

# **Raspberry Pi**

## **Compute Module 4**

A Raspberry Pi for deeply  
embedded applications

# Colophon

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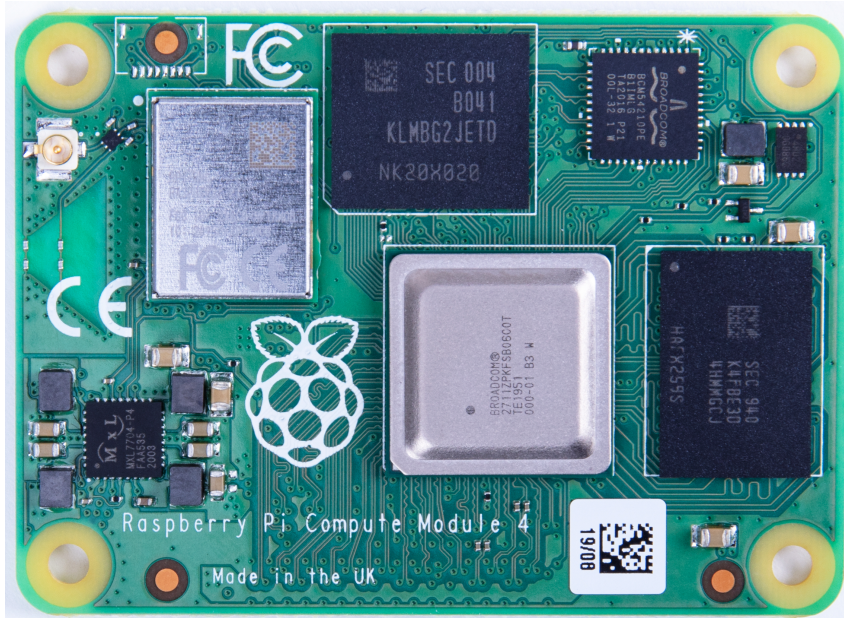
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# Chapter 1. Introduction

## 1.1. Introduction

Figure 1. The Raspberry Pi Compute Module 4 (CM4).



The Raspberry Pi Compute Module 4 (CM4) is a System on Module (SoM) containing processor, memory, eMMC Flash, and supporting power circuitry. These modules allow a designer to leverage the Raspberry Pi hardware and software stack in their own custom systems and form factors. In addition, these modules have extra IO interfaces over and above what is available on the Raspberry Pi boards, opening up more options for the designer.

The design of the CM4 is loosely based on the Raspberry Pi 4 Model B, and for cost-sensitive applications it can be supplied without the eMMC fitted; this version is called the Raspberry Pi Compute Module 4 Lite (CM4Lite).

While [previous generations of the Compute Module](#) have all shared the same DDR2-SODIMM-mechanically-compatible form factor, the new CM4 and CM4Lite are different. The electrical interface of the CM4 is via two 100-pin high density connectors, and the new physical form factor has a smaller footprint overall when the connectors are taken into account.

This change is due to the addition of new interfaces: an additional second HDMI, PCIe, and Ethernet. The addition of these new interfaces, especially PCIe, would not have been possible while preserving the previous form factor.

### **i** NOTE

Unless otherwise stated, for this document CM4 also refers to CM4Lite.

## 1.2. Features

Key features of the CM4 are as follows:

- Broadcom [BCM2711](#), quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- Small Footprint 55mm × 40mm × 4.7mm module
  - 4 × M2.5 mounting holes

- H.265 (HEVC) (upto 4Kp60 decode), H.264 (upto 1080p60 decode, 1080p30 encode)
- OpenGL ES 3.0 graphics
- Options for 1GB, 2GB, 4GB or 8GB LPDDR4-3200 SDRAM with ECC (see [Appendix B](#))
- Options for 0GB (**CM4Lite**), 8GB, 16GB, or 32GB eMMC flash memory (see [Appendix B](#))
  - Peak eMMC bandwidth 100MBps (four times faster than previous Compute Modules)
- Option (see [Appendix B](#)) for certified radio module with:
  - 2.4 GHz, 5.0 GHz IEEE 802.11 b/g/n/ac wireless
  - Bluetooth 5.0, BLE
  - On board electronic switch to select between PCB trace or external antenna
- Gigabit Ethernet PHY supporting IEEE 1588
- 1 × PCIe 1-lane Host, Gen 2 (5Gbps)
- 1 × USB 2.0 port (high speed)
- 28 × GPIO supporting either 1.8V or 3.3V signalling and peripheral options:
  - Up to 5 × UART
  - Up to 5 × I2C
  - Up to 5 × SPI
  - 1 × SDIO interface
  - 1 × DPI (parallel RGB display)
  - 1 × PCM
  - Up to 2× PWM channels
  - Up to 3× GPCLK outputs
- 2 × HDMI 2.0 ports (up to 4Kp60 supported)
- MIPI DSI:
  - 1 × 2-lane MIPI DSI display port
  - 1 × 4-lane MIPI DSI display port
- MIPI CSI-2:
  - 1 × 2-lane MIPI CSI camera port
  - 1 × 4-lane MIPI CSI camera port
- 1 × SDIO 2.0 (**CM4Lite**)
- Single +5V PSU input.

