Raspberry Pi Compute Module 5 IO Board

An application board for Raspberry Pi Compute Module 5.

Colophon

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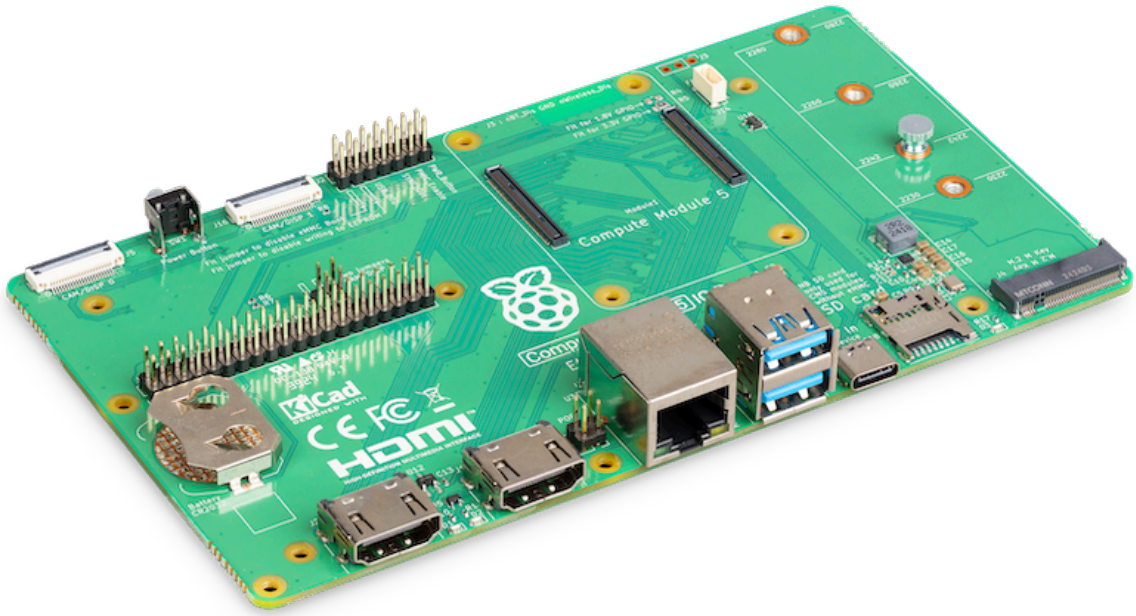
1. Introduction

The Raspberry Pi Compute Module 5 IO Board (CM5IO) is the companion carrier board for Raspberry Pi Compute Module 5 (CM5), designed to assist in the development of products that make use of CM5. It connects the signals exposed by CM5 to familiar ports, including USB, Ethernet, HDMI, MIPI and so on. For a full list of features, see Section 1.3. Features.

Figure 1.
The Raspberry Pi Compute Module 5 IO Board.



The Raspberry Pi Compute Module 5 IO Board contains many of the interfaces that Raspberry Pi 5 has. For general usage guidance, see the Raspberry Pi 5 documentation.

1.1. Applications

CM5 is like a Raspberry Pi but without any physical connectors on the board. Its companion board, the CM5IO, provides the physical connectors for CM5.

The CM5IO can be used as either a reference design for interfacing with CM5, or as a standalone product for direct deployment. The compact form factor, standard connectors, integrated cooling options, and power management of the CM5IO allow for rapid prototyping and embedded systems development around CM5.

Designers can selectively include only the connectors that their application requires. This helps to keep designs simpler, smaller, and more cost-effective. Its functionality can also be extended through M.2 M key cards and Raspberry Pi HATS. For more information, see Section 4. Expansion and storage.

Design files for the CM5IO are freely available from the Compute Module 5 IO board documentation.

1.2. Connection to CM5

The CM5 attaches directly to two high-density connectors on CM5IO. These connectors give access to nearly all of CM5's interfaces, including GPIOs, PCIe, USB, HDMI, camera, display, power, and other signals.

Connector placement is designed to optimise routing and performance. The connectors are positioned so that the on-board wireless antenna is placed at the edge of the board for optimal wireless signal.

