



ConnectCore MP13

Development Board

Hardware Reference Manual

Revision history—90002552

Revision	Date	Description
1P	March 2023	Initial draft.
2P	July 2023	Revised features list, updating Power, Multimedia, Storage, and Communications sections; replaced placement bottom view; changed name of Ethernet PHY and added caution statement; revised Supply voltages section and table; removed height value from Mechanical specifications; replaced PCB-level connection image from Appendix A; changed description of pin 13 of the GPIO connector; fixed typos and minor formatting errors.
A	February 2024	Added USB OTG caution statement, rephrased boot modes statement in System boot topic, noted that ETH2 interface correction applies to old versions of the PCB.

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About the ConnectCore MP13 DVK

The Digi ConnectCore MP13 wireless SOM kit is a complete development platform for intelligent, connected and secure embedded products with a broad suite of tools and turnkey Linux software support.

Note While the ConnectCore MP13 system-on-module is designed to be used in a production environment, the ConnectCore MP13 Development Kit is designed only for development and testing in a pre-production environment.

Features and functionality

- ConnectCore MP13 module
 - STM32MP133C ARM Cortex-A7 core operating at speeds up to 650 MHz
 - Up to 256 MB, 16-bit DDR3 memory
 - Up to 256 MB, 8-bit SLC NAND flash memory
 - IEEE 802.11 a/b/g/n/ac WLAN and Bluetooth 5.0
- Power
 - Power jack or industrial-dedicated 5V power connector
 - Coin-cell battery connector, supplying the on-board RTC
 - Power and reset buttons
- Boot source configuration
 - NAND, USB, microSD
- Debug
 - Standard IEEE 1149.1 JTAG interface
 - Serial console at AB-type micro-USB connector and TTL level
- Multimedia
 - Audio CODEC with the following functionality
 - One 3.5 mm headphone jack
 - One 3.5 mm microphone jack
 - Two speaker outputs
 - One line-out output
 - Two line-in inputs
- Storage
 - microSD card slot
- Communication
 - RS-232
 - RS-485
 - One CAN FD

- One 10/100 Ethernet with RJ-45 connector
- One Gigabit Ethernet with RJ-45 connector
- Two USB Host 2.0 interfaces through a stacked USB A type connector
- USB OTG with AB-type micro-USB connector
- SISO IEEE 802.11 a/b/g/n/ac + Bluetooth 5.0 with on-module U.FL or external SMA antenna connector
- PCI Express Mini Card slot supporting full and half-size cards
- MikroBus socket
- XBee socket supporting XBee Cellular
- User interface
 - Three user LED, two of them shared with user buttons
- Dimensions:
 - 120 x 160 mm