# Chapter 2. Interfaces

## 2.1. Wireless

The CM4 can be supplied with an on-board wireless module based on the Cypress CYW43455 supporting both:

- 2.4 GHz, 5.0 GHz IEEE 802.11 b/g/n/ac wireless
- Bluetooth 5.0, BLE

These wireless interfaces can be individually enabled or disabled as required. For instance, in the case of a kiosk application, a service engineer could enable wireless operation and then disable it once finished.

The CM4 has an on-board antenna. If used it should be positioned in the product such that it is not surrounded by metal, including any ground plane (see [Chapter 3](#) for further details). Alternatively there is a standard U.FL connector on the module, see [Figure 1](#), so that an external antenna can be used.

Raspberry Pi Ltd has an antenna kit which is certified to be used with the CM4. If a different antenna is used then separate certification will be required.

### ⚠ WARNING

Raspberry Pi Ltd will not be able to assist with certification for third-party antennas.

The selection of internal or external antenna is done at boot time using the `config.txt` file, and can not be changed during operation. The `config.txt` options are `dtparam=ant1` to select the internal antenna, or `dtparam=ant2` for the external antenna.

### 2.1.1. WL\_nDisable

This pin serves a number of functions;

1. It can be used to monitor the enable/disable state of wireless networking. A logic high means the wireless networking module is powered up.
2. When driven or tied low it prevents the wireless network module from powering up. This is useful to reduce power consumption or in applications where it is required to physically ensure the wireless networking is disabled. If the interface is enabled after being disabled, the wireless interface driver needs reinitialised.

### i NOTE

On CM4 modules without wireless, this pin is reserved.

### 2.1.2. BT\_nDisable

This pin serves a number of functions;

1. It can be used to monitor the enable/disable state of Bluetooth. A logic high means the Bluetooth module is powered up.
2. When driven, or tied low, it prevents the Bluetooth module from powering up. This is useful to reduce power consumption, or in applications where it is required to physically ensure the Bluetooth is disabled. If the interface is enabled after being disabled, the Bluetooth interface driver needs reinitialised.

**NOTE**

On CM4 modules without wireless, this pin is reserved.

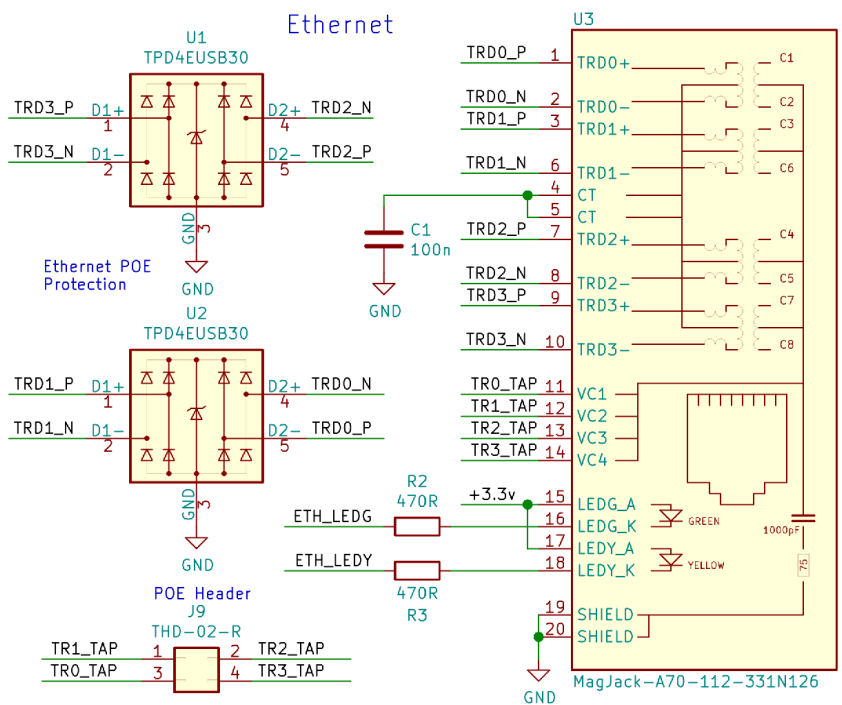
## 2.2. Ethernet

The CM4 has an on-board Gigabit Ethernet PHY – the Broadcom [BCM54210PE](#) – some of the major features of this PHY include;

- [IEEE 1588-2008](#) compliant
- MDI crossover, pair skew and pair polarity correction

A standard 1:1 RJ45 MagJack is all that is necessary to provide an Ethernet connection to the CM4. Typical wiring of a MagJack supporting PoE, and with added ESD protection, can be seen in [Figure 2](#).