1.3. Features

The CM5IO is a compact (160 mm × 90 mm) carrier board that accepts both CM5 and Raspberry Pi Compute Module 5 Lite (CM5Lite). Key features of the CM5IO include:

- **Power and control connectors.**
  - External 5 V input through Type-C PSU.
  - Power button to wake up and shut down CM5.
  - Real time clock (RTC) battery socket.
- **Video and display connectors.**
  - Two full-size HDMI 2.0 connectors, supporting 4K displays.
  - Two MIPI DSI/CSI-2 (dual-purpose) FPC connectors (22-pin 0.5 mm pitch cable) supporting Raspberry Pi-compatible touch displays and cameras.
- **Networking and connectivity connectors.**
  - Gigabit Ethernet (RJ-45) for network connectivity, with PoE+ support through an optional HAT.
  - Two USB 3.0 (Type-A) ports for keyboards, storage, or peripherals.
  - One USB 2.0 (Type-C) port for flashing CM5 or additional peripherals.
- **Expansion and storage options.**
  - M.2 M key PCIe socket for NVMe SSDs.
  - microSD card slot (for CM5Lite without eMMC).
  - HAT footprint with 40-pin GPIO connector.
- **Configuration options.**
  - Jumpers to disable features such as eMMC booting, EEPROM writing, and wireless connectivity.
  - Selectable R4/R5 Vref voltage to support different voltage requirements.
- **Fan connector.** Four-pin JST-SH PWM fan connector for active cooling.

2. Power management and status indicators

CM5IO requires an external 5 V power source for normal operation. The following sections describe the power inputs, control mechanisms, distribution to peripherals, RTC support, and status indicators of the CM5IO, providing guidance for safe operation and system monitoring.

2.1. Power supply unit (PSU) input

The main power input (`J11`) is a standard Type-C connector. By default, when a compatible Type-C power supply (PSU) is connected, the CM5IO negotiates 5 V at 5 A using USB Power Delivery (PD). If the connected PSU for CM5IO doesn't provide 5 A, CM5 displays a warning; you can disable this warning by adding `PSU_MAX_CURRENT=5000` to the EEPROM configuration, which sets the maximum allowed current in milliamps.

You can power CM5IO with a standard Raspberry Pi 5 power supply. Alternatively, you can supply an external 5 V supply to the board through `J8` . The exact power consumption depends on the processor load and peripherals plugged into the CM5IO.

2.2. Power button behaviour

The power button replicates the function of the power button on the Raspberry Pi 5:

- **Short press.** A short press brings up the shutdown menu; another press powers the system down.
- **Long press.** A long press forces the system to power down.
- **Short press from shutdown.** A short press from a previously shutdown system boots the system.

2.3. Power distribution and current limits

The CM5IO distributes power to on-board peripherals with appropriate current limits to protect the board and devices.

- **HDMI 2.0 connectors.** The HDMI 2.0 connectors receive 5 V through a current-limited switch. For more information about the HDMI 2.0 connectors in the CM5IO, see Section 3.1. HDMI 2.0 connectors.
- **USB 3.0 (Type A) connectors.** The two USB 3.0 ports are limited to approximately 1.2 A combined through an internal current switch. For more information about the USB 3.0 ports, see Section 3.4. USB 3.0 (Type-A) and USB 2.0 (Type-C) connectors.
- **Power over Ethernet (PoE).** PoE supplies 5 V to the CM5IO through the RJ45 magjack connector. For more information about PoE, see Section 3.3. Ethernet (RJ45) connector.
- **Fan connector.** The fan connector is powered from the 5 V rail. For more information, see Section 3.5. Fan connector.

2.4. Real time clock (RTC) battery

The CM5IO provides a battery socket for a CR2032 battery to maintain the board's real-time clock (RTC) when the main power is off. This ensures that date and time settings are preserved across shutdowns or power loss. Typical battery life is up to 5 years.

2.5. LEDs

The CM5IO includes two on-board LEDs that replicate the standard behaviour of Raspberry Pi 5 for quick visual feedback about the board's status.

- **Red LED:** Power status. When the LED is red, the CM5IO is on and receiving sufficient power.
- **Green LED:** System activity. When the green LED is flashing, there is activity, such as boot progress or storage access.

3. Connectors

CM5 provides multiple interface options for video, networking, USB connectivity, and fan connectivity. For video, the CM5IO includes dual HDMI 2.0 connectors and MIPI DSI/CSI-2 connectors that support displays and cameras. For networking, it offers a Gigabit Ethernet connector with PoE support, and USB connectivity provided through two USB 3.0 (Type-A) connectors and a USB 2.0 (Type-C) data connector.

