW2, and SW3 – Reset LED D14 – RGB LED D15 – Pmod connector J7 (not populated) – mikroBUS socket connector J6 – Arduino socket connector J3 – MCU-Link LEDs D5, D7, and D8 – Target MCU external debugger connector J18 (not populated)
From VDD_BOARD supply		VDD_P3T	Supplies power to I3C sensor U8
		MCU_LINK_3V3 (3.3 V)	Provides VDD, USB0_3V3, and USB1_3V3 powers to the LPC55S69 MCU (MCU-Link)
		VREF_MCULINK	Provides VREFP power to the LPC55S69 MCU (MCU-Link)

2.1.1 Current measurement

The FRDM-MCXA153 board supports current measurement using an ampere meter (ammeter) on power supplies shown in Table 8.

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Table 8. Power supplies with current measurement support

Power supply	Description	Current measurement jumper	Current measurement steps
VDDA_MCU	Target MCU (MCXA1xx) analog power	JP1 (DNP)	1. Remove resistor R66 and populate JP1. 2. Connect the ammeter between pins 1 and 2 of JP1.
VDD_MCU	Target MCU digital power	JP2	1. Open JP2. 2. Connect the ammeter between pins 1 and 2 of JP2.
MCU_VDD_P3V3	Target MCU total (analog + digital) power	JP3 (DNP)	1. Remove resistor R2 and populate JP3. 2. Connect the ammeter between pins 1 and 2 of JP3.
VDD_BOARD	Board (except target MCU) power	JP6 (DNP)	1. Remove resistor R68 and populate JP6. 2. Connect the ammeter between pins 1 and 2 of JP6.

2.2 Clocks

Table 9 provides details about inputs clocks on the FRDM-MCXA153 board.

Table 9. FRDM-MCXA153 clocks

Clock generator	Manufacturer and part number	Clock	Frequency	Destination
Crystal Y1 (DNP)	Diodes Incorporated FY0800027	XTAL48M, EXTAL48M	8 MHz	MCXA1xx MCU
Crystal Y2	KYOCERA AVX CX3225GA16000 D0PTVCC	MCU_LINK_[P, N]_16 MHz	16 MHz	LPC55S69 MCU

The MCXA1xx MCU also provides a clock output CLKOUT, which can be accessed by populating clock output test point connector J19.

2.3 USB interface

The MCXA1xx MCU has one Universal Serial Bus Full Speed (USBFS) module (USBFS0), which supports only Device mode. The FRDM-MCXA153 board implements support for the USBFS module through a USB Type-C connector, J8. The USB connector works in Device mode. It also flows 5 V power in the board.

2.4 LPUART interface

The MCXA1xx MCU has three Low-Power Universal Asynchronous Receiver/Transmitter (LPUART) modules: LPUART0, LPUART1, and LPUART2. The FRDM-MCXA153 board supports communication only with the LPUART0 and LPUART2 modules.

Figure 8 shows the FRDM-MCXA153 LPUART diagram.