Figure 2. Ethernet schematic interface for the Raspberry Pi Compute Module 4 supporting PoE, and with added ESD protection.



The differential Ethernet signals should be routed as 100Ω differential pairs, with suitable clearances. Length matching between pairs should be better than 50mm, so in the typical case no length matching is required. However the signals within a pair need to be length matched, ideally to better than 0.15mm.

The PHY also supports up to 3 LEDs to give user status feedback, these are low active. These LEDs can have a range of functions, and you should consult your OS driver to see which functions are supported by your driver.

The PHY also provides `SYNC_IN` and `SYNC_OUT` at 3.3V signalling to support [IEEE 1588-2008](#).

## 2.3. PCIe (Gen2 x1)

The CM4 has an internal PCIe 2.0 x1 host controller. While on the Raspberry Pi 4 Model B this has been connected to a USB 3 host controller (using the Via Labs [VLI805](#)), on the CM4 the product designer is free to choose how the interface is used.

**⊖ WARNING**

You should ensure that there is a suitable OS driver for any host controller that is chosen before proceeding to a prototype.

**i NOTE**

The on-board PCIe Host controller doesn't support 64-bit accesses from the ARM, they must be split up into two 32-bit accesses.

Connecting a PCIe device follows the standard PCIe convention. The CM4 has on-board AC coupling capacitors for **CLK** and **PCIe\_TX** signals. However the **PCIe\_RX** signals need external coupling capacitors close to the driving source (the device **TX**), if you are using an external PCIe/NVMe card these capacitors will be on-board. The PCIe convention is that if you are wiring directly to an IC then the TX and RX pairs need to be swapped (i.e. TX → RX, RX → TX). If you are wiring to a connector then this is typically labelled from the host point of view and so TX/RX swaps aren't required. Additionally the **PCIe\_CLK\_nREQ** must be connected to ensure the CM4 produces a clock signal, and the **PCIe\_nRST** should also be connected to ensure the device is correctly reset when required.

The differential PCIe signals should be routed as 90Ω differential pairs, with suitable clearances. There is no need to match the lengths between pairs, only the signals within a Pair need to be length matched ideally to better than 0.1mm.

**💡 TIP**

5.10 kernels and newer have had support for MSI-X added. There is a limit of upto 32 IRQs available. If the device has problems with interrupts then adding `pci=noms_i` to `cmdline.txt` (and rebooting) often fixes the issue.

## 2.4. USB 2.0 (high speed)

The USB 2.0 interface supports up to 480Mbps signalling. The differential pair should be routed as a 90Ω differential pair. The length of the P/N signals should ideally be matched to better than 0.15mm.

**💡 TIP**

The firmware disables the USB interface by default to save power. In recent versions of Raspberry Pi OS (Bullseye) it is automatically enabled by the `otg_mode=1` setting in the `config.txt` file. If you are using a different OS, or an older version of Raspberry Pi OS, you will need to add this to `config.txt` to enable the USB interface.

**i NOTE**

The port is capable of being used as a true USB On-The-Go (OTG) port. While there is no official documentation, some users have had success making this work. The **USB\_OTG\_ID** pin is used to select between USB host and device that is typically wired to the ID pin of a Micro USB connector. To use this functionality it must be enabled in the OS. If using either as a fixed slave or fixed master, please tie the **USB\_OTG\_ID** pin to ground.

## 2.5. GPIO

There are 28 pins available for general purpose I/O (GPIO), which correspond to the GPIO pins on the Raspberry Pi 4 Model B 40-pin header. These pins have access to internal peripherals: SMI, DPI, I2C, PWM, SPI, and UART. The [BCM2711 ARM peripherals book](#) describes these features in detail, along with the multiplexing options available. The drive strength and slew rate should ideally be set as low as possible to reduce any EMC issues. GPIO2 and GPIO3 have 1.8kΩ pull up resistors.