3.1. HDMI 2.0 connectors

The CM5IO includes two full-size HDMI 2.0 connectors that support 4K displays. These HDMI connectors require a 5 V supply, which is provided through a current-limited switch on the CM5IO.

CM5 is primarily responsible for handling the communication between HDMI devices and does most of the interfacing required for the HDMI interface. The HDMI interface signals are routed directly to CM5.

3.2. MIPI connectors (DSI/CSI-2)

The CM5IO includes two 22-pin MIPI DSI/CSI-2 FPC connectors with a 0.5 mm pitch cable, which serve dual purposes for displays and cameras. These connectors are compatible with Raspberry Pi 5 accessories, such as touch displays and cameras.

- The CAM/DISP 0 connector can connect either a display or a camera, and includes a signal to power down the camera for energy savings.
- The CAM/DISP 1 connector can also connect either a display or camera, but requires two jumpers at `J6` to route I2C signals from the GPIO connector. When used with a camera, it isn't possible to power down the camera.

3.3. Ethernet (RJ45) connector

For wired networking, the CM5IO includes a standard 1:1 Gigabit Ethernet RJ45 magjack connector. This connector also supports Power over Ethernet (PoE), allowing the board to receive both data and power through a single cable when connected to a compatible PoE source.

Additional ESD protection is provided on the CM5IO, which is important for PoE applications. PoE signals from the RJ45 magjack connector are routed to `J9` . A PoE HAT supplies 5 V to the CM5IO to power connected peripherals and the CM5.

3.4. USB 3.0 (Type-A) and USB 2.0 (Type-C) connectors

The CM5IO provides the following USB connectors:

- **USB 3.0 (Type-A).** For general-purpose devices. These data ports support high-speed data transfer between devices, like storage drives, peripherals, or cameras. They also provide power (VBUS) through an internal current-limiting switch set to approximately 1.2 A.
- **USB 2.0 (Type-C).** Primarily intended for data transfer and enabling board updates through `rpiboot` . The USB port on the host computer must provide sufficient power to the CM5IO. If the host computer isn't capable, use a powered USB hub.

3.5. Fan connector

The CM5IO uses the same fan connector as Raspberry Pi 5. This means that you can use any fans that work with Raspberry Pi 5 on the CM5IO.

Fan speed is controlled with a PWM pin from CM5. When the board is powered down, the PWM pin stops sending this signal and, as a result, some fans might run continuously. If you're designing your own carrier board and you don't want the fan to run when the board is off, you can instead power the fan from the USB VBUS enable (`U6`). When CM5 is shutdown, the `VBUS_EN` is pulled low and so VBUS is shutdown.

4. Expansion and storage

The CM5IO provides options for expanding storage and connecting additional peripherals. These interfaces allow you to add high-speed NVMe SSDs and take advantage of the extensive ecosystem of Raspberry Pi HATs and accessories. For CM5Lite you can also add microSD storage.

4.1. M.2 M key connector

The CM5IO includes an M.2 M key connector, designed for standard M.2 M key cards. This connector is typically used for NVMe SSDs, which are fast storage drives that use the PCIe interface to communicate.

Ensure that the operating system (OS) has a compatible driver for your card. Without the driver, the card might not work properly.

By default, the M.2 M key connector runs at PCIe Gen 2 ×1, which provides 5 Gb/s. PCIe Gen 3 ×1 (which provides 8 Gb/s) is possible, but experimental and therefore unsupported.

4.2. Raspberry Pi HAT connector

The CM5IO provides a standard 40-pin Raspberry Pi HAT connector, enabling use of existing Raspberry Pi HATs and accessories. The connector exposes GPIO, I2C, SPI, UART, PWM, and power rails as defined in the Raspberry Pi HAT specification.

To ensure mechanical compatibility with standard HAT boards, the CM5IO includes mounting holes and a board outline for alignment. While the CM5IO includes 4 mounting holes, some HATs have two mounting holes instead of four. In either case, the HAT should be oriented such that it covers the battery on the CM5IO.

For electrical pinout details, refer to the Raspberry Pi HAT specification.

