## **Application Note**

# Raspberry Pi Compute Module 4 IO USB 3.0 Board

Using USB 3.0 with Compute Module 4

# Colophon

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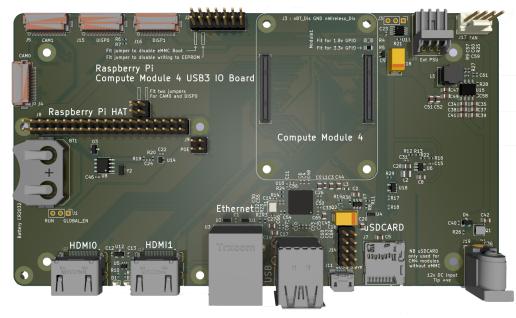
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# **Chapter 1. Introduction**

Figure 1. Render of the Raspberry Pi Compute Module 4 IO USB 3.0 Roard



The Raspberry Pi Compute Module 4 IO USB 3.0 Board (CM4IO-USB3) is designed to assist in the development of products that make use of Raspberry Pi Compute Module 4. The Raspberry Pi Compute Module 4 IO USB 3.0 Board contains many of the interfaces that Raspberry Pi 4 Model B has, and for general usage you should refer to the Raspberry Pi 4 Model B documentation. The significant difference between the CM4IO and CM4IO-USB3 boards is the removal of the PCIe socket and the addition of an USB3 xHCI host controller.

#### IMPORTANT

The Raspberry Pi Compute Module 4 IO USB 3.0 Board in this application note is a reference design, not a product. Users should understand the design and use the relevant sections in their own design. Schematics and layout files are available for KiCad at <a href="https://datasheets.raspberrypi.com/cm4io/CM4IOUSB3-KiCAD.zip">https://datasheets.raspberrypi.com/cm4io/CM4IOUSB3-KiCAD.zip</a>. KiCad is a free, open source suite of tools for designing PCBs and can be found at <a href="https://kicad.org/">https://kicad.org/</a>.

Chapter 1. Introduction

# Chapter 2. Features

- · Accepts the complete range of CM4 modules
- External +12V PSU
- 2 × full-size HDMI 2.0 connectors
- · Gigabit Ethernet RJ45 with PoE support
- · Micro USB socket for updating CM4
- microSD card socket for CM4Lite modules
- USB3 xHCl host controller with two USB3.0 ports and a connector for two USB2.0 ports
- · Standard fan connector
- External power connector (+5V, +12V)
- 2 × MIPI DSI display FPC connectors (22-pin 0.5mm pitch cable)
- 2 × MIPI CSI-2 camera FPC connectors (22-pin 0.5mm pitch cable)
- Raspberry Pi HAT connector
- · RTC with battery socket and ability to wake up CM4
- Jumpers to disable features, e.g. wireless, EEPROM writing

#### 2.1. CM4 module connectors

The two CM4 module connectors are positioned so the on-board wireless antenna is at the edge of the board for best wireless performance.

### 2.2. PSU input

The main PSU input (J19) is a 2.1mm DC tip positive +12V input. There is an on-board +12V to +5V DC-DC converter to power the CM4. There is also an on-board +5V to +1.05V DC-DC converter PSU which is only used for the xHCI USB controller. The +12V input feeds the fan connector directly. If this isn't being used then a wider input supply is possible (+7.5V to +28V).

With a +12V supply via the DC barrel jack, an external PSU connector (J20 with +5V and +12V) is provided. You should ensure that the PSUs aren't overloaded. The J20 mating connector is known as "Berg" connector, part number AMP/TE Connectivity 171822-4 or similar.

The exact current required from the +12V PSU is dependent on the application and on what is connected to the Raspberry Pi Compute Module 4 IO USB 3.0 Board. We recommend budgeting at least 15W for CM4 and the USB peripherals.

If you want to supply an external +5V supply to the board, e.g. via J20 or via PoE J9, then we recommend that L5 be removed. Removing L5 will prevent the on-board +5V supply from starting up and +5V coming out of the DC jack socket (J19).

#### 2.3. Dual full-size HDMI 2.0 connectors

CM4 does most of the interfacing required for the HDMI interface so that most signals are directly connected to the CM4 board. HDMI connectors require a +5V supply, which is provided on the Raspberry Pi Compute Module 4 IO USB

2.1. CM4 module connectors

3.0 Board via a current-limiting IC.

## 2.4. Gigabit Ethernet RJ45

The Raspberry Pi Compute Module 4 IO USB 3.0 Board uses a standard 1:1 Ethernet magjack, which supports PoE as well. Additional ESD protection is provided on the Raspberry Pi Compute Module 4 IO USB 3.0 Board as it is typically needed in PoE applications. The PoE signals from the RJ45 connector are connected to J5. Typically a PoE HAT will supply +5V to the Raspberry Pi Compute Module 4 IO USB 3.0 Board. As a typical PoE HAT doesn't generate a +12V power rail the fan will not function.

#### 2.5. Micro USB connector

The micro USB connector is designed to enable CM4 to be updated via rpiboot.