The BCM2711 GPIO bank is powered by **GPIO\_VREF**, this can either be connected to +1.8V for 1.8V signalling GPIO, or



+3.3V for 3.3V signalling. You should keep the load on the 28 GPIO pins to below 50mA in total. `GPIO_VREF` must be powered for the CM4 to start up correctly.

## 2.5.1. Alternative function assignments

Up to six alternative functions are available. The [BCM2711 ARM peripherals book](#) describes these features in detail. The table below gives a quick overview.

Table 1. GPIO pins alternative function assignment

| GPIO   | Pull | ALT0       | ALT1          | ALT2      | ALT3             | ALT4       | ALT5       |
|--------|------|------------|---------------|-----------|------------------|------------|------------|
| GPIO0  | High | SDA0       | SA5           | PCLK      | SPI3_CE0_N       | TXD2       | SDA6       |
| GPIO1  | High | SCL0       | SA4           | DE        | SPI3_MISO        | RXD2       | SCL6       |
| GPIO2  | High | SDA1       | SA3           | LCD_VSYNC | SPI3_MOSI        | CTS2       | SDA3       |
| GPIO3  | High | SCL1       | SA2           | LCD_HSYNC | SPI3_SCLK        | RTS2       | SCL3       |
| GPIO4  | High | GPCLK0     | SA1           | DPI_D0    | SPI4_CE0_N       | TXD3       | SDA3       |
| GPIO5  | High | GPCLK1     | SA0           | DPI_D1    | SPI4_MISO        | RXD3       | SCL3       |
| GPIO6  | High | GPCLK2     | SOE_N / SE    | DPI_D2    | SPI4_MOSI        | CTS3       | SDA4       |
| GPIO7  | High | SPI0_CE1_N | SWE_N / SRW_N | DPI_D3    | SPI4_SCLK        | RTS3       | SCL4       |
| GPIO8  | High | SPI0_CE0_N | SD0           | DPI_D4    | RSCSL / CE_N     | TXD4       | SDA4       |
| GPIO9  | Low  | SPI0_MISO  | SD1           | DPI_D5    | RSCSL / MISO     | RXD4       | SCL4       |
| GPIO10 | Low  | SPI0_MOSI  | SD2           | DPI_D6    | RSCSL SDA / MOSI | CTS4       | SDA5       |
| GPIO11 | Low  | SPI0_SCLK  | SD3           | DPI_D7    | RSCSL SCL / SCLK | RTS4       | SCL5       |
| GPIO12 | Low  | PWM0_0     | SD4           | DPI_D8    | SPI5_CE0_N       | TXD5       | SDA5       |
| GPIO13 | Low  | PWM0_1     | SD5           | DPI_D9    | SPI5_MISO        | RXD5       | SCL5       |
| GPIO14 | Low  | TXD0       | SD6           | DPI_D10   | SPI5_MOSI        | CTS5       | TXD1       |
| GPIO15 | Low  | RXD0       | SD7           | DPI_D11   | SPI5_SCLK        | RTS5       | RXD1       |
| GPIO16 | Low  | <reserved> | SD8           | DPI_D12   | CTS0             | SPI1_CE2_N | CTS1       |
| GPIO17 | Low  | <reserved> | SD9           | DPI_D13   | RTS0             | SPI1_CE1_N | RTS1       |
| GPIO18 | Low  | PCM_CLK    | SD10          | DPI_D14   | SPI6_CE0_N       | SPI1_CE0_N | PWM0_0     |
| GPIO19 | Low  | PCM_FS     | SD11          | DPI_D15   | SPI6_MISO        | SPI1_MISO  | PWM0_1     |
| GPIO20 | Low  | PCM_DIN    | SD12          | DPI_D16   | SPI6_MOSI        | SPI1_MOSI  | GPCLK0     |
| GPIO21 | Low  | PCM_DOUT   | SD13          | DPI_D17   | SPI6_SCLK        | SPI1_SCLK  | GPCLK1     |
| GPIO22 | Low  | SD0_CLK    | SD14          | DPI_D18   | SD1_CLK          | ARM_TRST   | SDA6       |
| GPIO23 | Low  | SD0_CMD    | SD15          | DPI_D19   | SD1_CMD          | ARM_RTCK   | SCL6       |
| GPIO24 | Low  | SD0_DAT0   | SD16          | DPI_D20   | SD1_DAT0         | ARM_TDO    | SPI3_CE1_N |
| GPIO25 | Low  | SD0_DAT1   | SD17          | DPI_D21   | SD1_DAT1         | ARM_TCK    | SPI4_CE1_N |
| GPIO26 | Low  | SD0_DAT2   | <reserved>    | DPI_D22   | SD1_DAT2         | ARM_TDI    | SPI5_CE1_N |
| GPIO27 | Low  | SD0_DAT3   | <reserved>    | DPI_D23   | SD1_DAT3         | ARM_TMS    | SPI6_CE1_N |