4.3. microSD card connector (CM5Lite only)

CM5Lite doesn't include on-board eMMC and so relies on the microSD card connector for external storage. The microSD card connector isn't available for the standard CM5, which already has built-in eMMC storage.

The microSD card connector for CM5Lite is a push-push slot:

- To insert a microSD card, gently push it in to the slot until it clicks.
- To release a microSD card, gently push on the card to unlock it, then pull it out.

5. Configuration options

You can tailor the behaviour of the CM5IO for different use cases without requiring firmware changes. Use jumpers to quickly change settings like boot mode, wireless connectivity, or I2C routing; use resistor options for selecting I/O reference voltage (Vref).

5.1. J2 jumpers (boot and EEPROM overrides)

The J2 jumpers control boot behaviour, EEPROM write protection, timing signal, power management, and external wake/shutdown. These settings are useful for recovery and protecting the EEPROM. Table 1 lists the J2 jumper pins on CM5IO and what each jumper does.

Table 1.
J2 jumper pins on the Raspberry Pi Compute Module 5 IO Board (CM5IO)

Pin	Function	Description
1-2	`nRPIBOOT`	If a jumper is placed here, it forces CM5 to boot from USB instead of the on-board eMMC. This is useful if the eMMC is corrupted or unavailable.
3-4	`EEPROM_nWP`	If a jumper is placed here, the jumper write-protects the EEPROM on CM5, preventing accidental or unauthorised modifications.
6	`SYNC_OUT`	This pin provides an IEEE1588 timing signal; it can also be configured as an input for external timing.
12	`PMIC_ENABLE`	This pin controls the Power Management IC (PMIC), enabling or disabling certain power functions.
13-14	Wake/shutdown button	These pins connect a push button to allow manual wakeup or shutdown of CM5.

5.2. J3 jumpers (Wi-Fi and Bluetooth disable)

J3 is an optional jumper block (not fitted by default) that allows you to selectively turn off Wi-Fi or Bluetooth. Installing jumpers between pins 1 and 2 disables Wi-Fi; installing jumpers between pins 3 and 2 disables Bluetooth. Table 2 describes the J3 jumper pins on the CM5IO and what each jumper does.

Table 2.
J3 jumper pins on the Raspberry Pi Compute Module 5 IO Board (CM5IO) (not fitted by default)

Pin	Function	Description
1	`WL_nDIS`	When this pin is connected to ground, Wi-Fi is disabled.
2	`GND`	Ground reference for the other pins.
3	`BT_nDIS`	When this pin is connected to ground, Bluetooth is disabled.

5.3. J6 jumpers (CSI/DSI)

The J6 jumpers route I2C signals to the MIPI CSI/DSI connectors. When using CAM/DISP 1, both jumpers must be fitted to ensure proper communication between the board and attached cameras or displays.

5.4. R4/R5 Vref voltage selection

You can use the `R4` and `R5` resistor positions to select the GPIO reference voltage (Vref), which determines the logic voltage level for the GPIO pins on CM5, ensuring compatibility with the peripherals you're connecting. Moving a surface-mount component is a hardware change, so it requires soldering.

By default, the CM5IO sets the CM5 GPIO voltage to 3.3 V through the `R5` surface-mount resistor. To change the GPIO voltage to 1.8 V, remove `R5` and install it at `R4` instead. Only one resistor (`R4` or `R5`) must be fitted at a time; installing both could damage the board or connected devices.

- Use 3.3 V Vref for most Raspberry Pi HATs, accessories, and general-purpose peripherals.
- Use 1.8 V Vref only if you need to interface with devices that require lower GPIO voltage levels, such as certain sensors or memory devices.