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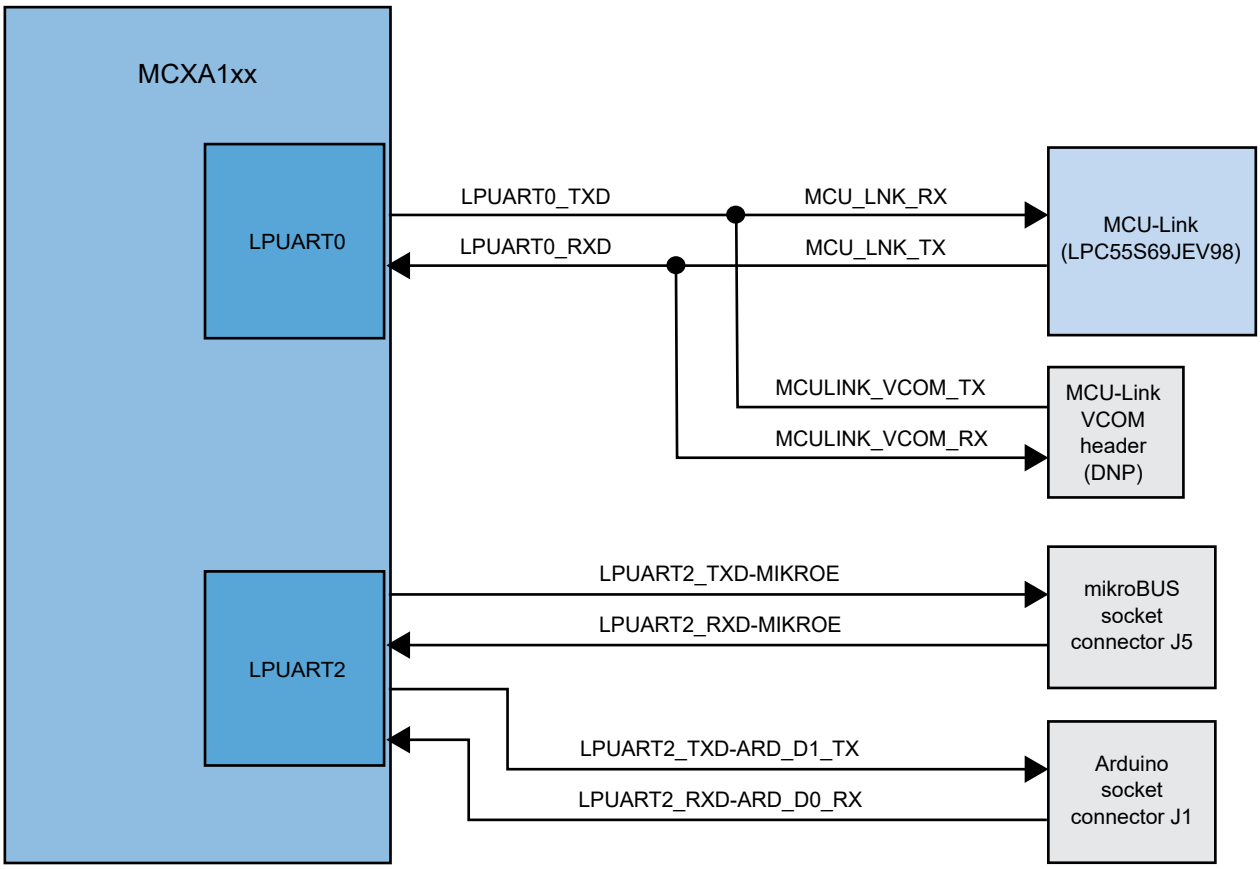

Figure 8. LPUART diagram

Table 10 describes the FRDM-MCXA153 LPUART connections.

Table 10. LPUART connections

LPUART module	Peripheral devices		
	Part identifier	Manufacturer and part number	Description
LPUART0	U4	NXP LPC55S69JEV98	MCU-Link, a 32-bit MCU based on the Arm Cortex-M33 core with speeds of up to 150 MHz. MCU-Link can be used as a USB-to-UART bridge to debug the target MCU (MCXA1xx) through a VCOM port.
	J25 (DNP)	—	MCU-Link VCOM header, a 1x3-pin header for accessing the MCU-Link VCOM port through an external connection. J25 is not populated on the board. J25 pinout is defined as follows: • Pin 1: MCULINK_VCOM_TX • Pin 2: GND • Pin 3: MCULINK_VCOM_RX
LPUART2	J5	—	One of the two mikroBUS socket connectors that allows a UART connection between the target MCU and the plugged-in mikroBUS click board.

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Table 10. LPUART connections*...continued*

LPUART module	Peripheral devices		
	Part identifier	Manufacturer and part number	Description
	J1	—	One of the four Arduino socket connectors that allows a UART connection between the target MCU and the plugged-in Arduino board.

2.5 LPSPI interface

The MCXA1xx MCU has two Low-Power Serial Peripheral Interface (LPSPI) modules: LPSPI0 and LPSPI1. Each LPSPI module supports two modes: Master mode (with support for up to four peripheral chip selects) and Slave mode.

The FRDM-MCXA153 board supports communication with both the LPSPI modules of the MCXA1xx MCU.

Figure 9 shows the FRDM-MCXA153 LPSPI diagram.

