LPCXpresso860-MAXUM

LPCXpresso860-MAX Board User Manual

Rev. 1 — 8 May 2023 **User manual**

Document Information

Information	Content
Keywords	LPCXpresso860-MAXUM, LPCXpresso860-MAX, LPC865
Abstract	The LPCXpresso860-MAX board is a powerful and flexible, evaluation and development platform for NXP LPC865 microcontroller (MCU).

1 LPCXpresso860-MAX overview

The LPCXpresso860-MAX board is a powerful and flexible, evaluation and development platform for NXP LPC865 microcontroller (MCU). It belongs to the LPCXpresso family of boards — boards for NXP LPC MCUs based on Arm Cortex-M cores.

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

The LPCXpresso860-MAX board uses an onboard debug probe, for debugging the LPC865 MCU. The onboard debug probe is based on another MCU, LPC11U35. The LPC865 MCU is referred to as "target MCU" in this document for simplicity and for differentiating it from the LPC11U35 MCU.

This document provides detailed information about the LPCXpresso860-MAX board interfaces, power supplies, clocks, jumpers, push buttons, and LEDs.

1.1 Acronyms and abbreviations

Table 1 lists and explains the acronyms and abbreviations used in this document.

Table 1. Acronyms and abbreviations

Term	Description
ADC	Analog-to-digital converter
DNP	Indicates that this component is not populated at the factory
FPGA	Field-programmable gate array
GPIO	General-purpose input/output
HS	High-speed
I2C	Inter-integrated circuit
I3C	Improved inter-integrated circuit
IDE	Integrated development environment
ISP	In-system programming
LED	Light-emitting diode
MCU	Microcontroller unit
POR	Power-on reset
PWM	Pulse width modulation
SDK	Software development kit
SPI	Serial peripheral interface
SWD	Serial wire debug
SWO	Serial wire debug trace output
UART	Universal asynchronous receiver/transmitter
USART	Universal synchronous/asynchronous receiver/transmitter
USB	Universal serial bus
VCOM	Virtual communication

1.2 Related documentation

Table 2 lists and explains the additional documents and resources that you can refer to for more information on the LPCXpresso860-MAX 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 2. Related documentation

Document	Description	Link / how to access
LPC86x User manual (UM11607)	Intended for system software and hardware developers and application programmers who want to develop products with LPC86x MCU	UM11607.pdf
LPC86x Data Sheet	Provides information about electrical characteristics, hardware design considerations, and ordering information	LPC86x.pdf
LPC11U3x/2x/1x User manual (UM10462)	Intended for system software and hardware developers and application programmers who want to develop products with LPC11U3x/2x/1x MCU	UM10462.pdf

1.3 Block diagram

Figure 1 shows the LPCXpresso860-MAX block diagram.