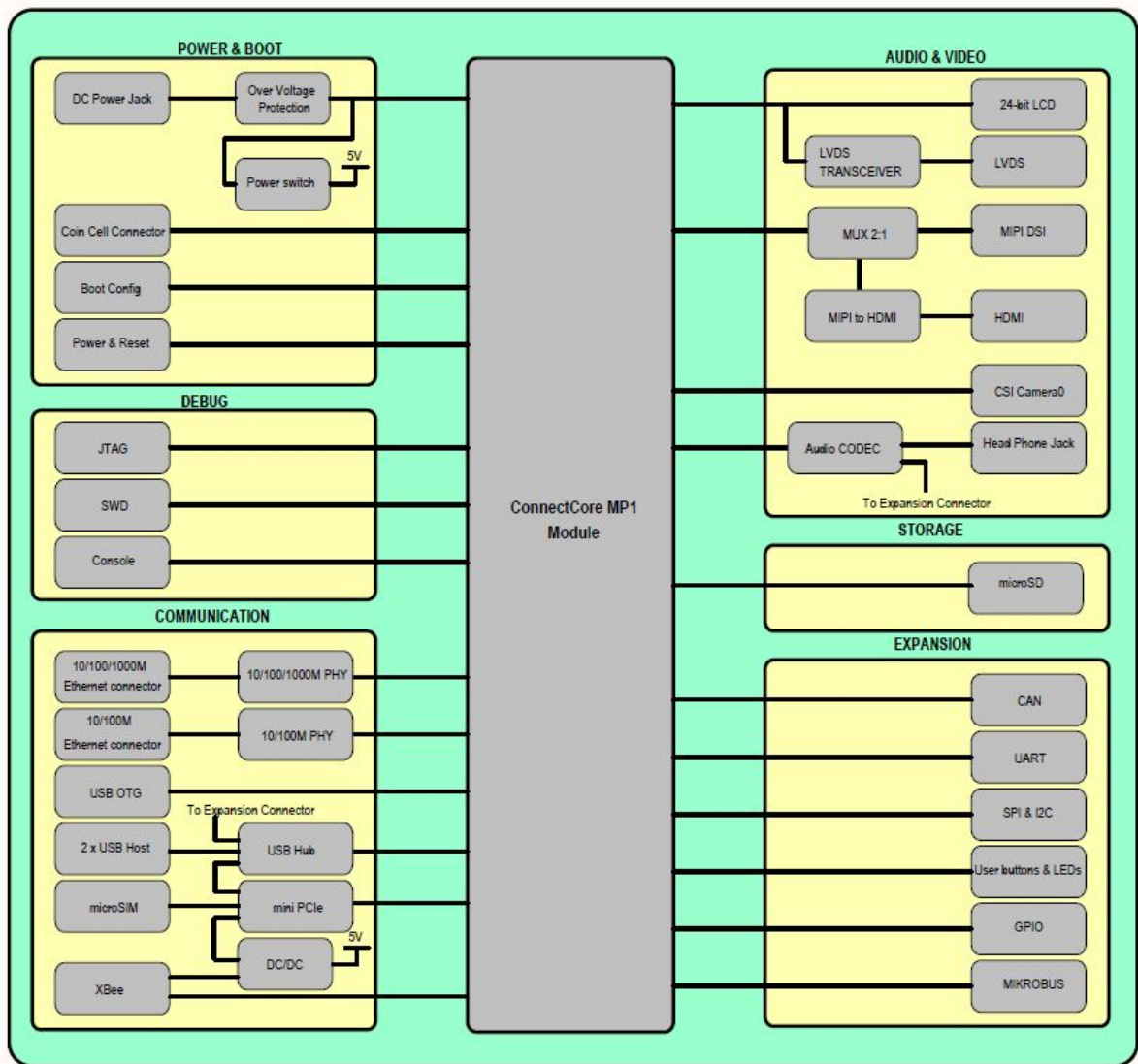
Safety instructions

- The ConnectCore MP13 Development Board cannot be guaranteed operation due to the radio link and so should not be used for interlocks in safety critical devices such as machines or automotive applications.
- The ConnectCore MP13 Development Board has not been approved for use in (this list is not exhaustive):
 - nuclear applications
 - explosive or flammable atmospheres
- There are no user serviceable components inside the ConnectCore MP13 Development Board. Do not modify the ConnectCore MP13 in any way. Modifications may exclude the Development Board from any warranty and can cause the ConnectCore MP13 to operate outside of regulatory compliance for a given country, leading to the possible illegal operation of the radio.
- Use industry standard ESD protection when handling the ConnectCore MP13 Development Board.
- Take care while handling to avoid electrical damage to the PCB and components.
- Do not expose ConnectCore MP13 Development Board to water or moisture.
- Use this product with the antennas specified in the ConnectCore MP13 Development Board user guides.

ESD

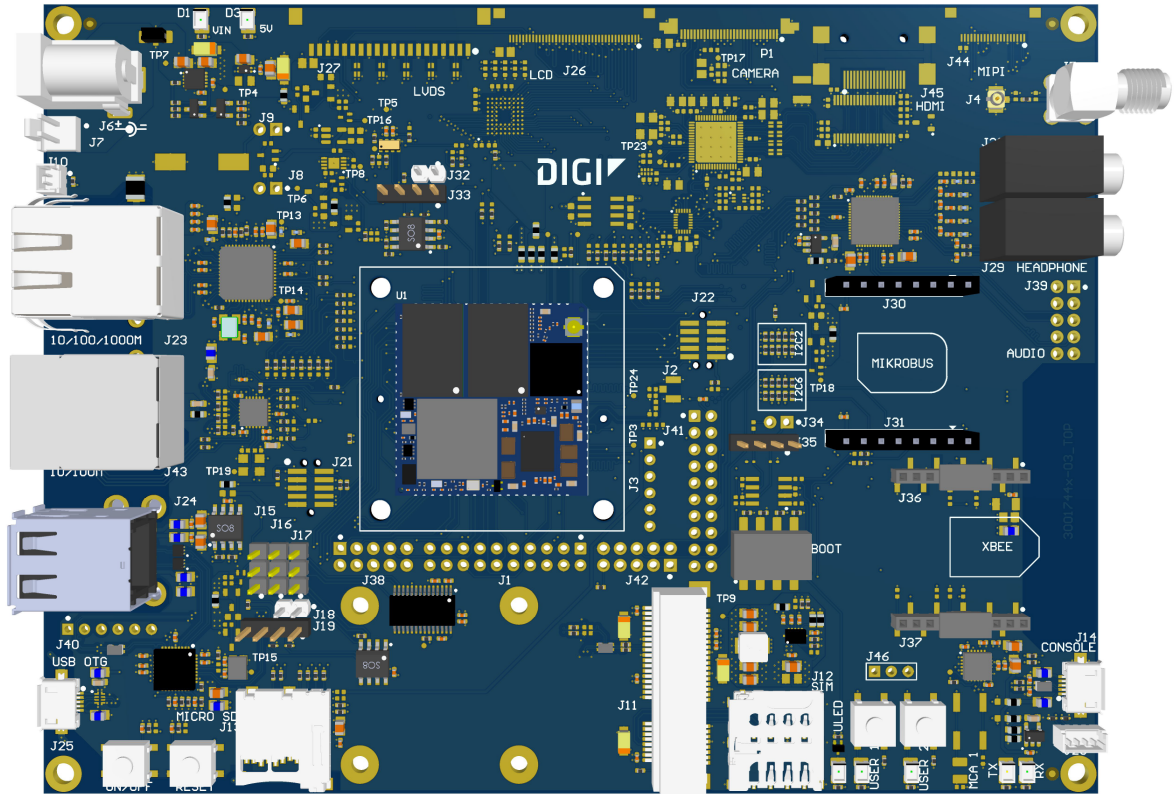
The ConnectCore MP13 Development Board has no additional ESD protection added to USB Host (J24) and microSD card (J13) ports. For this reason, ESD stickers have been added to the corresponding connectors. Please consider this when using the ConnectCore MP13 Development Board. Additional ESD protection shall be added to end products using these interfaces of ConnectCore MP13 SOM.