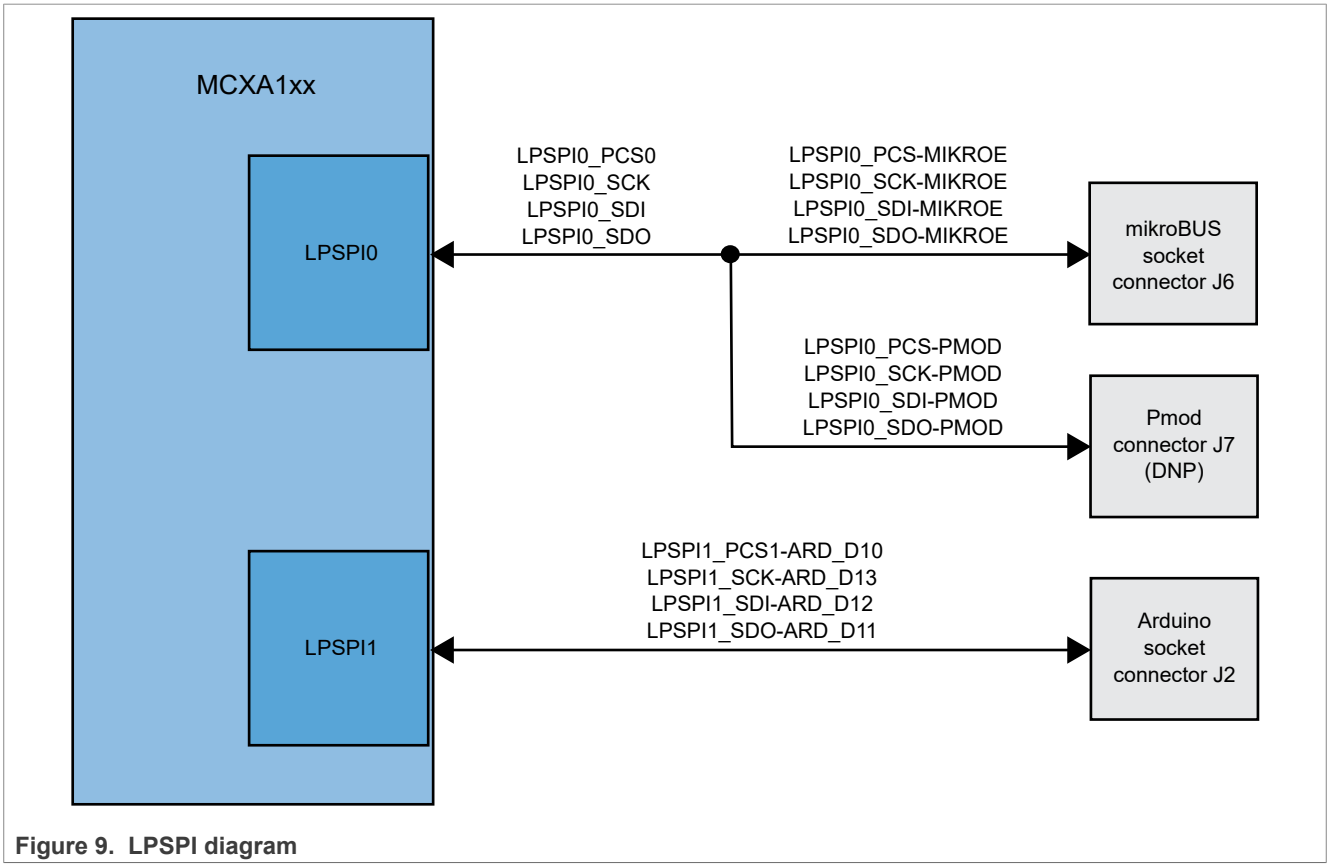

Figure 9. LPSPI diagram

Table 11 describes the FRDM-MCXA153 LPSPI connections.

Table 11. LPSPI connections

LPSPI module	Peripheral chip select	Peripheral devices	
		Part identifier	Description
LPSPI0	PCS0	J6	One of the two mikroBUS socket connectors that allows a SPI connection between the target MCU and the plugged-in mikroBUS click board.

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Table 11. LPSPI connections...*continued*

LPSPI module	Peripheral chip select	Peripheral devices	
		Part identifier	Description
		J7 (DNP)	Pmod connector, which allows a SPI connection between the target MCU and the plugged-in Pmod board. J7 is not populated on the board.
LPSPI1	PCS1	J2	One of the four Arduino socket connectors that allows a SPI connection between the target MCU and the plugged-in Arduino board.