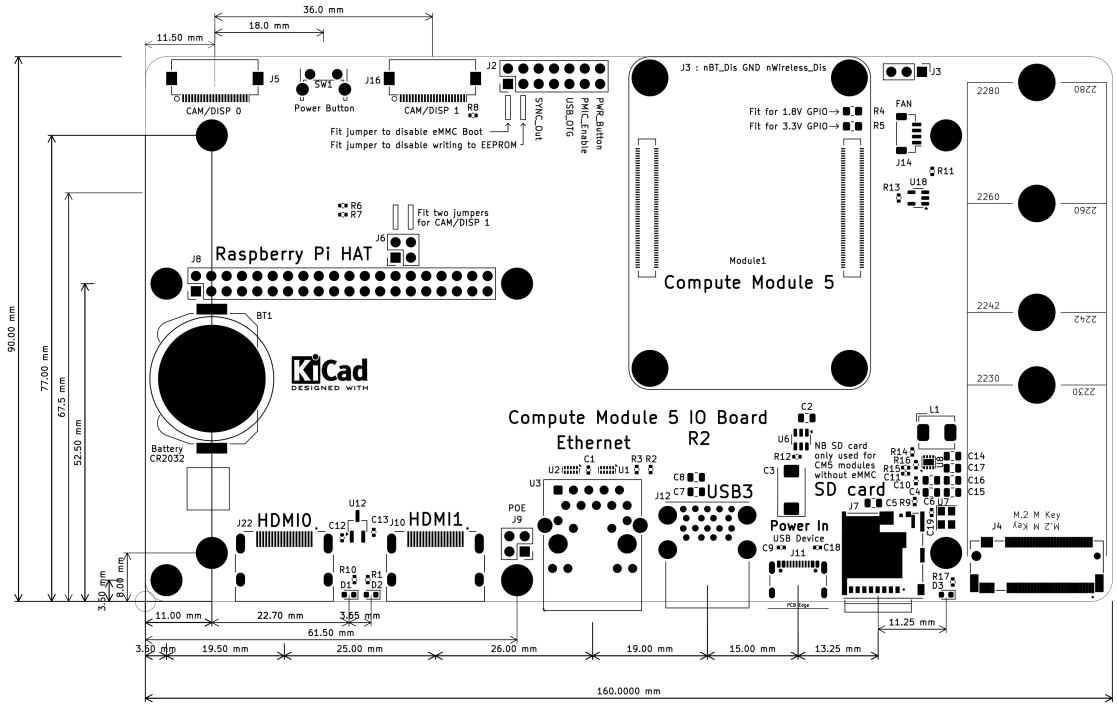
6. Specifications

This section outlines the CM5IO's mechanical layout (including key dimensions and component placement), and its reliability, measured by mean time between failure (MTBF).

6.1. Mechanical layout

The mechanical diagram in Figure 2 illustrates the outline (160 mm × 90 mm), component placement, and dimensions of the CM5IO as seen from the top. For more detailed visual references, see Appendix A. Circuit diagrams and the CM5 design files.

Figure 2.
Mechanical diagram of the Raspberry Pi Compute Module 5 IO Board (CM5IO) as seen from the top



6.2. Mean time between failure (MTBF)

Mean time between failure (MTBF) measures how long, on average, a device is expected to operate before failure. Table 3 shows the expected lifetime of the CM5IO, which can vary depending on the environment it operates in:

Table 3.
Mean time between failure (MTBF) for Raspberry Pi Compute Module 5 IO Board (CM5IO)

Environment	Description	MTBF
Ground, benign	A stable, non-mobile environment where temperature and humidity are controlled, such as laboratories, business and scientific computer complexes, and medical equipment rooms. In these environments, devices generally last longer.	131 000 hours
Ground, mobile	A high-stress environment with vibration, temperature swings, humidity variations, and frequent movement, such as equipment in vehicles and handheld communication devices. In these environments, life expectancy drops.	15 000 hours

Appendix A. Circuit diagrams

This section includes schematic circuit diagrams that show the functional relationships between components on the CM5IO. For full reference material, see the CM5 design files, which include IO board designs in KiCad format. These can be used in your own reference designs.

The following figures illustrate different parts of the CM5IO circuitry:

- Figure 3 is a top-level diagram that shows the main functional blocks of the CM5IO and how these are connected. The main functional blocks are then shown in more detail in the subsequent three figures.
- Figure 4 details the high-speed connectors on the CM5IO, including DSI/CSI, USB 3.0, and HDMI 2.0. It also shows the receiving connector on the left side of the CM5IO, and the current-limit switch.
- Figure 5 details the GPIO-related connectors on the CM5IO, including the GPIO header, Ethernet, and CM5Lite SD card. It also shows the receiving connector on the right side of the CM5IO .
- Figure 6 details the M.2 connector and the associated PCIe power supply on the CM5IO.