Block diagram

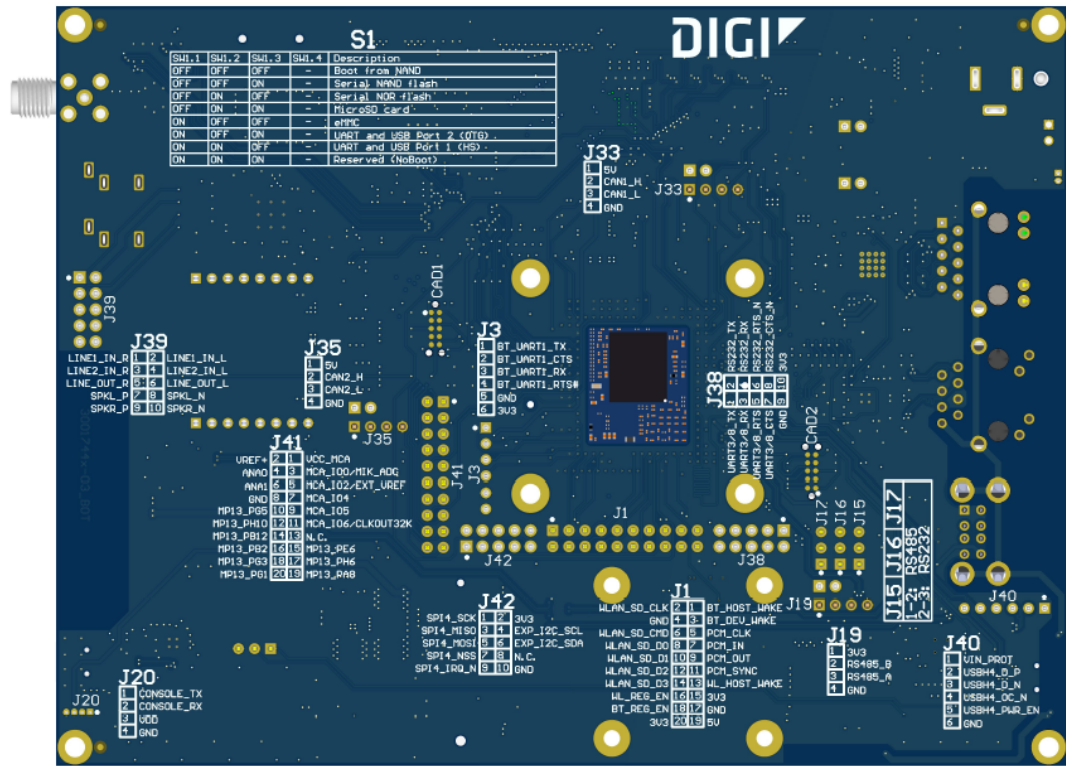


Placement

Top view



Bottom view



Connectors

The following table lists all connectors on the ConnectCore MP13:

Connector	Interface
J1	WLAN/Bluetooth expansion
J2	u.FL
J3	Bluetooth UART
J4	u.FL
J5	SMA
J6	5V power-in jack
J7	5V power in
J8	VCC_MCA series jumper
J9	Supercap series jumper

Connector	Interface
J10	Coin cell
J11	Mini PCIe
J12	Micro SIM
J13	microSD
J14	USB Console
J15	RS232/RS485 TX line selector jumper
J16	RS232/RS485 RX line selector jumper
J17	RS232/RS485 RTS line selector jumper
J18	RS485 termination resistor jumper
J19	RS485
J20	TTL Console
J21	STM32MP1 JTAG
J22	MCA SWD
J23	10/100/1000 Mbps RJ-45
J24	Dual USB A-type
J25	USB OTG
J28	Microphone jack
J29	Headphone jack
J30-J31	MikroBus socket
J32	CAN1 termination resistor jumper
J33	CAN1
J36-J37	XBee socket
J38	UART/RS232 expansion
J39	Audio expansion
J40	USB expansion
J41	GPIO expansion
J42	SPI/I2C expansion
J43	10/100 Mbps RJ-45
S1	Boot switches

Connector	Interface
SW1	Power button
SW2	Reset button
SW3	User button
SW4	User button
SW5	User button
CAD1	STM32MP1 JTAG Tag Connect
CAD2	MCA SWD Tag Connect

Interfaces

The following interfaces are available on the ConnectCore MP13:

Power interfaces

This section describes the ConnectCore MP13 power interfaces.

DC-in jack connector

The input voltage of the ConnectCore MP1 Development Board is 5V. This input power supply can be provided from two different connectors:

- DC-in power jack.
- J7, a 2-pin, 2.54 mm pitch connector:

Pin	Signal name	Description
1	VIN	5V power supply
2	GND	

Note Digi recommends *not* powering both connectors at the same time.

An overvoltage circuit protects the board from overvoltage and overcurrent events. Downstream from these input power protections, there are two regulators/switches for powering the carrier board circuitry:

- 5V Load switch (U6): A 5V load switch that controls the power delivery to different interfaces on the carrier board.
- PCIe regulator (U7): A dedicated adjustable regulator for the PCIe socket.

Coin cell connector

Connector J10 on the board is included for attaching an external coin-cell to the system:

Pin	Signal name	Description
1	VCC_LICELL	Power supply for RTC
2	GND	

Power and reset buttons

One power button (SW1) and one reset button (SW2) are included on the development board.

System boot

The ConnectCore MP13 module supports different boot modes (see the [ConnectCore MP13 System-on-Module Hardware Reference Manual](#) for detailed information). All of them are supported on the development board, where a quadruple switch (S1) allows swapping between them:

S1.1	S1.2	S1.3	Boot mode
Open	Open	Open	On-module NAND
Open	Open	Close	Serial NAND flash
Open	Close	Open	Serial NOR flash
Open	Close	Close	MicroSD card
Close	Open	Open	eMMC
Close	Open	Close	UART and USB Port 2
Close	Close	Open	UART and USB Port 1
Close	Close	Close	Reserved

Debug interfaces

JTAG

The ConnectCore MP13 Development Board provides a Tag Connect footprint for accessing the STM32MP1 JTAG debug port. Additionally, a standard 10-pin, 1.27 mm pitch connector (J21) is available for accessing the JTAG interface:

Pin	Signal name	Description
1	VDD	3.3V power supply
2	JTMS-SWDIO	Mode select line
3	GND	
4	JTCK-SWCLK	Clock line
5	GND	
6	JTDO-TRACESWO	Data output line
7	NC	
8	JTDI	Data input line

Pin	Signal name	Description
9	GND	
10	NRST	Reset line of the CPU

Console port

A dedicated USB micro AB-type port (J14) provides access to the console port of the ConnectCore MP1 system-on-module. This USB port is routed directly to the CY7C65211 bridge, which converts the USB bus into TTL level. UART4 is used as the console debug port of the STM32MP1 CPU. This UART can also be accessed directly at TTL level through J20 connector:

Pin	Signal name	Description
1	UART4_TX	UART transmission line
2	UART4_RX	UART receiver line
3	VDD	3.3V power supply
4	GND	

Default console port settings:

- Baud rate: 115200
- Data: 8 bit
- Parity: none
- Stop: 1 bit
- Flow control: none

Multimedia

Audio

The Maxim MAX98089 audio codec manages the audio interface on the development board. The board provides the following audio functionality:

- 3.5 mm headphone jack
- 3.5 mm microphone jack
- x2 speaker outputs (left and right)
- x1 line-out output
- x2 line-in inputs

The speakers, line-out signals and line-in signals are available over a 10-pin connector (J39):

Pin	Signal name	Description
1	LINE1_IN_R	Single-ended line input A1

Pin	Signal name	Description
2	LINE1_IN_L	Single-ended line input A2
3	LINE2_IN_R	Single-ended line input B1
4	LINE2_IN_L	Single-ended line input B2
5	LINE_OUT_R	Right line output
6	LINE_OUT_L	Left line output
7	SPKL_P	Positive left-channel class D speaker output
8	SPKL_N	Negative left-channel class D speaker output
9	SPKR_P	Positive right-channel class D speaker output
10	SPKR_N	Negative right-channel class D speaker output

Storage interface

MicroSD

A microSD socket connected to the SDMMC2 port of the STM32MP1 CPU is available on the ConnectCore MP13.

Communication

Gigabit Ethernet

10Base-T/100Base-Tx/1000Base-T Ethernet interface is fully integrated in the board through the Marvell 88E1512 Ethernet PHY. The Ethernet interface is accessible through a RJ-45 connector with integrated link/activity LEDs.



CAUTION! The RJ-45 connector LEDs are connected with reversed polarity, which makes them light when there is no Ethernet link established. The PHY should drive the cathodes of the diodes instead of the anodes.

10/100 Mbps Ethernet

The ConnectCore MP13 Development Board supports one 10Base-T/100Base-Tx Ethernet interface through the Microchip LAN8720Ai 10/100 PHY. This interface is also available through a RJ-45 connector with integrated link/activity LEDs.

See [Appendix A - ETH2 Interface Correction](#) for information on an issue related to the connection of the reference clock.

UART/RS-232/RS-485

RS-232 and RS-485 standards are supported on the ConnectCore MP13 Development Board, by sharing one CPU UART port (UART7). This means that only one of the two protocols can be used at

a time. Selection between both is done through three three-position headers (J15, J16 and J17). RS-232 port is available in connector J38, where USART3 is also connected:

Pin	Signal name	Description
1	USART3/8_TX	UART3 transmission line
2	RS232_7_TX	RS232 transmission line
3	USART3/8_RX	UART3 receiver line
4	RS232_7_RX	RS232 receiver line
5	USART3/8_RTS	UART3 RTS line (output)
6	RS232_7_RTS_N	RS232 RTS line (output)
7	USART3/8_CTS	UART3 CTS line (input)
8	RS232_7_CTS_N	RS232 CTS line (input)
9	GND	
10	3V3	3.3V power supply

Note USART3 interface is shared with XBee socket and CAN.

RS-485 is on J19:

Pin	Signal name	Description
1	3V3	3.3V power supply
2	RS485_B	RS485 B line
3	RS485_A	RS485 A line
4	GND	

CAN

One CAN FD bus is available on the development board through connector J33 (CAN1). The pinout of this connector is as follows:

Pin	Signal name	Description
1	5V	5V power supply
2	CAN1_H	CAN high line
3	CAN1_L	CAN low line
4	GND	

You can connect 120Ω terminator resistors to the port by closing J32.

USB Host

The ConnectCore MP13 Development Board offers support for four USB Host interfaces. Two of them are available over a stackable dual USB A-type connector. The third USB Host is connected to the PCI Express Mini card connector. The fourth is connected to the XBee socket as well as to a 6-pin, 1.25 mm pitch expansion connector (J40). All USB Hosts can operate at full, high, and low speed.

The following table shows the pinout of the USB expansion connector:

Pin	Signal name	Description
1	VIN_PROT	5V power supply
2	USBH4_D_P	USB 4 differential data signal (+)
3	USBH4_D_N	USB 4 differential data signal (-)
4	USBH4_OC_N	Over current input
5	USBH4_PWR_EN	Power enable output
6	GND	