2.6 LPI2C interface

The MCXA1xx MCU has one Low-Power Inter-Integrated Circuit (LPI2C) module, LPI2C0, which supports serial I2C communication through a pair of control and data signals.

The FRDM-MCXA153 board supports communication with the LPI2C0 module.

Figure 10 shows the FRDM-MCXA153 LPI2C diagram.

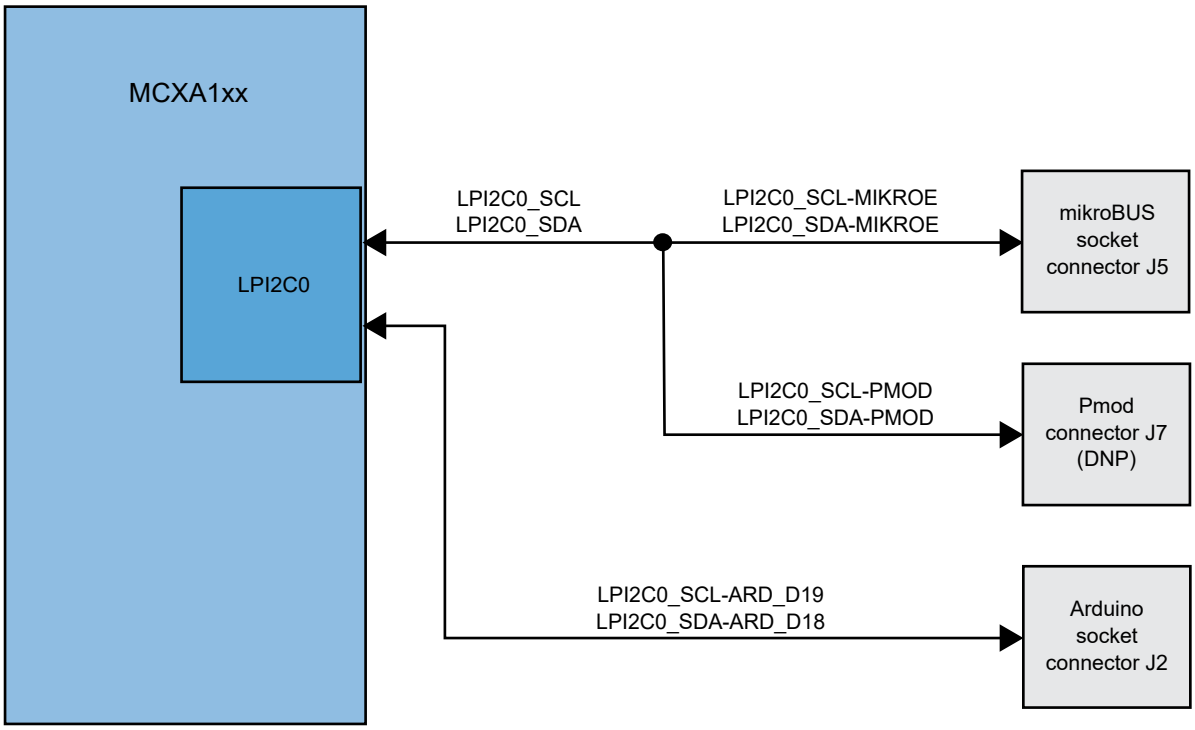

Figure 10. LPI2C diagram

Table 12 describes the FRDM-MCXA153 LPI2C devices. The I2C address of each device depends on the plugged-in board/module.

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Table 12. LPI2C devices

LPI2C module	Peripheral devices	
	Part identifier	Description
LPI2C0	J5	One of the two mikroBUS socket connectors that allows an I2C connection between the target MCU and the plugged-in mikroBUS click board.
	J7 (DNP)	Pmod connector, which allows an I2C connection between the target MCU and the plugged-in Pmod board. J7 is not populated on the board.
	J2	One of the four Arduino socket connectors that allows an I2C connection between the target MCU and the plugged-in Arduino board.