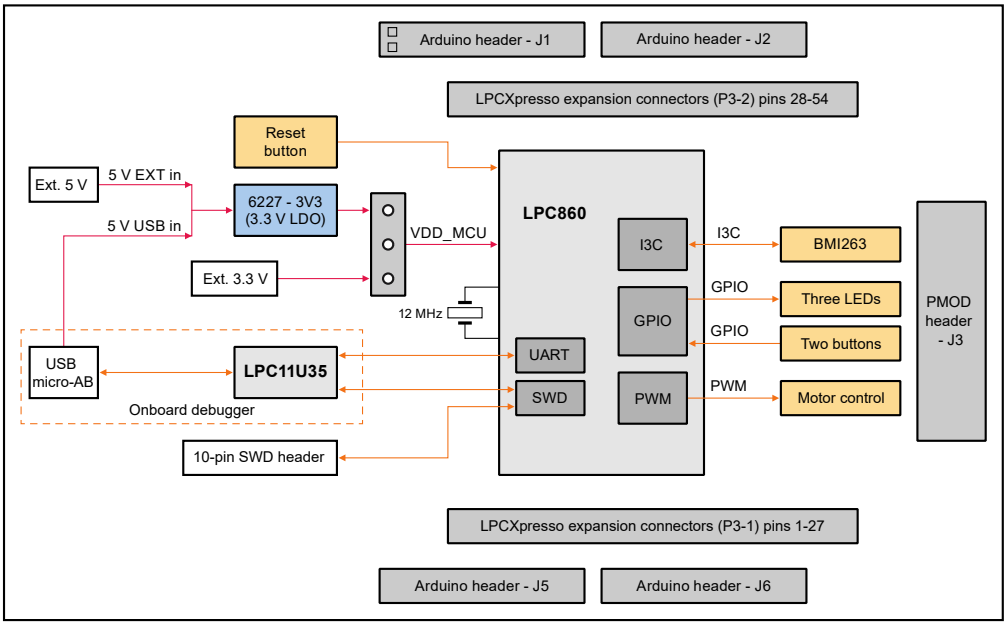

Figure 1. LPCXpresso860-MAX block diagram

1.4 Board features

Table 3 describes the features of the LPCXpresso860-MAX board.

Table 3. LPCXpresso860-MAX features

Board feature	Target MCU feature used	Description
MCU (target MCU)		LPC86x MCU with 32-bit Arm Cortex-M0+ core.

Table 3. LPCXpresso860-MAX features*...continued*

Board feature	Target MCU feature used	Description
		Note: *For more details on the LPC86x MCU, see LPC86x User manual (UM11607).*
UART	USART module (USART0)	• Supports a USB-to-UART bridge between the debug probe MCU and target MCU • Supports an external UART connection through LPCXpresso expansion connector (DNP)
Arduino connectors	FlexTimer module (FTM0), I2C module (I2C0), I3C module (I3C0)	Four Arduino UNO compatible connectors (2x6, 2x8, 2x10, and 2x8 positions)
Pmod connector (DNP)	SPI module (SPI0/SPI1), I2C module (I2C0)	A 2x6 connector to work with a remote host, or as an interface to the Pmod expansion boards
Motion sensor (DNP)	I3C module (I3C0)	A 6-axis motion sensor with a 3-axis gyroscope and a 3-axis accelerometer
USB connector		• Connects onboard debug probe to the host computer by creating a high-speed USB connection • Provides external 5 V power to the board
Power supply		The board is powered with external 5 V power through the USB connector
Clock		Two 12 MHz crystals provide clocks to the target MCU and onboard debug probe
Debug		• The onboard debug probe can be used to debug the target MCU using a USB micro-AB connector provided on the board. It supports debugging based on CMSIS-DAP firmware. • An external debug probe can also be attached for debugging the target MCU

1.5 Board pictures

Figure 2 shows the top-side view of the LPCXpresso860-MAX board, with connectors, jumper, push buttons, and LEDs highlighted.