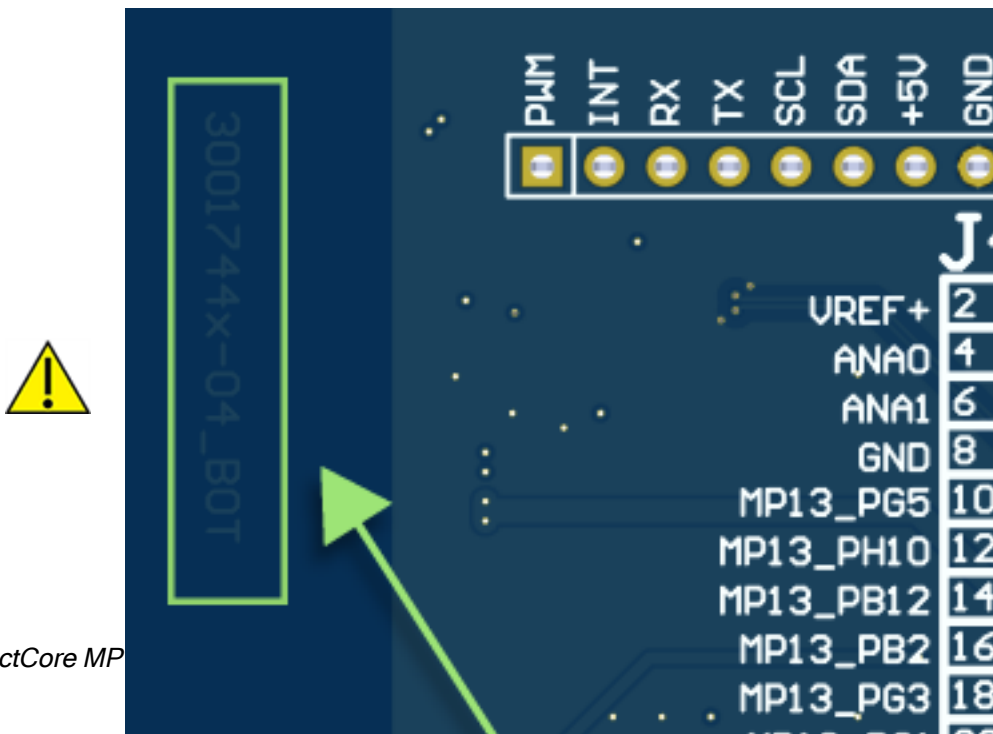
USB OTG

A micro-AB type receptacle for USB OTG connection is available on the ConnectCore MP13 Development Board. This interface can operate in both Host and Device mode.

High-speed, full-speed, and low-speed connections are supported in Host mode. High-speed and full-speed connections are supported in Device mode.

Do not connect the USB OTG port of the ConnectCore MP13 Development Board to a downstream port (e.g a host PC) if the main power of the board is removed. This could cause permanent damage to the system. Refer to the [ConnectCore MP13 System-on-Module Hardware Reference Manual](#) and the application note AN4879 from ST for more information.

This issue is fixed as of PCB version 30017442-04. You can find the version number printed on both the top and bottom of the PCB.



Mini PCI Express slot

The ConnectCore MP13 Development Board provides a Mini PCI Express socket supporting USB and I2C connection to the ConnectCore MP13 module. A micro SIM socket is also connected to the Mini PCI Express slot.

XBee socket

One XBee socket is populated on the development board, supporting XBee Cellular modules. The UART bus connected to the XBee socket (USART3) is shared with CAN2.

MikroBus socket

The ConnectCore MP13 Development Board provides a socket compatible with MikroElektronika MikroBus click boards, supporting I2C, UART, SPI, ADC and PWM connectivity.

SPI and I2C

An expansion connector provides access to one SPI interface (shared with the MikroBus socket) and the I2C2 bus:

Pin	Signal name	Description
1	SPI4_SCK	SPI clock line
2	3V3	3.3V power supply
3	SPI4_MISO	SPI MISO line
4	EXP_I2C_SCL	STM32MP1 I2C2 bus clock line
5	SPI4_MOSI	SPI MOSI line
6	EXP_I2C_SDA	STM32MP1 I2C2 bus data line
7	SPI4_NSS	SPI slave select line
8	NC	
9	SPI1_IRQ_N	Interrupt line/GPIO
10	GND	

GPIO

An additional expansion connector provides access to different IOs for general purpose usage:

Pin	Signal name	Description
1	VCC_MCA	MCA power supply
2	VREF+	STM32MP1 internal ADC/DAC reference voltage
3	MCA_IO0/MIK_ADC	MCA IO

Pin	Signal name	Description
4	ANA0	STM32MP1 ADC
5	MCA_IO2/EXT_VREF	MCA IO
6	ANA1	STM32MP1 ADC
7	MCA_IO4	MCA IO
8	GND	
9	MCA_IO5	MCA IO
10	MP13_PG5	MP13 IO
11	MCA_IO6/CLKOUT32K	MCA IO and 32 kHz output clock
12	MP13_PH10	MP13 IO
13	NU	Not used on MP13
14	MP13_PB12	MP13 IO
15	MP13_PE6	MP13 IO
16	MP13_PB2	MP13 IO
17	MP13_PH6	MP13 IO
18	MP13_PG3	MP13 IO
19	MP13_PA8	MP13 IO
20	MP13_PG1	MP13 IO

User interfaces

Three LEDs are available on the development board, all of them are connected to CPU GPIOs. Two of them are shared with user buttons.

Wireless

There is a u.FL connector (J4) which is routed directly to a SMA connector (J5). The purpose is to adapt the u.FL form factor to the SMA form factor to extend the number of antennas that can be used on the development board for either the on-module antenna path or any other RF path that could be used on a PCIe or XBee board.

Specifications

Electrical specification

Supply voltages

The ConnectCore MP13 Development Board has one primary supply input, VIN, which powers both the ConnectCore MP13 Development Board and the ConnectCore MP13 system-on-module. An additional input supply powers the RTC of development board when the main supply is not present.

The following table shows the voltage range of the input supplies of the ConnectCore MP13 Development Board:

Signal	Description	Min	Typ	Max	Unit
VIN	Power jack input	4.6	5.0	5.5	V
VCC_LICELL	Supply for RTC	1.1		5.5	V

Mechanical specification

The ConnectCore MP13 Development Board dimensions are 120 x 160 mm. Four 3.2mm drills are located on the four corners of the PCB for assembling the board into an enclosure. These drills have a 5.5mm round metalized area for the screws and nuts. The board has four 2.6mm drills to assembly a half size or a full size PCI express mini card module, with 5.8mm x 5.8mm square metalized area for the screws and nuts.