2.7 I3C sensor

The FRDM-MCXA153 board provides a digital temperature sensor, which is supported through the Improved Inter-Integrated Circuit (I3C) module (I3C0) of the MCXA1xx MCU. Table 13 describes the I3C sensor.

Table 13. I3C sensor

Part identifier	Manufacturer and part number	Description	7-bit I2C address
U8	NXP P3T1755DP	Temperature-to-digital converter with an on-chip band gap temperature sensor and support for over-temperature detection. It operates in the temperature range from -40 ℃ to +125 ℃ with ±0.5 ℃ accuracy. It has a temperature register to store the digital temperature reading that can be read by a controller via the 2-wire serial I3C (up to 12.5 MHz) or I2C (up to 3.4 MHz) interface. For more information on P3T1755DP, visit nxp.com.	0x90

The FRDM-MCXA153 board also provides the following two I3C test point connectors:

- J20: Supports I3C data signal.
- J21: Supports I3C clock signal.

The temperature reading from the U8 sensor can be read through an external device controller by populating test point connectors J20 and J21.

2.8 Pmod connector

Digilent Pmod (peripheral module) devices are small I/O interface boards that can be easily integrated with programmable logic and embedded control boards for expanding their capabilities.

The FRDM-MCXA153 board supports a Pmod connector J7 (Digilent PPPC062LJBN-RC) for expanding the capabilities of the board. The J7 connector is not populated on the board. If populated, it can be used to access the SPI and I2C ports of the MCXA1xx MCU. It can be used to work with a remote host, or as an interface to a Pmod expansion board.

Table 14 shows the pinout of the Pmod connector J7.

Table 14. Pmod connector pinout

Pin number	Signal name
1	P1_3/LPSPI0_PCS-PMOD
2	P2_4/GPIO-PMOD

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Table 14. Pmod connector pinout*...continued*

Pin number	Signal name
3	P1_0/LPSPI0_SDO-PMOD
4	P3_1/GPIO-PMOD
5	P1_2/LPSPI0_SDI-PMOD
6	P3_27/LPI2C0_SCL-PMOD
7	P1_1/LPSPI0_SCK-PMOD
8	P3_28/LPI2C0_SDA-PMOD
11, 12	VDD_BOARD
9, 10	GND

2.9 mikroBUS socket

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

The FRDM-MCXA153 board has a mikroBUS socket with two 1x8 position receptacles, J5 and J6. Figure 11 shows the pinouts of the mikroBUS socket connectors.

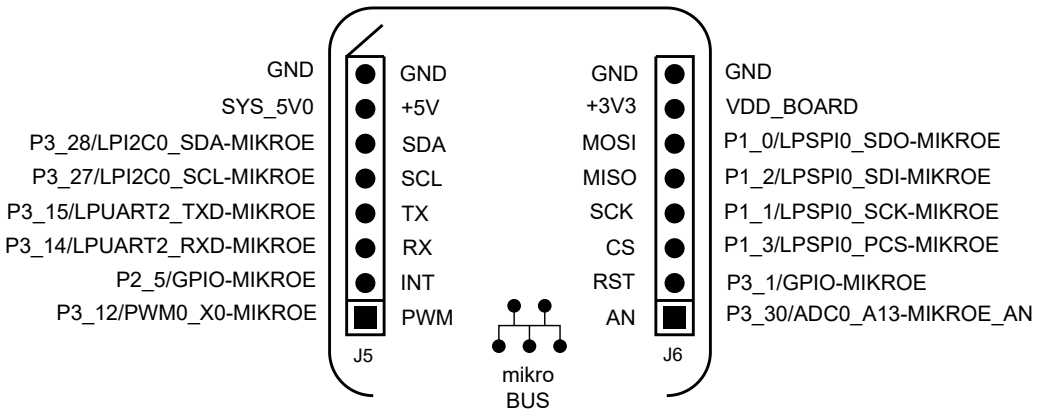

Figure 11. mikroBUS socket connector pinouts

The FRDM-MCXA153 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 manufacturers of click boards. You can find details of some example click boards for the FRDM-MCXA153 mikroBUS socket at MIKROE website.