| GPIO   | Pull | ALT0   | ALT1 | ALT2 | ALT3       | ALT4       | ALT5           |
|--------|------|--------|------|------|------------|------------|----------------|
| GPIO44 | -    | GPCLK1 | SDA0 | SDA1 | <reserved> | SPI0_CE1_N | SD_CARD_VOLT   |
| GPIO45 | -    | PWM0_1 | SCL0 | SCL1 | <reserved> | SPI0_CE2_N | SD_CARD_POWER0 |

Special function legend:

Table 2. GPIO pins alternative function legend

| Name             | Function                                    |
|------------------|---|
| SDA0             | BSC master 0 data line <sup>a</sup>         |
| SCL0             | BSC master 0 clock line                     |
| SDAx             | BSC master 1,3,4,5,6 data line <sup>b</sup> |
| SCLx             | BSC master 1,3,4,5,6 clock line             |
| GPCLKx           | General purpose clock 0,1,2                 |
| SPIx_CE2_N       | SPI 0,3,4,5,6 chip select 2                 |
| SPIx_CE1_N       | SPI 0,3,4,5,6 chip select 1                 |
| SPIx_CE0_N       | SPI 0,3,4,5,6 chip select 0                 |
| SPIx_MISO        | SPI 0,3,4,5,6 MISO                          |
| SPIx_MOSI        | SPI 0,3,4,5,6 MOSI                          |
| SPIx_SCLK        | SPI 0,3,4,5,6 serial clock                  |
| PWMx_0           | PWM 0,1 channel 0                           |
| PWMx_1           | PWM 0,1 channel 1                           |
| TXDx             | UART 0,2,3,4,5 transmit data                |
| RXDx             | UART 0,2,3,4,5 receive data                 |
| CTSx             | UART 0,2,3,4,5 clear to send                |
| RTSx             | UART 0,2,3,4,5 request to send              |
| PCM_CLK          | PCM clock                                   |
| PCM_FS           | PCM frame sync                              |
| PCM_DIN          | PCM data in                                 |
| PCM_DOUT         | PCM data out                                |
| SAx              | Secondary mem address bus                   |
| SOE_N / SE       | Secondary mem controls                      |
| SWE_N / SRW_N    | Secondary mem controls                      |
| SDx              | Secondary mem data bus                      |
| BSCSL SDA / MOSI | BSC slave data, SPI slave MOSI              |
| BSCSL SCL / SCLK | BSC slave clock, SPI slave clock            |
| BSCSL - / MISO   | BSC <not used>, SPI MISO                    |
| BSCSL - / CE_N   | BSC <not used>, SPI CSn                     |
| SPI1_CE2_N       | SPI 1 chip select 2 <sup>c</sup>            |

| Name       | Function                   |
|------------|----------------------------|
| SPI1_CE1_N | SPI 1 chip select 1        |
| SPI1_CE0_N | SPI 1 chip select 0        |
| SPI1_MISO  | SPI 1 MISO                 |
| SPI1_MOSI  | SPI 1 MOSI                 |
| SPI1_SCLK  | SPI 1 serial clock         |
| TXD1       | UART 1 transmit data       |
| RXD1       | UART 1 receive data        |
| CTS1       | UART 1 clear to send       |
| RTS1       | UART 1 request To send     |
| ARM_TRST   | ARM JTAG reset             |
| ARM_RTCK   | ARM JTAG return clock      |
| ARM_TDO    | ARM JTAG data out          |
| ARM_TCK    | ARM JTAG clock             |
| ARM_TDI    | ARM JTAG data in           |
| ARM_TMS    | ARM JTAG mode select       |
| PCLK       | Display parallel interface |
| DE         | Display parallel interface |
| LCD_VSYNC  | Display parallel interface |
| LCD_HSYNC  | Display parallel interface |
| DPI_Dx     | Display parallel interface |

<sup>a</sup> The Broadcom serial control bus is a proprietary bus compliant with the Philips® I2C bus/interface.

<sup>b</sup> BSC master 2 & 7 are not user-accessible.

<sup>c</sup> SPI 2 is not user-accessible.

## 2.6. Dual HDMI 2.0

The CM4 supports two HDMI 2.0 interfaces, each one capable of driving 4K images. If both HDMI outputs are used then each can be driven upto 4Kp30, however if only HDMI0 interface is being used then images up to 4Kp60 are possible.