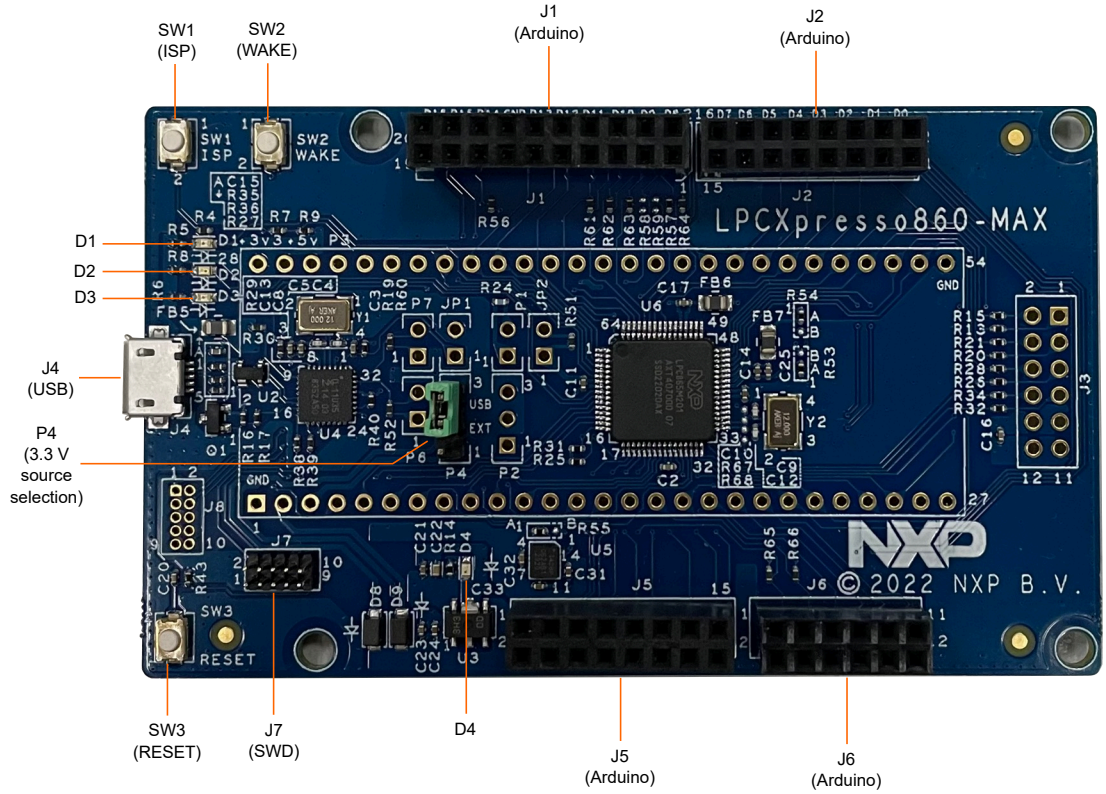

Figure 2. LPCXpresso860-MAX top-side view

Figure 3 shows the bottom-side view of the LPCXpresso860-MAX board, with four connectors and one LED highlighted.

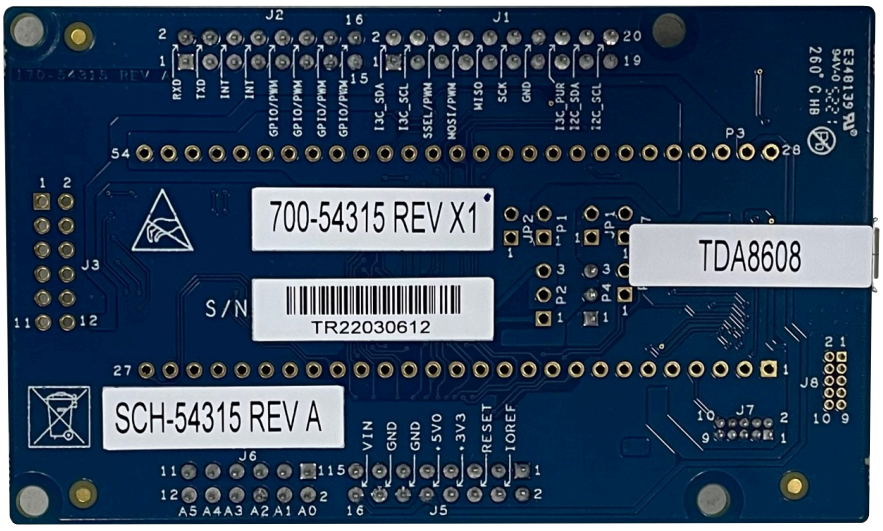

Figure 3. LPCXpresso860-MAX bottom-side view

1.6 Connectors

The LPCXpresso860-MAX connectors are shown in Figure 2 and are described in Table 4.

Table 4. LPCXpresso860-MAX connectors

Part identifier	Connector type	Description	Reference section
J4	USB 2.0 micro-AB receptacle	USB connector for debug probe and board power	Section 2.7
J1	2x10 pin header	Arduino socket connectors	Section 2.4
J2	2x8 pin header		
J5	2x8 pin header		
J6	2x6 pin header		
J3 (DNP)	2x6 pin header	Pmod connector	Section 2.5
J7	2x5 pin header	Target MCU SWD connector	Section 3.3
J8 (DNP)	2x5 pin header	Debug MCU SWD connector	For more details on these connectors, see LPCXpresso860-MAX board schematics
P3 (DNP)	2x27 pin header	LPCXpresso expansion connector	

1.7 Jumpers

Table 5 describes the LPCXpresso860-MAX jumpers. Figure 2 shows the jumper populated on the board.