2.10 Arduino socket

The FRDM-MCXA153 board has an Arduino socket with the following four connectors:

- J1: 2x8-position receptacle
- J2: 2x10-position receptacle
- J3: 2x8-position receptacle
- J4: 2x6-position receptacle

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The two 2x8-position receptacles are placed diagonally opposite to each other. The socket is pin-compatible with an Arduino Uno revision 3 (R3) board.

The Arduino socket allows communication with the following modules of the target MCU:

- Low-Power Universal Asynchronous Receiver/Transmitter 2 (LPUART2)
- Low-Power Serial Peripheral Interface 1 (LPSPI1)
- Low-Power Inter-Integrated Circuit 0 (LPI2C0)
- Analog-to-Digital Converter 0 (ADC0)
- Pulse Width Modulator 0 (PWM0)

Figure 12 shows the pinouts of the Arduino socket connectors.

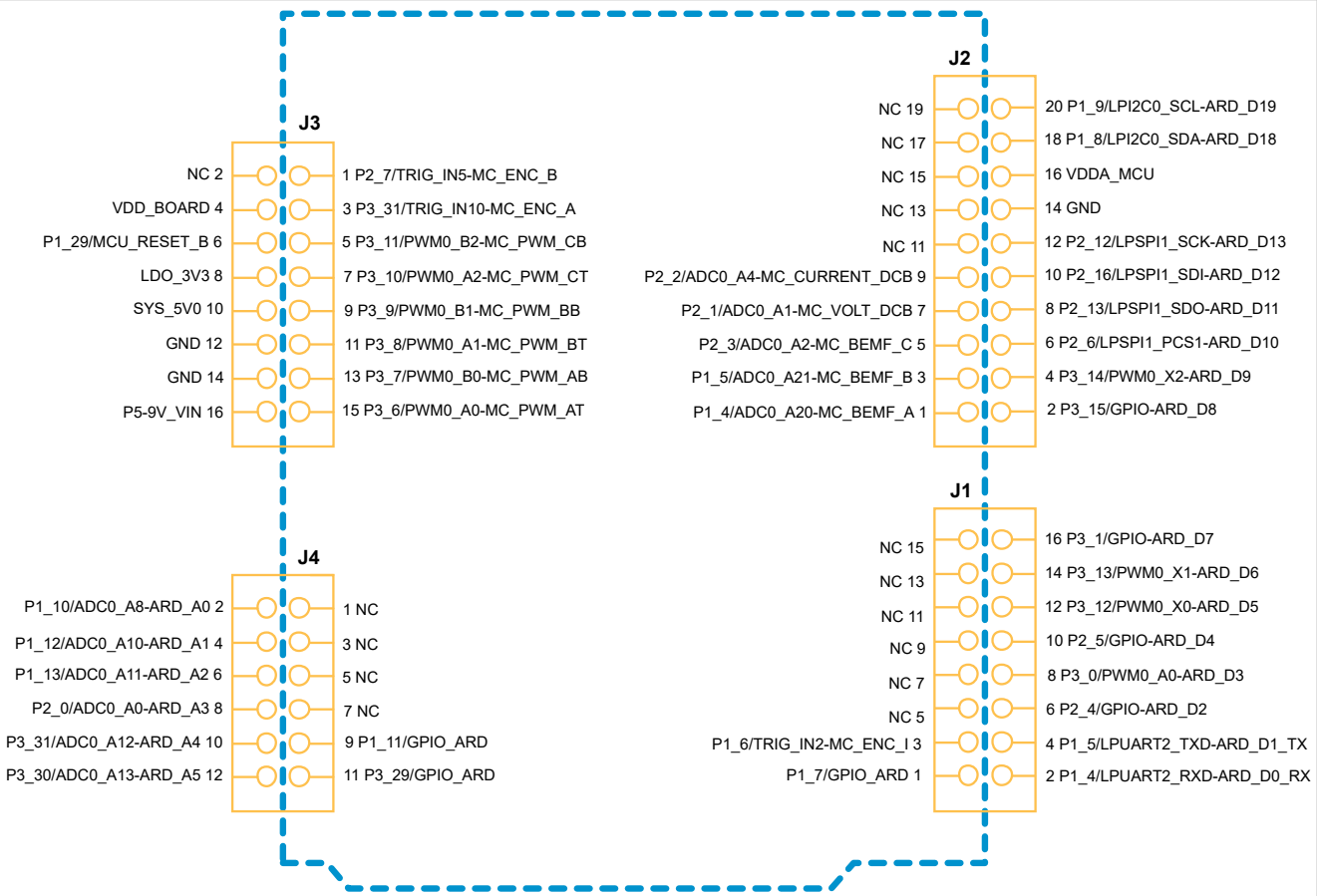

Figure 12. Arduino socket connector pinouts

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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 LPC55S69 MCU, which is based on the Arm Cortex-M33 core.