HDMI signals should be routed as 100Ω differential pairs. Each signal within a pair should ideally be matched to better than 0.15mm. Pairs don't typically need any extra matching, as they only have to be matched to 25mm.

CEC is also supported; an internal 27kΩ pullup resistor is included in the CM4.

Basic on-board ESD protection is provided for the I2C EDID signals and the CEC signals; internal pullup and pulldown resistors are also provided. On the Raspberry Pi 4 Model B the HDMI signals don't have any extra ESD protection. Depending on the application, extra ESD protection may be required.

## 2.7. CSI-2 (MIPI serial camera)

The CM4 supports two camera ports: **CAM0** (2 lanes) and **CAM1** (4 lanes). CSI signals should be routed as 100Ω differential pairs. Each signal within a pair should ideally be matched to better than 0.15mm.

The documentation around the CSI interface can be found on the [Raspberry Pi website](#), while [Linux kernel drivers](#) can be found on GitHub.

### **i** NOTE

The official Raspberry Pi firmware supports the OmniVision OV5647, Sony IMX219, Sony IMX296, Sony IMX477 and Sony IMX708 camera sensors. No security device is required on Compute Module devices in order to use these camera sensors.

## 2.8. DSI (MIPI serial display)

The CM4 supports two display ports: **DISP0** (2 lanes) and **DISP1** (4 lanes). Each lane supports a maximum data rate per lane of 1Gbps.

Although [Linux kernel drivers](#) are available, the DSI interface is not currently documented. Only DSI displays supported by the official Raspberry Pi firmware are supported. DSI signals should be routed as 100Ω differential pairs; each signal within a pair should ideally be matched to better than 0.15mm.

### **i** NOTE

While only official DSI displays are supported, other displays can be added using the parallel DPI interface which is available as a GPIO alternative function. The CM4 supports up to three displays of any type (HDMI, DSI, DPI) at any one time.

## 2.9. I2C (SDA0 SCL0)

This internal I2C bus is normally allocated to the CSI1 and DSI1, as these devices are controlled by the firmware. It can be used as a general I2C bus if the CSI1 and DSI1 interfaces aren't being used, or are being controlled by the firmware. For example libcamera runs on the ARM and doesn't use the firmware, so in this case you may use CSI1 and this I2C bus. SDA0 is connected to GPIO44 on the BCM2711 and SCL0 is connected to GPIO45.

## 2.10. I2C (ID\_SD ID\_SC)

This I2C bus is normally used for identifying HATs and controlling CSI0 and DSI0 devices. If the firmware isn't using the I2C bus e.g. CSI0 and DSI0 aren't being used then these pins may be used as GPIO 0 and GPIO 1 if required.

### **i** NOTE

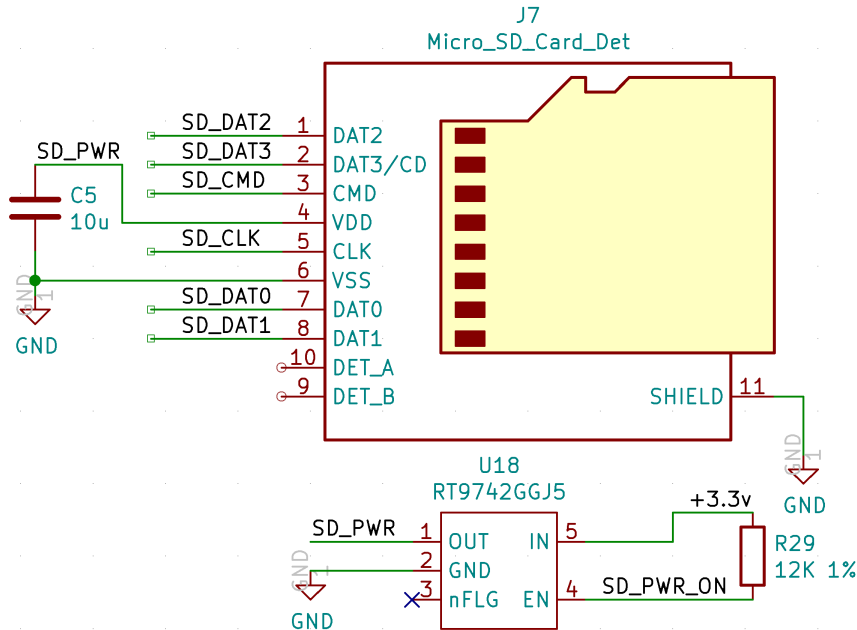
If these pins are used as GPIO pins, then to prevent the firmware from checking to see if there is a HAT EEPROM available, add `force_eeprom_read=0` and `disable_poe_fan=1` to the config.txt file.