Figure 3.
The main functional blocks of the Raspberry Pi Compute Module 5 IO Board (CM5IO), connected to the USB 2.0 (Type-C) power connector

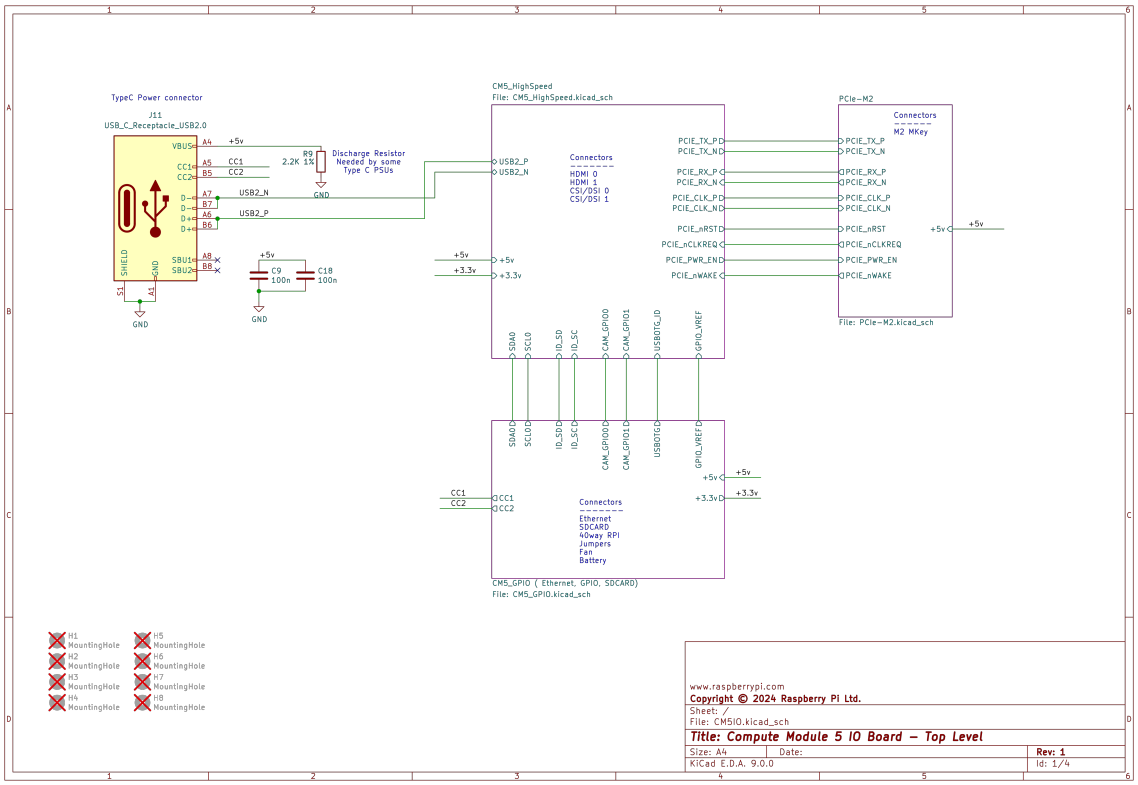


Figure 4.

High-speed connectors on the Raspberry Pi Compute Module 5 IO Board (CM5IO)