Table 5. LPCXpresso860-MAX jumpers

Part identifier	Jumper type	Description	Reference section
P4	1x3 pin header	3.3 V power supply source selection jumper: • Pins 1-2 shorted: 3.3 V supply is sourced from LPCXpresso header, P3 (pin 3) • Pins 2-3 shorted (default setting): 3.3 V supply is sourced from voltage regulator, U3	Section 2.1
JP1 (DNP)	1x2 pin header	This jumper is not populated on the board. To use an external debug probe, you must short this jumper that disables the serial wire debug (SWD) feature of onboard debug probe (LPC11U35).	Section 3.3
P6 (DNP)	1x2 pin header	These jumpers are not populated on the board. They can be populated to isolate the USART0 port of the LPC865 MCU from onboard debug probe (LPC11U35).	For more details on these jumpers, see LPCXpresso860-MAX board schematics
P7 (DNP)	1x2 pin header		
P1 (DNP)	1x2 pin header	This jumper is not populated on the board. It can be populated to measure the total current drawn by the LPC865 MCU, using a multimeter in voltage mode.	
JP2 (DNP)	1x2 pin header	This jumper is not populated on the board. It can be populated to measure the total current drawn by the LPC865 MCU, using a multimeter in current mode.	
P2 (DNP)	1x3 pin header	This jumper can be used for VREF selection on the board. By default, the jumper is not populated. In this case: • VREFP pin of the LPC865 MCU connects to 3.3 V	

Table 5. LPCXpresso860-MAX jumpers...*continued*

Part identifier	Jumper type	Description	Reference section
		• VREFN pin of the LPC865 MCU connects to GND If you populate the jumper and move each of the resistors R54 and R53 to its position "B", then: • VREFP pin of the LPC865 MCU can connect to external V+ through pin 1 of the jumper • VREFN pin of the LPC865 MCU can connect to external V- through pin 3 of the jumper	

1.8 Push buttons

The LPCXpresso860-MAX push buttons are shown in Figure 2 and are described in Table 6.

Table 6. LPCXpresso860-MAX push buttons

Part identifier	Switch name	Description
SW1	ISP button (ISP)	The target MCU (LPC865) can be forced into ISP Boot mode by holding down the ISP button (SW1) and then holding and releasing reset. The ISP button is connected to the target MCU pin, PIO0_12, which is also routed to the cathode of the red user LED (D1). The PIO0_12 of the LPC865 MCU can be reconfigured by software so that the button can be used by an application as a general-purpose button.
SW2	Wake-up button (WAKE)	Wakes up the target MCU (LPC865) from the Deep Power-down mode. It connects to the target MCU pin, PIO0_4, which is also connected to pin 35 of the LPCXpresso expansion connector (P3).
SW3	Reset button (RESET)	Causes the target MCU and board peripherals to reset to their default states and execute the boot code. If the target MCU is in the Deep Power-down mode, it comes out of this mode. SW3 connects to the target MCU pin, PIO0_5.

1.9 LEDs

The LPCXpresso860-MAX light-emitting diodes (LEDs) are shown in Figure 2 and are described in Table 7.

Table 7. LPCXpresso860-MAX LEDs

Part identifier	LED color	MCU (LPC865) pin	Description
D1	Red	PIO0_12	ISP LED. It is connected to the ISP button. When ON, it indicates that target MCU (LPC865) is forced into ISP boot mode.
D2	Green	PIO1_12	User LED
D3	Orange	PIO0_28	User LED
D4	Yellow		Power LED

2 LPCXpresso860-MAX functional description

This chapter describes the features and functions of the LPCXpresso860-MAX board. You can use the functionality described in this chapter as a reference while designing your own target board.

Note: *For details of the LPC86x MCU features, see LPC86x User manual (UM11607).*

The chapter is divided into the following sections:

2.1 Power supplies

Table 8 provides power supply details of the LPCXpresso860-MAX board.

Table 8. LPCXpresso860-MAX power supplies

Power source	Manufacturing part number	Power supply rail	Description
External 5 V supply through USB connector (J4) or LPCXpresso expansion connector (P3, DNP) pin 2		+5V (5 V)	Supplies power to Arduino connector J5, LPCXpresso header P3, and voltage regulator U3
Voltage regulator U3	XC6227C331PR-G	+3.3V (3.3 V) ***Note:*** *Input voltage selection for this power supply can be made using jumper P4.*	• Supplies power to target MCU (LPC865M201 JBD64), target MCU SWD connector (J7), debug MCU (LPC11U35FHI33), Arduino connectors (J1, J2, J5, and J6), LPCXpresso header (P3), push buttons (SW1, SW2, and SW3), and LEDs (D1, D2, D3, and D4) • Also supplies power to DNP components, including debug MCU SWD connector (J8), Pmod connector (J3), and motion sensor (U5)
External 3.3 V supply through LPCXpresso expansion connector (P3, DNP) pin 3			

2.2 Clocks

Table 9 describes the clocks available on the LPCXpresso860-MAX board.