The MCU-Link architecture is configurable to support different debug feature options. The architecture is used both in standalone debug probes (such as MCU-Link Pro) and for onboard debug probes in evaluation boards (such as FRDM-MCXA153). The onboard implementation of MCU-Link is referred to as *MCU-Link OB*.

The FRDM-MCXA153 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-MCXA153 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 supports only limited features, including debug/SWO and VCOM. For information on how to update the firmware, see Section 3.4.

3.1 Supported MCU-Link features

MCU-Link includes several mandatory and optional features. Table 15 summarizes the MCU-Link features supported on the FRDM-MCXA153 board.

Table 15. 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 working as a USB-to-UART bridge.
External debug probe support	The MCU-Link interface supports debugging the target MCU (MCXA1xx) using an external debug probe, instead of MCU-Link. Support for an external debug probe is enabled by disabling the SWD feature.
External target support[1]	MCU-Link can also be used to debug an external target.

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

3.2 Supported debug scenarios

Table 16 describes the debug scenarios supported on the FRDM-MCXA153 board.

Table 16. Supported debug scenarios

Debug scenario	Feature support	Required jumper/connector settings
Use MCU-Link for debugging the MCXA1xx MCU	SWD: Enabled	MCU-Link SWD disable jumper JP20 is open.
		Target MCU external debugger connector J18 (DNP) is not used for external connection.
	VCOM: Enabled	MCU-Link VCOM port disable jumper JP19 is open.
Use an external debugger for debugging the MCXA1xx MCU	SWD: Not supported	Short JP20.
		Populate J18 and connect the external debugger to it.
	VCOM: Supported	JP19 is open.

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Table 16. Supported debug scenarios*...continued*

Debug scenario	Feature support	Required jumper/connector settings
Use MCU-Link for debugging an external target	SWD: Enabled	JP20 is open.
		Populate J18 and connect the external target to it.
	VCOM: Not supported	Short JP19.

3.3 MCU-Link host driver and utility installation

The MCU-Link debug probe is supported on Windows 10/11, MacOS X, and Ubuntu Linux platforms. It uses standard OS drivers. For Windows, the 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. Running the Linkserver installer also installs all the drivers and a firmware update utility required for MCU-Link.

NXP recommends you to use the Linkserver utility for installing the MCU-Link drivers and firmware update utility, unless you are using MCUXpresso IDE version 11.6.1 or earlier. For more details on this utility, visit the https://nxp.com/linkserver page.

Note: *Installing the Linkserver utility (using the Linkserver installer) only installs the device drivers required for MCU-Link, it does not update the MCU-Link firmware. The Linkserver installation package includes the utilities that are used to update the firmware. If you are using MCUXpresso IDE version 11.6.1 or earlier, you must install the firmware update utility version 2.263, which is not included in the Linkserver installation package.*

If you cannot use the Linkserver utility, follow these steps to install the MCU-Link drivers and firmware update utility:

1. Visit the board page on the NXP website (not available yet).
2. Go to the **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 (see Table 17).

Table 17. 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

3.4 Updating MCU-Link firmware

When updating the MCU-Link firmware, MCU-Link must be powered up in ISP mode. To configure MCU-Link in ISP mode and update MCU-Link firmware, follow these steps:

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1. Disconnect the board from the host computer, short jumper JP8, and reconnect the board. The red MCU-Link status LED D7 lights up and stays on. For more details on MCU-Link LEDs, 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 utility for CMSIS-DAP or J-Link firmware version.
4. Disconnect the board from the host computer, open jumper JP8, and reconnect the board. The board enumerates on the host computer as a WinUSB or HID device (depending on the firmware version).