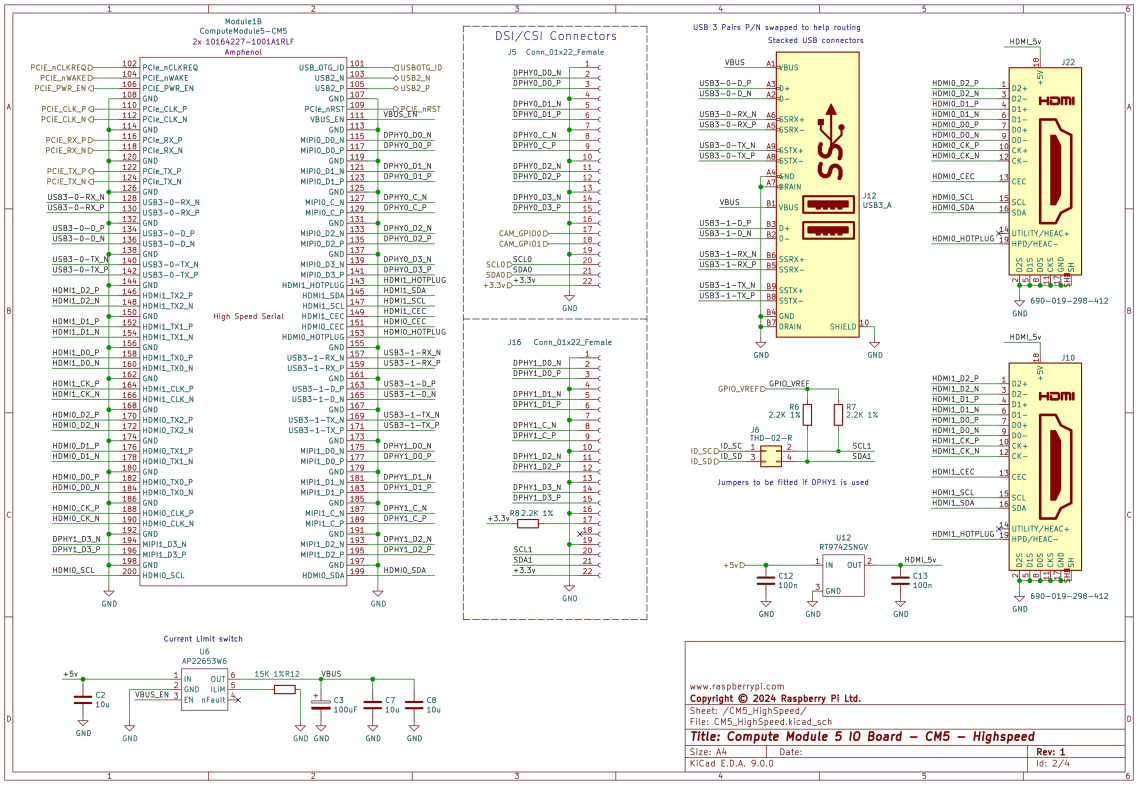


Figure 5.

GPIO-related connectors on the Raspberry Pi Compute Module 5 IO Board (CM5IO)