Table 9. LPCXpresso860-MAX clocks

Clock generator	Clock	Frequency	Destination
Y2: Crystal Oscillator	XTALIN, XTALOUT	12 MHz	Target MCU (LPC865M201JDB64)
Y1: Crystal Oscillator	XTALIN, XTALOUT	12 MHz	Debug probe (LPC11U35FHI33)

2.3 UART interface

The LPC865 MCU has three USART modules, USART0, USART1, and USART2. The MCU provides switch matrix to allow connecting MCU peripherals to specific MCU pins so that the peripherals can be accessed through those pins from outside the MCU.

In the LPCXpresso860-MAX board, USART0 module of the LPC865 MCU is available for external UART connection through MCU pins PIO1_16 (works as RX pin) and PIO1_17 (works as TX pin).

Table 10 describes the LPCXpresso860-MAX UART connections.

Table 10. LPCXpresso860-MAX UART connections

Target MCU USART module	Connected board device/connector
USART0	Onboard debug probe MCU (LPC11U35). The target MCU is connected to the debug probe MCU through a USB-to-UART bridge, which can be used to debug the target MCU from the debug probe MCU.
	LPCXpresso expansion connector P3 (not populated on the board). If P3 is populated, then its pins 14 (RXD) and 13 (TXD) can be used to establish a UART connection with the target MCU.

2.4 Arduino connectors

The LPCXpresso860-MAX board provides Arduino UNO revision 3 compatible connectors, J1, J2, J5, and J6. These connectors provide I2C, SPI, UART, PWM, and analog function connections for shielding boards that are available from various third-party suppliers, or for customer use. Some connections are shared with the LPCXpresso connector (P3).

Table 11, Table 12, Table 13, and Table 14 show the pinouts for Arduino connectors.

Table 11. J1 pinout

Pin	Arduino signal	Target MCU pin	LPCXpresso connector pin
1	P0_20-BEMF_A	PIO0_20	NA
2	I3C_SDA	PIO0_26	10
3	P0_19-BEMF_B	PIO0_19	NA
4	I3C_SCL	PIO1_14	9
5	P0_18-BEMF_C	PIO0_18	
6	SSEL / PWM	NA	43
7	P0_17-VOLT_DCB	PIO0_17	
8	MOSI / PWM	NA	42
9	P0_13-CUR_DCB	PIO0_13	
10	MISO	PIO1_8	37
11	NC	NA	NA
12	SCK	PIO1_9	36
13	NC	NA	NA
14	GND	NA	NA
15	NC	NA	NA
16	I3C_PUR	PIO1_15	11
17	NC	NA	NA
18	I2C_SDA	PIO0_11	40
19	NC	NA	NA
20	I2C_SCL	PIO0_10	41

Table 12. J2 pinout

Pin	Arduino signal	Target MCU pin	LPCXpresso connector pin
1	NC	NA	NA
2	RXD	PIO0_24	22
3	P0_31-ENC_I	PIO0_31	NA
4	TXD	PIO0_25	21
5	NC	NA	NA
6	INT	NA	48
7	NA	NA	NA
8	INT	NA	49
9	NA	NA	NA
10	GPIO / PWM	NA	47
11	NA	NA	NA
12	GPIO / PWM	NA	46
13	NA	NA	NA
14	GPIO / PWM	NA	45
15	NA	NA	NA
16	GPIO / PWM	NA	44

Table 13. J5 pinout

Pin	Arduino signal	Target MCU pin	LPCXpresso connector pin
1	P0_30-ENC_B	PIO0_30	NA
2	NC	NA	NA
3	P0_29-ENC_A	PIO0_29	NA
4	IOREF	NA	NA
5	P1_1-PWM_CB	PIO1_1	NA
6	RESET	PIO0_5	4
7	P0_16-PWM_CT	PIO0_16	NA
8	+3V3	NA	NA
9	P1_2-PWM_BB	PIO1_2	NA
10	+5V0	NA	NA
11	P0_27-PWM_BT	PIO0_27	NA
12	GND	NA	NA
13	P1_5-PWM_AB	PIO1_5	NA
14	GND	NA	NA
15	P1_6-PWM_AT	PIO1_6	NA
16	VIN	NA	NA