#### 2.6. microSD card socket



WARNING

For use only with CM4Lite modules

The microSD card socket is a push-push socket. To release the microSD card, a gentle push on the card will enable it to be removed.

#### 2.7. USB3 xHCl host controller

The Raspberry Pi Compute Module 4 IO USB 3.0 Board contains an on-board PCIe xHCI USB3 host controller from VIA Labs (VL805). This is exactly the same host controller as used on Raspberry Pi 4 Model B. Typically this host controller requires an external EEPROM. CM4 can be set up via its EEPROM config file to program the VL805. This means an external EEPROM isn't required, which saves a manufacturing process in production as well as the cost of the EEPROM. To enable this feature, "VL805=1" must be added to the CM4 EEPROM config file. The VL805, when set up by CM4, only supports 2 × USB3.0 ports and 2 × USB2.0 ports. For other configurations you would need to source your own EEPROM image and add an EEPROM to your board.

If you are using the xHCl controller in your own designs then you must ensure good quality decoupling of the xHCl controller. Also, you must observe standard PCIe and USB3 signal routing on your board.

The VL805 part can be hard to source. If you are having difficulties, try contacting http://www.promate.com.tw/ iccomponent/ic\_vli.html

#### 2.8. Fan connector

This connector supports standard +12V fans with PWM drive and tacho output. An EMC2301 controls the fan via I2C. The mating connector part number is Molex 47054-1000 or similar. The +12V power for the fan comes from the +12V input and isn't regulated.

2.4. Gigabit Ethernet RJ45

TIP

To enable the I2C bus to the fan controller, you will need <a href="https://dec.puc-on.gov/dec-no.g

# 2.9. Dual DSI display connectors (22-pin 0.5mm pitch cable)

Both DSI interfaces (2-channel and 4-channel) are brought out to separate 22-way 0.5mm pitch connectors. These connectors are the same as on the existing CMIO board; note that they are different from Raspberry Pi 4 Model B. If the DSIO interface (2-channel) is used, then the two jumpers on J6 must be fitted to route the I2C bus to the connector.

# 2.10. Dual CSI-2 camera connectors (22-pin 0.5mm pitch cable)

Both CSI-2 interfaces (2-channel and 4-channel) are brought out to separate 22-way 0.5mm pitch connectors. These connectors are the same as on the existing CMIO board; note that they are different from Raspberry Pi 4 Model B. If the CSI0 interface (2-channel) is used, then the two jumpers on J6 must be fitted to route the I2C bus to the connector.

### 2.11. Raspberry Pi HAT connector

The Raspberry Pi Compute Module 4 IO USB 3.0 Board has a standard Raspberry Pi 40-way HAT connector. Mounting holes are also provided so that standard HATs may be used.

## 2.12. Real time clock (RTC)

A PCF85063AT RTC is provided on the Raspberry Pi Compute Module 4 IO USB 3.0 Board. A battery socket is provided for a CR2032 battery. On initial setup, the CLKOUT of the RTC should be disabled to save power.

The alarm output of the RTC is used to wake CM4 from a previous shutdown. If an alarm goes off during normal operation, the CM4 will be reset; this can be used as a watchdog timer if required.



TIP

To enable the I2C bus to the RTC you will need  $dtparam=i2c\_vc=on$  set in config.txt. The RTC then will be on i2c-10 address 0x51 (7-bit address).

## 2.13. Jumpers

R4/R5 Vref voltage selection

By default the Raspberry Pi Compute Module 4 IO USB 3.0 Board sets the CM4 IO voltage to +3.3V via R5. Moving R5 to R4 sets the IO voltage on CM4 to +1.8V. Moving the resistor requires the use of a soldering iron.

#### NOTE

Only one of R4 or R5 may be fitted at any one time.

#### NOTE

J6 CSI0 DSI0 I2C enable

For the J6 jumpers, if either CSI0 or DSI0 is used then both jumpers must be fitted to route the I2C bus to the connectors.

Table 1. J2 jumpers

Pin	Function
1-2	nRPIBOOT - if fitted, forces USB booting; it is useful if the eMMC becomes corrupted
3-4	EEPROM_nWP - if fitted, write-protects the EEPROM on CM4
5	AIN0 MXL7704 - analog input; consult MXL7704 datasheet for details
6	AIN1 MXL7704 - analog input; consult MXL7704 datasheet for details
7	GND for AIN signals
8	SYNC_IN
9	SYNC_OUT
10	GND
11	TV_OUT
12	GND
13-14	Connect a push button to wake CM4 from low-power mode. It can't be used to shut down CM4.