Note:

- *Starting version V3.xxx, the MCU-Link firmware uses WinUSB instead of HID for higher performance. However, it requires MCUXpresso IDE version 11.7.0 or higher.*
- *MCU-Link firmware versions starting V3.117 provide CMSIS-SWO support, which means they can enable SWO-related features in non-NXP IDEs.*

3.5 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, and Arm Keil MDK.

3.5.1 Using MCU-Link with MCUXpresso IDE

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 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 update the firmware for the 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. However, the MCU-Link firmware version you can use depends on the MCUXpresso IDE installed on your host computer. To check the compatibility of the MCU-Link firmware you want to use with your MCUXpresso IDE, see Table 17.

3.5.2 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.

3.5.3 Using MCU-Link with third-party IDEs

The MCU-Link debug probe can be used with IAR Embedded Workbench and Arm Keil MDK, and may also work with other third-party tools. Refer to the documentation for these products, covering the use of generic CMSIS-DAP probes or J-Link probes (depending on the firmware image you are using).

3.6 MCU-Link USB connector

The FRDM-MCXA153 board has a USB Type-C connector J15, which allows you to connect MCU-Link with your host computer. It can also be used to supply 5 V power to the board.

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3.7 VCOM port (USB to target 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 while working as a USB-to-UART bridge.

In the FRDM-MCXA153 board, MCU-Link is connected to the LPUART0 port of the target MCU. To use MCU-Link as a USB-to-UART bridge, verify the following jumper settings and connect the J15 connector on the board to the USB port of the host computer:

- Jumper JP8 is open (MCU-Link boots normally)
- Jumper JP19 is open (MCU-Link VCOM port is enabled)

When you boot the FRDM-MCXA153 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 JP19, before powering up the board. Changing the jumper JP19 setting (open/short) after powering up the board has no impact on the VCOM function in terms of how MCU-Link behaves.

3.8 MCU-Link status LEDs

The FRDM-MCXA153 board has seven status indicator LEDs for MCU-Link. Table 18 lists these LEDs and describes how each LED behaves in different MCU-Link modes.

Table 18. 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_ACTIVE	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.
D7	ISP_EN	Red	Indicates MCU-Link status / SWD activity. It blinks rapidly at startup, if an error occurs. The LED acts as a heartbeat LED (fades in/out repeatedly), with SWD activity overlaid.	The LED remains OFF.	The LED lights up when MCU-Link (LPC55S69) boots in ISP mode.
D8	VCOM_ACTIVE	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.

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4 Board errata

Not applicable for the current board revision.

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5 Related documentation

Table 19 lists some additional documents and resources that you can refer to for more information on the FRDM-MCXA153 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 19. Related documentation

Document	Description	Link / how to obtain
MCXA1xx Reference Manual	Provides a detailed description about the MCXA1xx MCU and its features, including memory maps, power supplies, and clocks.	Contact an NXP FAE / sales representative
MCXA1xx Low-Power MCU sub-family Data Sheet	Provides information about electrical characteristics, hardware design considerations, and ordering information.	
MCXA153VLH_P07H Errata	Lists all known silicon errata for the MCXA1xx MCU.	
FRDM-MCXA153 board design files	Board schematics, assembly layout	

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6 Acronyms

Table 20 lists the acronyms used in this document.

Table 20. Acronyms

Acronym	Description
ADC	Analog-to-Digital Converter
BLDC	Brushless direct current
DNP	Do not populate / do not place
FS	Full-speed
I2C	Inter-Integrated Circuit
I3C	Improved Inter-Integrated Circuit
IoT	Internet of Things
IP	Intellectual property
ISP	In-System Programming
LDO	Low-dropout regulator
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
MIPI	Mobile Industry Processor Interface
OB	Onboard
Pmod	Peripheral module
PMSM	Permanent magnet synchronous motor
PWM	Pulse Width Modulator
SPI	Serial Peripheral Interface
SWD	Serial wire debug
SWO	Serial wire debug trace output
USB	Universal Serial Bus
USBFS	Universal Serial Bus Full Speed
UART	Universal Asynchronous Receiver/Transmitter
VCOM	Virtual communication

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7 Revision history

Table 21 summarizes the revisions to this document.

Table 21. Revision history

Document ID	Release date	Description
UM12012 v.1	25 January 2024	Initial public release

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