## 2.11. SDIO/eMMC (CM4Lite only)

The CM4Lite does not have on-board eMMC. The eMMC signals are available on the connector so that an external eMMC or SD card can be used.

The `SD_PWR_ON` signal is used to enable an external power-switch to turn on power to the SD card; for eMMC it typically isn't used. If booting from SD card is required, then a pullup resistor must also be fitted to default the power-switch to be on. When `SD_VDD_OVERRIDE` is high ( 3.3V ), this forces 1.8V signalling on the SDIO interface. Typically this is used with eMMC memory.

Figure 3. CM4Lite SD card interface.



## 2.12. Analog IP0/IP1

These are the two spare inputs on the `MXL7704`. The `MXL7704` datasheet should be consulted if these pins are to be used. On-board filtering is provided by a 100nF capacitor to ground for each signal. On the Raspberry Pi 4 Model B these are connected to the USB C connector `CC1` and `CC2` pins.

## 2.13. Global\_EN

Pulling this pin low puts the CM4 in the lowest possible power-down state. After software shutdown, `Global_EN` needs to be pulled low for > 1ms to restart the power system on the CM4.

### TIP

It is recommended to only pull this pin low once the OS has shut down.

## 2.14. RUN\_PG

This pin when high signals that the CM4 has started. Driving this pin low resets the module. This should be done with caution; if files on a filesystem are open they will not be closed.

## 2.15. nRPI\_BOOT

During boot if this pin is low, booting from eMMC will be stopped and booting will be transferred to rpi boot which is via USB.

## 2.16. LED\_nACT

This pin is designed to drive an LED to replicate the green LED on the Raspberry Pi 4 Model B. Under Linux this pin will flash to signify eMMC access. If any error occurs during booting, then this LED will flash an error pattern which can be decoded using the [look up table](#) on the Raspberry Pi website.

## 2.17. LED\_nPWR

This pin needs to be buffered to drive an LED. The signal is designed to replicate the red power LED on the Raspberry Pi 4 Model B.

## 2.18. EEPROM\_nWP

It is recommended that final products pull this pin low to prevent the end users changing the contents of the on-board EEPROM. See the Raspberry Pi 4 Model B documentation for instructions on the software settings required to support [EEPROM write protection](#).

# Chapter 3. Electrical and mechanical

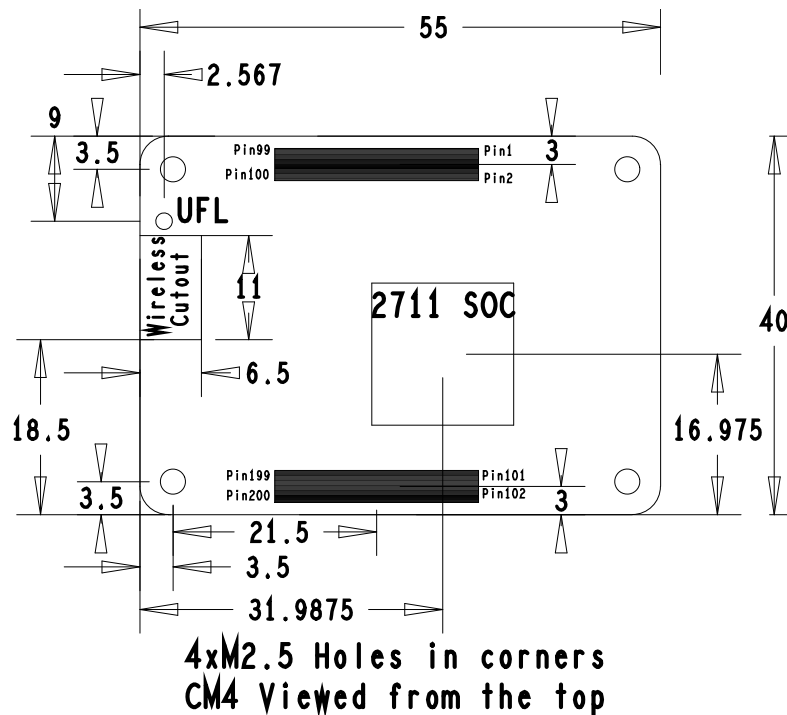
## 3.1. Mechanical

The CM4 is a compact 40mm × 55mm module. The Module is 4.7mm deep, but when connected the height will be 5.078mm or 6.578mm depending on the stacking height chosen.