Environmental specification

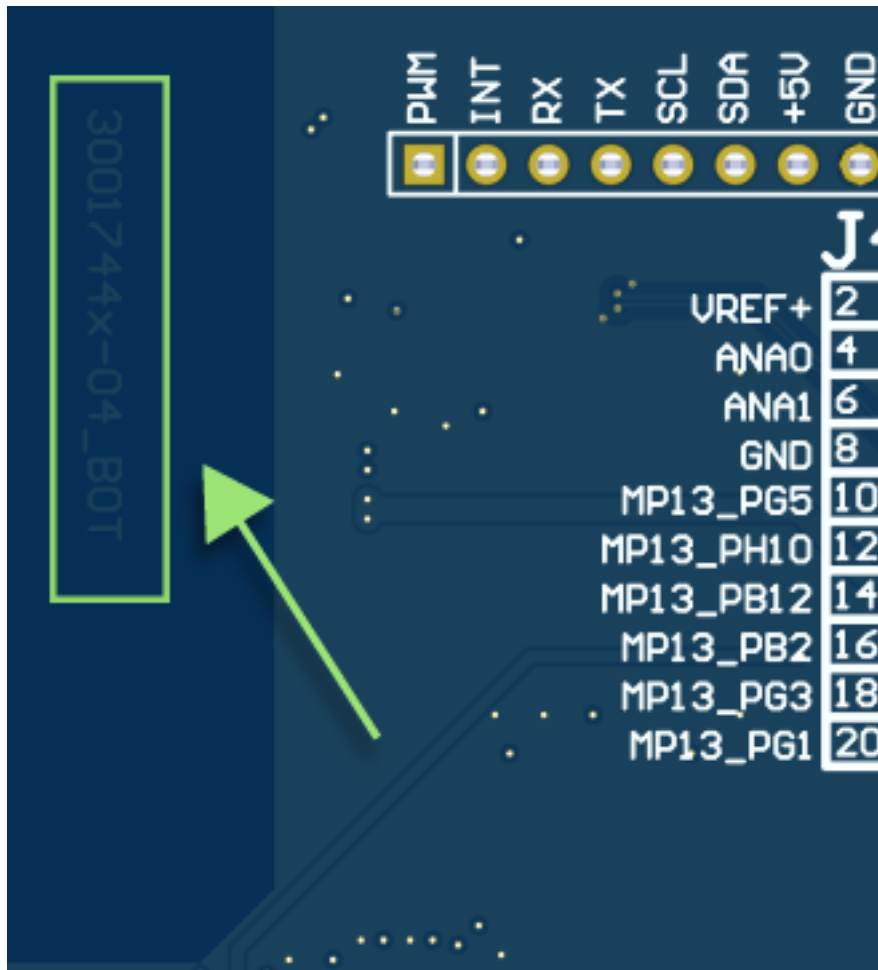
Specification	Operating temperature
Industrial	-40° C to +85° C

WLAN specification

For a complete WLAN specification, refer to the [ConnectCore MP13 System-on-Module Hardware Reference Manual](#).

Appendix A - ETH2 Interface Correction

This issue is fixed as of PCB version 30017442-04. You can find the version number printed on both the top and bottom of the PCB.



Background

The default connection of the ETH2 bus to the 10/100 MB PHY on the ConnectCore MP13 DVK is incorrect, preventing this interface from working on the ConnectCore MP13 module. The issue is related to the connection of the reference clock.

The strategy Digi follows to clock the 10/100 MB PHY is to use a TTL clock from the MAC (CPU), instead of using an external crystal. The PHY input pin for the reference clock is XTAL1/CLKIN (pin 5). This pin is currently connected to pad D11 of the SOM, which corresponds to the PH11 pin of the CPU. This pin can be multiplexed as ETH2_RMII_REF_CLK (AF11), which is an input reference clock, not an output:

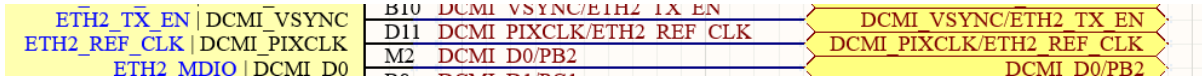


Figure 1. Default connection of the 10/100 MB PHY clock to the SOM (pad D11).

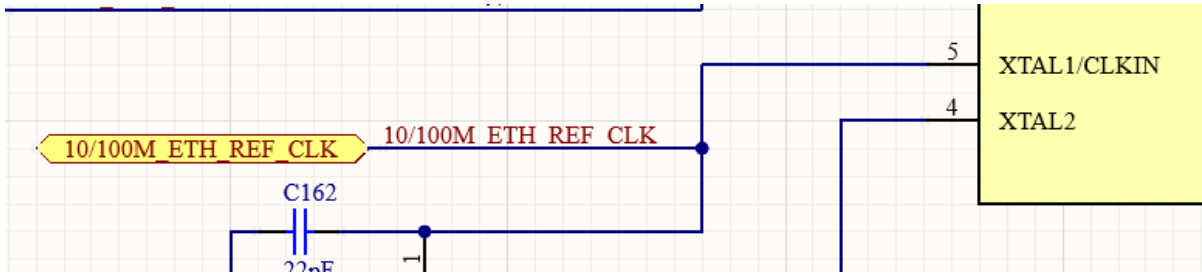


Figure 2. Connection of the clock to the 10/100 MB PHY. DCMI_PIXCLK/ETH2_REF_CLK is connected to 10/100M_ETH_REF_CLK through a 0-ohm resistor (R298). That is why the net changes its name.