Table 14. J6 pinout

Pin	Arduino signal	Target MCU pin	LPCXpresso connector pin
1	NC	NA	NA
2	PIO0_21/ADC_5	PIO0_21	15
3	NC	NA	NA
4	PIO0_22/ADC_4	PIO0_22	16
5	NC	NA	NA
6	PIO0_23-ADC_3-ACMP_I4	PIO0_23	17
7	NC	NA	NA
8	PIO0_14-ADC_2-ACMP_I3	PIO0_14	18
9	NC	NA	NA
10	PIO0_6-ADC_1-ACMPVREF	PIO0_6	19
11	NC	NA	NA
12	PIO0_7/ADC_0	PIO0_7	20

2.5 Pmod connector

Peripheral module (Pmod) interface is an open standard defined by Digilent Inc. for peripherals used with FPGA or microcontroller development boards. Pmod devices from Digilent are small I/O interface boards that you can use to extend the capabilities of your board.

LPCXpresso860-MAX supports one Pmod connector (J3), which is not populated on the board. If populated, this connector can be used to access the SPI and I2C ports of the target MCU. It can be used to work with a remote host, or as an interface to the Pmod expansion boards.

Table 15 shows the pinout for the Pmod connector.

Table 15. Pmod connector pinout

Pin number	Signal name	Target MCU pin
1	P1_4	PIO1_4
2	P0_0-SPI_SSEL	PIO0_0
3	P0_1	PIO0_1
4	P1_7-SPI_MOSI	PIO1_7
5	P0_10-I2C0_SCL	PIO0_10
6	P1_19-SPI_MISO	PIO1_19
7	P0_11-I2C0_SDA	PIO0_11
8	P1_18-SPI_SCK	PIO1_18
9, 10	GND	
11, 12	+3.3V	

2.6 Motion sensor

LPCXpresso860-MAX supports motion sensing with ICM-42688-P, a 6-axis MEMS MotionTracking device that combines a 3-axis gyroscope and a 3-axis accelerometer. ICM-42688-P supports highly accurate external clock input that helps to reduce system-level sensitivity error, improve orientation measurement from gyroscope data,

reduce ODR sensitivity to temperature, and device-to-device variation. The sensor is not populated on the board.

ICM-42688-P can be populated on LPCXpresso860-MAX at U5, which is connected to the target MCU through the I3C interface, I3C0.

2.7 Debug probe USB

The LPCXpresso860-MAX board has a USB 2.0 micro-AB connector J4 (Hirose Electric ZX62-AB-5P). This connector is used to supply 5 V power to the board. It can also be used to create a high-speed USB connection between the onboard debug probe (LPC11U35) and host computer.

3 LPCXpresso860-MAX Debug

The LPCXpresso860-MAX board has an onboard debug probe, LPC11U35, which is a 32-bit MCU based on an Arm Cortex-M0 core. The LPC11U35 MCU supports serial wire debug (SWD) functions.

The LPCXpresso860-MAX onboard debug probe provides debug probe functionality based on the CMSIS-DAP protocol. It also provides virtual communication (VCOM) port support.

3.1 VCOM serial port

The debug probe available on the LPCXpresso860-MAX board supports the VCOM serial port feature, which adds a serial COM port on the host computer. The VCOM feature allows you to connect the host computer to the target MCU by using the onboard debug probe as a USB-to-UART bridge.

The onboard debug probe UART port is connected to the PIO1_16 and PIO1_17 pins of the target MCU (LPC865) and pins 13 and 14 of the LPCXpresso connector (P3). The VCOM feature bridges the LPC865 serial port via USB, allowing host computer applications (such as TeraTerm, PuTTY, and the built-in serial terminal on MCUXpresso IDE) to communicate with the target MCU.

When you boot the LPCXpresso860-MAX board, a VCOM port with the name NXP LPC11Uxx VCOM (COMxx) is enumerated on the host computer, where “xx” may vary from one computer to another. Each board with LPC11U35-based debug probe has a unique VCOM number associated with it.

3.2 Installing VCOM driver and updating debug probe firmware

Operating systems, such as Windows 10, Mac OS, and Linux have built-in VCOM support, and therefore, a host computer running any of these operating systems already has basic VCOM support for the LPC11U35 debug probe. For a host computer running Windows operating system, you must install the VCOM driver to get user-friendly device names.