Table 2. J3 (not fitted by default)

Pin	Function
1	WL_nDIS - when connected to ground the wireless interface will be disabled
2	GND - ground
3	BT_nDIS - when connected to ground the Bluetooth interface will be disabled

Table 3. J1 (not fitted by default)

Pin	Function
1	GLOBAL_EN
2	GND
3	RUN_PG

## 2.14. LEDs

#### Red LED

This LED duplicates the function of the red LED on Raspberry Pi 4 Model B

#### Green LED

This LED duplicates the function of the green LED on Raspberry Pi 4 Model B

2.14. LEDs

# Chapter 3. Circuit diagram

Figure 2. Top level

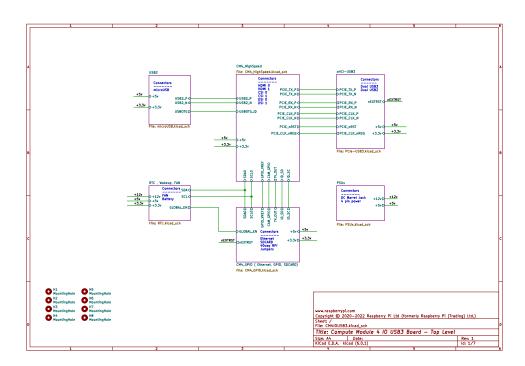


Figure 3. CM4 high speed

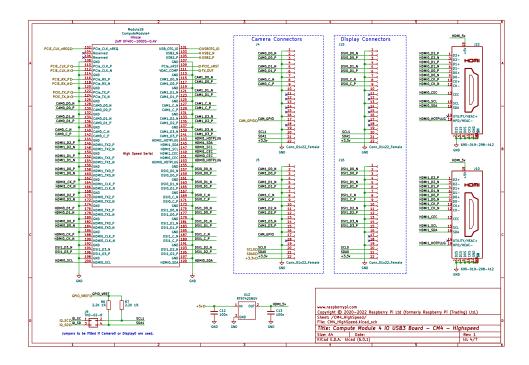


Figure 4. CM4 GPIO

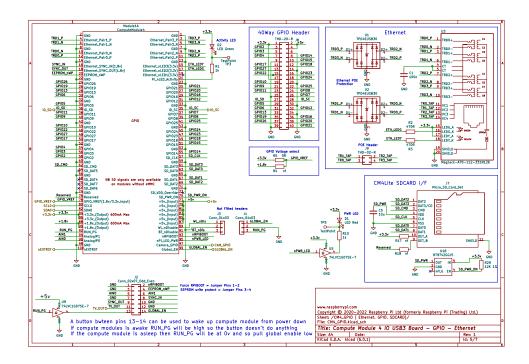


Figure 5. xHCI-USB3

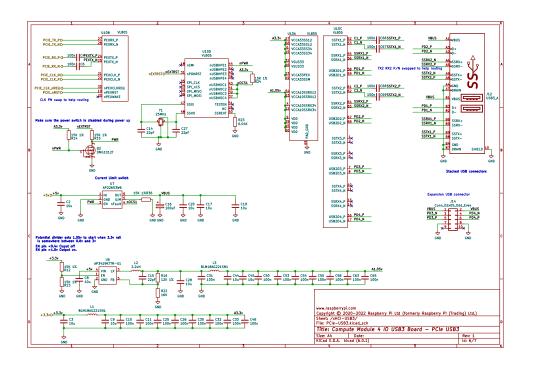


Figure 6. USB2 hub

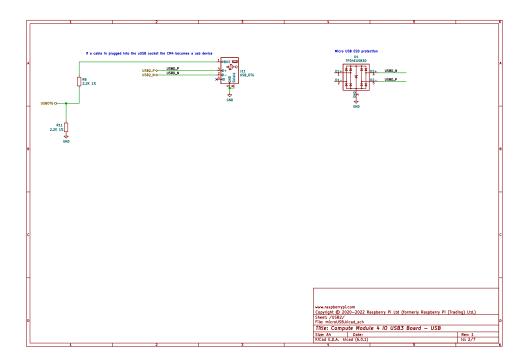


Figure 7. RTC wakeup and fan

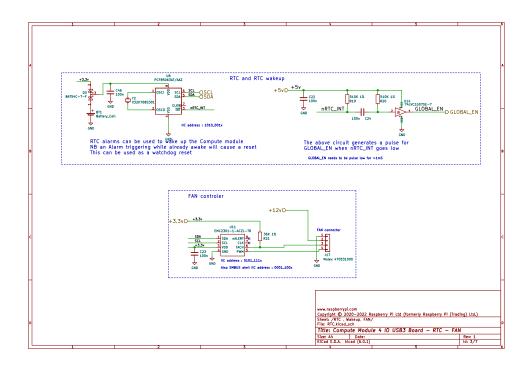
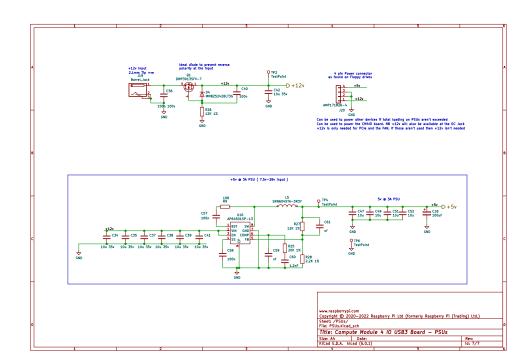


Figure 8. PSU





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