D11	LGA_D11	ETH2_REF_CLK	PH11	AF1: SPI5_NSS AF2: TIM5_CH2 AF3: SAI2_SD_A AF5: SPI2_NSS/I2S2_WS AF6: I2C4_SCL AF7: USART6_RX AF9: QUADSPI_BK2_IO0 AF11: ETH2_MII_RX_CLK/ETH2_RGMII_F X_CLK/ETH2_RMII_REF_CLK AF12: FMC_A12
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Figure 3. Multiplexing options of CPU pin PH11, currently connected to the PHY input clock.

Solution

To fix this issue, you must remove the current connection and tie the input clock pin of the PHY to a CPU pin that can be multiplexed as ETH2_CLK output clock. This functionality is available at two module pads: P19 and V20. P19 is currently used as part of a UART bus to keep compatibility with the ConnectCore MP15. V20 is used as a standard GPIO (PA11), intended to be used as the interrupt line of SPI4, and is connected directly to an expansion header. Therefore, you must use V20 to get the reference clock for the 10/100 MB PHY.

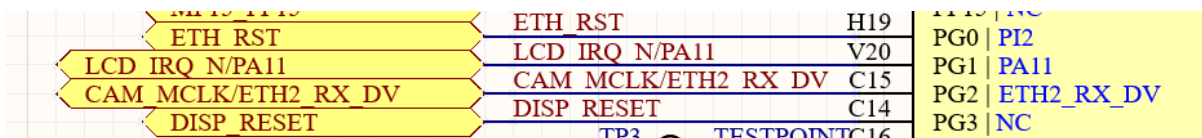


Figure 4. Default connection of SOM pad V20.

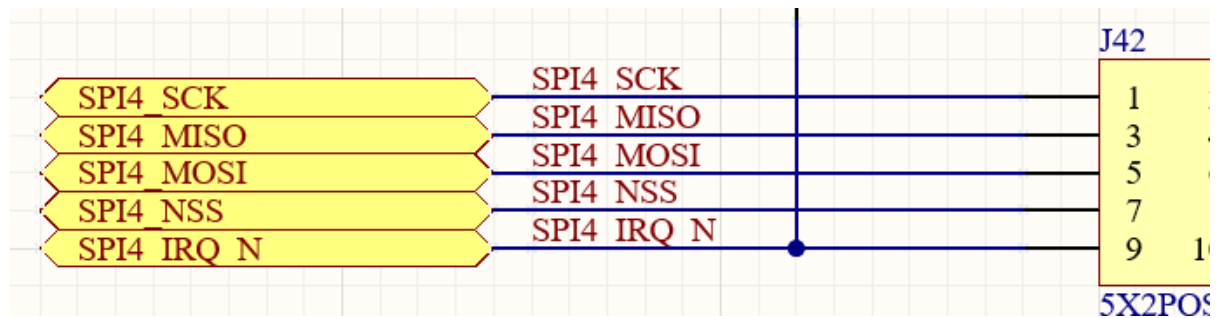


Figure 5. Current connection of PA11 to expansion header J42. LCD_IRQ_N/PA11 signal is connected through 0-ohm resistor (R283) to SPI4_IRQ_N. That is why the net changes its name.

V20	LGA_V20	PA11	PA11	AF1: TIM1_CH4 AF3: I2C5_SCL AF5: SPI2_NSS/I2S2_WS AF7: USART1_CTS/USART1_NSS AF10: ETH2_MII_RXD1/ETH2_RGMII_RXD1/ETH2_RMII_RXD1 AF11: ETH1_CLK AF13: ETH2_CLK
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Figure 6. Multiplexing options of CPU pin PA11, where ETH2_CLK output reference clock for 10/100 MB PHY is available (AF13).

To fix this connection, follow these steps:

- Depopulate R283.
- Depopulate R298.
- Wire a cable from CPU pad side of R283 to PHY pad side of R298.