The LPC11U35 debug probe is factory programmed with the CMSIS-DAP firmware, including the USB VCOM port functionality. A complete package, including CMSIS-DAP firmware and VCOM driver, is also available for the LPC11U35 debug probe on the NXP website.

Install the VCOM driver on the host computer by following these steps:

1. Access the Firmware and drivers for LPC11U35 debug probes page of the NXP website.
2. Accept the agreement. The firmware and driver package gets downloaded.
3. Unzip the downloaded package and run the installer (if installing on a Windows machine). An additional VCOM port appears in Windows Device Manager, as shown in Figure 4. This port can be used with any terminal program to allow communication with the target MCU UART over the USB connection.

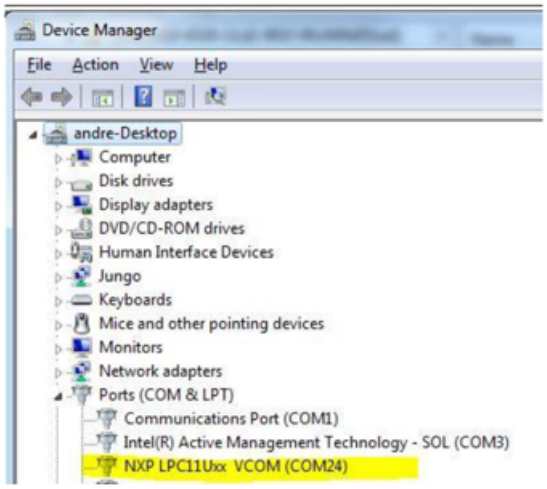

Figure 4. VCOM port

Now, your LPCXpresso860-MAX board is ready for use.

Normally, you do not require to update the debug probe firmware on the LPCXpresso860-MAX board but if needed, then you can update it as follows:

1. Connect the USB connector (J4) on the board to the USB port of the host computer through a USB cable. The board gets powered up.
2. Using File Explorer (or equivalent utility on Mac/Linux platforms), search for the `CRP_DISABLED` drive on your system.
3. Delete the existing `firmware.bin` file on the `CRP_DISABLED` drive.
4. Add to the `CRP_DISABLED` drive the new `firmware.bin` file from the firmware package you downloaded from the NXP website.
5. Disconnect and reconnect the LPCXpresso860-MAX board to the host computer.

3.3 Debug feature support

Table 16 summarizes the debug features supported on the LPCXpresso860-MAX board.

Table 16. Supported debug features

Feature	Description
Serial wire debug (SWD)	Allows SWD-based debugging
Virtual communication (VCOM) serial port	Adds a serial COM port on the host computer, and connects it to the target MCU by using onboard debug probe as a USB-to-UART bridge
External debug probe support	An external debug probe can be used to debug the target MCU, instead of the onboard debug probe. Support for external debug probe is enabled by disabling the onboard debug probe SWD feature.

Table 17 describes the debug scenarios supported on the LPCXpresso860-MAX board.

Table 17. Supported debug scenarios

Debug scenario	Feature support	
	SWD	VCOM
Use onboard debug probe for debugging target MCU (LPC865)	• Onboard debug probe SWD feature is enabled • Target MCU SWD interface connects to onboard debug probe • Target MCU SWD connector (J7) is not used for external connection	Onboard debug probe VCOM feature is enabled
Use external debug probe for debugging target MCU	1. Disable onboard debug probe SWD feature by shorting jumper JP1 (not populated) 2. Connect the external debug probe to the target MCU SWD connector J7. The target MCU SWD interface connects to the external debug probe	Onboard debug probe VCOM feature cannot be used

3.4 Using onboard debug probe with development tools

The LPC11U35 debug probe present on the LPCXpresso860-MAX board can be used with IDEs supported within the MCUXpresso ecosystem (MCUXpresso IDE, IAR Embedded Workbench, and Keil MDK). To get started on any of these IDEs, click "GET STARTED" link on the LPCXpresso860-MAX board page on the NXP website.

Note: *Other IDEs that support CMSIS-DAP protocol can also use the LPCXpresso860-MAX onboard debug probe; refer to the documentation for these IDEs for more information.*

4 Revision history

Table 18 summarizes the revisions to this document.

Table 18. Revision history

Revision number	Date	Substantive changes
1	8 May 2023	Updated document links in Table 2.
0	11 April 2022	Initial release

5 Legal information

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