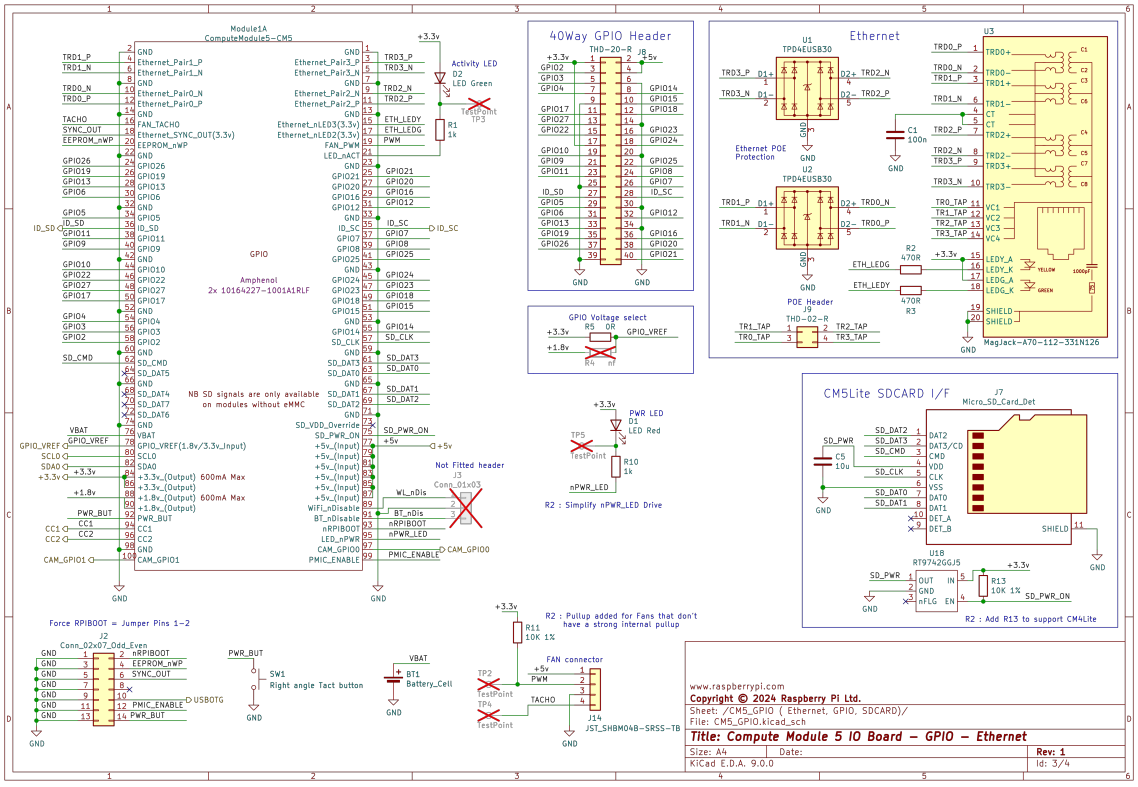
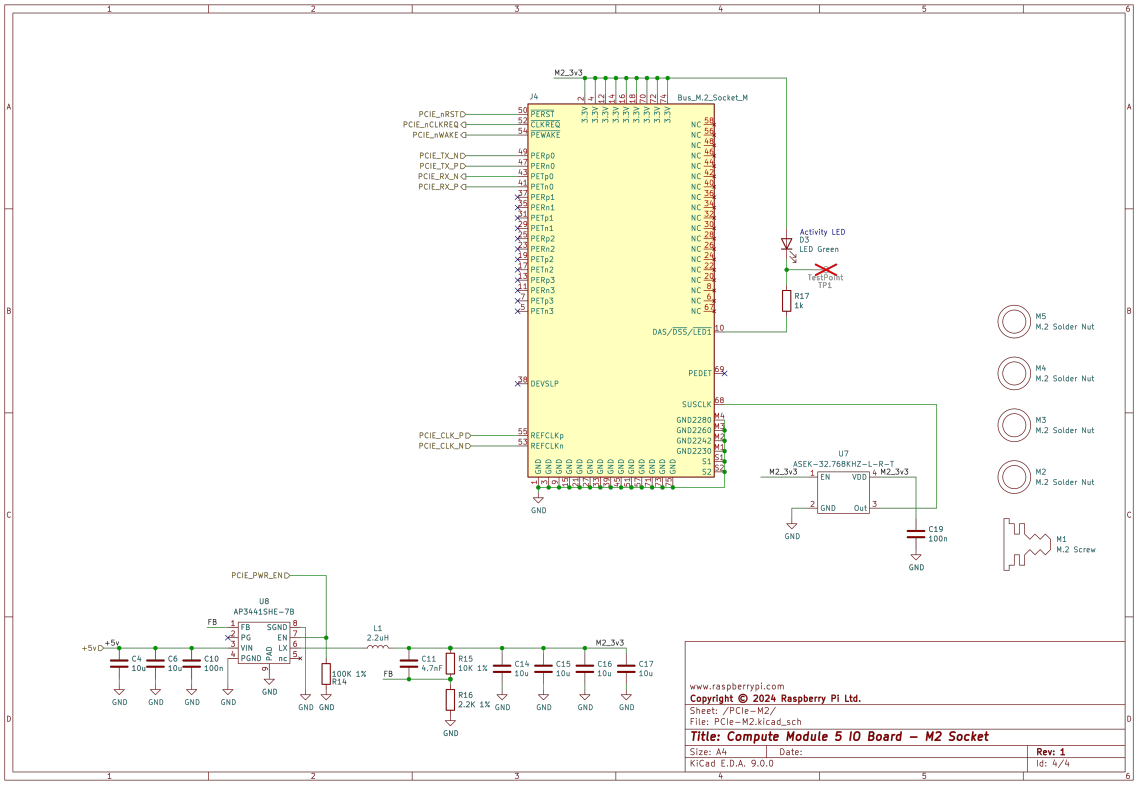


Figure 6.

M.2 connector and PCIe power supply on the Raspberry Pi Compute Module 5 IO Board (CM5IO)



Appendix B. Documentation history

Date	Changes
28 August, 2025	Updated structure, grammar, and wording for clarity and style. Made minor corrections. Added information about applications, connectors, and diagrams.
1 August, 2025	Revision 2 IO board update: added information about pull-up on FAN output for broader fan support; simplified LED drive circuit by removing buffer; corrected `USB_OTG_ID` and `Sync_Out` silkscreen.
21 July, 2025	Update to new company format.
27 November, 2024	Initial release of Raspberry Pi Compute Module 5 IO Board (CM5IO).

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