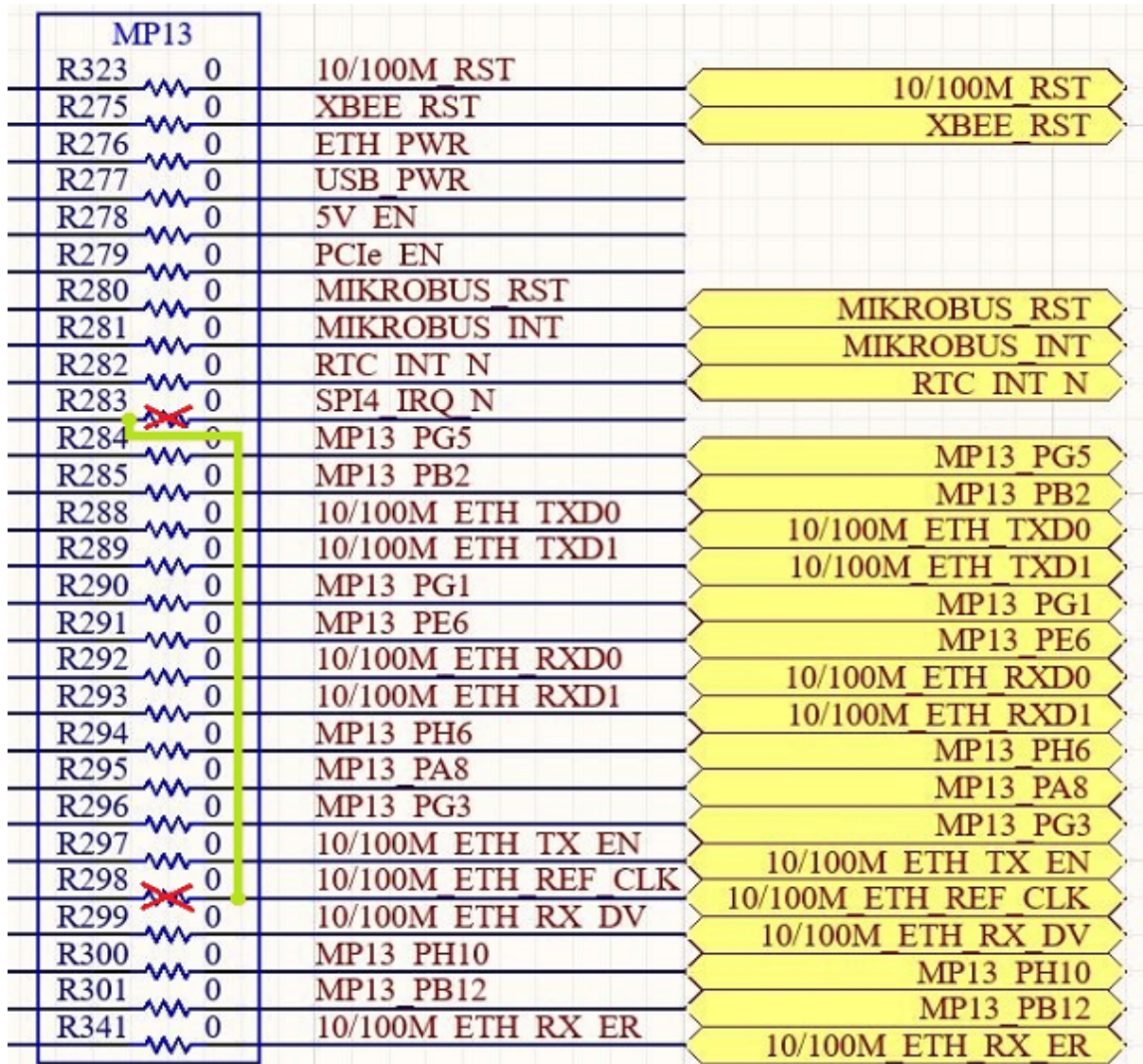


Figure 7. Fix connection at schematic level.

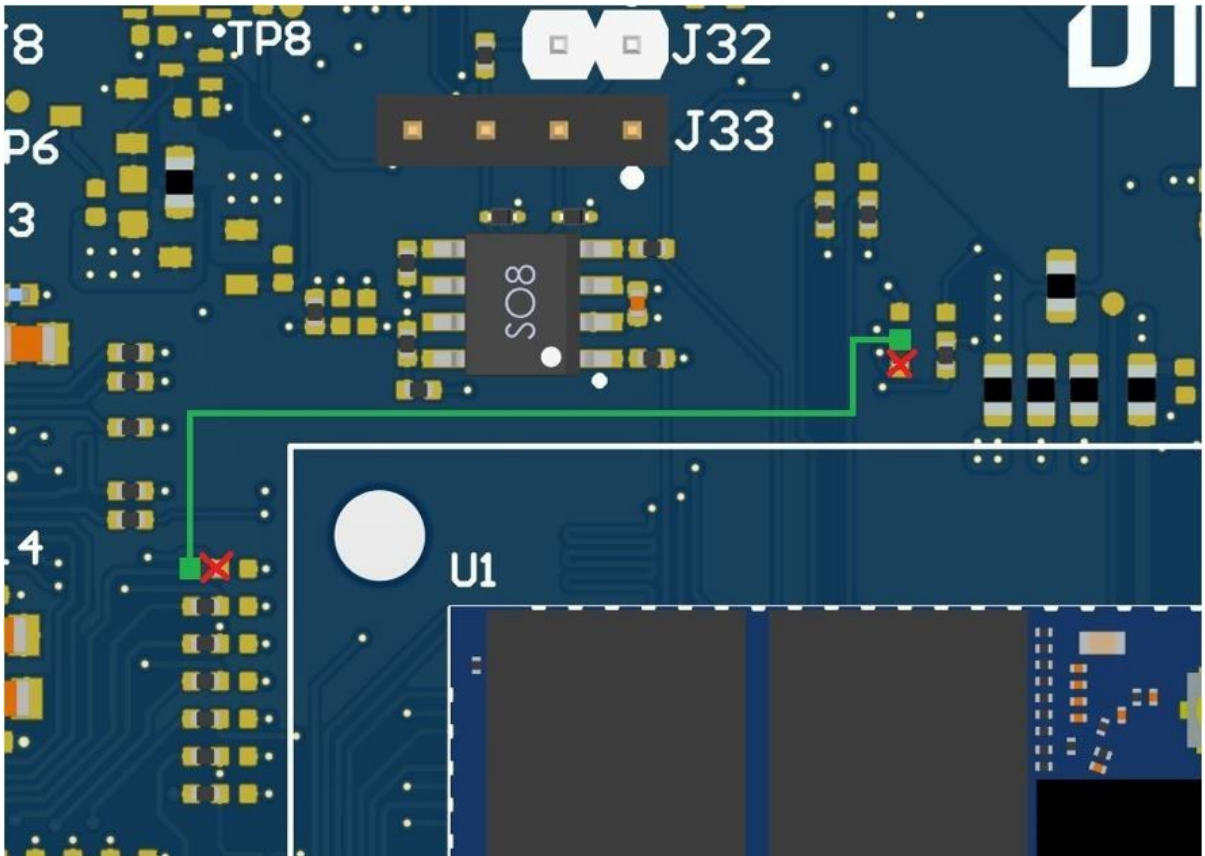


Figure 8. Fix connection at PCB level.

Note One downside to this patch is that SPI4_IRQ_N pin won't be available at connector J42; however you can use any other GPIO available at connector J41 for this purpose.