1. 4 × M2.5 mounting holes (inset 3.5mm from module edge)
2. PCB thickness 1.2mm ± 10%
3. [BCM2711](#) SoC height including solder balls 2.378 ± 0.11mm
4. Stacking height either:
  - a. 1.5mm with mating connector (clearance under CM4 0mm): DF40C-100DS-0.4v
  - b. 3.0mm with mating connector (clearance under CM4 1.5mm): DF40HC(3.0)-100DS-0.4v

If the on-board wireless antenna is used (see [Section 2.1](#)) it must be orientated towards the edge of the plastic enclosure and any nearby metal must have cut-outs or the wireless performance will be degraded. It is suggested that there is at least 10mm clearance around the PCB antenna, but the designer must check the performance.

Figure 4. Mechanical specification of the Raspberry Pi Compute Module 4



There must not be any metal, including ground planes, under the antenna. The ground plane cutout must be a minimum of 6.5mm × 11mm, but ideally at least 8mm × 15mm. If these requirements can't be met wireless performance may be degraded, especially in the 2.4GHz spectrum. It is recommended that the external antenna is used where possible.

**i NOTE**

The location and arrangement of components on the Compute Module may change slightly over time due to revisions for cost and manufacturing considerations; however the maximum component heights and PCB thickness will be kept as specified.

A step file of the CM4 is available as part of the CM4 design data package. This is for guidance only and is subject to changes over time due to revisions.

## 3.2. Thermal

The CM4 dissipates less power than the Raspberry Pi 4 Model B. The CM4 also contains less metal in the PCB and fewer connectors, which means that it has less passive heat sinking than the Raspberry Pi 4 Model B. Despite it consuming less power, it may run warmer than the Raspberry Pi 4 Model B.

The [BCM2711](#) will reduce the clock rate to try and keep its internal temperature below 85°C. So in high ambient temperatures it is possible that the clock will also be automatically throttled back. If the [BCM2711](#) is unable to lower its internal clocks enough to bring the temperature down, its case temperature will rise above 85°C. It is important that any thermal solution chosen keeps the ambient temperature for the other silicon devices on the CM4 within the operating temperature range.

Operating temperature range: -20°C - +85°C non-condensing. NB Optimal RF wireless performance is between -20°C and +75°C.

## 3.3. Electrical specification

**⊖ WARNING**

Stresses above those listed in [Table 3](#) may cause permanent damage to the device. This is a stress rating only; functional operation of the device under these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 3. Absolute maximum ratings

| Symbol           | Parameter          | Minimum | Maximum                | Unit |
|------------------|--------------------|---------|------------------------|------|
| $V_{IN}$         | 5V Input Voltage   | -0.5    | 6.0                    | V    |
| $V_{GPIO\_VREF}$ | GPIO Voltage       | -0.5    | 3.6                    | V    |
| $V_{gpio}$       | GPIO Input voltage | -0.5    | $V_{GPIO\_VREF} + 0.5$ | V    |

**i NOTE**

$V_{GPIO\_VREF}$  is the GPIO bank voltage, which must be tied to either the 3.3V or the 1.8V rail of the CM4.

Table 4. DC characteristics

| Symbol         | Parameter          | Conditions              | Minimum | Typical | Maximum          | Unit |
|----------------|--------------------|-------------------------|---------|---------|------------------|------|
| $V_{IL(gpio)}$ | Input low voltage  | $V_{GPIO\_VREF} = 3.3V$ | 0       | -       | 0.8              | V    |
| $V_{IH(gpio)}$ | Input high voltage | $V_{GPIO\_VREF} = 3.3V$ | 2.0     | -       | $V_{GPIO\_VREF}$ | V    |



|                |                       |                         |                        |      |                  |            |
|----------------|-----------------------|-------------------------|------------------------|------|------------------|------------|
| $V_{IL(gpio)}$ | Input low voltage     | $V_{GPIO\_VREF} = 1.8V$ | 0                      | -    | 0.35             | V          |
| $V_{IH(gpio)}$ | Input high voltage    | $V_{GPIO\_VREF} = 1.8V$ | 0.65                   | -    | $V_{GPIO\_VREF}$ | V          |
| $I_{L(gpio)}$  | Input leakage current | -                       | -                      | -    | 10               | $\mu A$    |
| $V_{OL(gpio)}$ | Output low voltage    | -                       | -                      | -    | 0.4              | V          |
| $V_{OH(gpio)}$ | Output high voltage   | -                       | $V_{GPIO\_VREF} - 0.4$ | -    | -                | V          |
| $I_{O(gpio)}$  | Output current        | 1mA                     | 0.87                   | 1.3  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 2mA                     | 1.75                   | 2.6  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 3mA                     | 2.63                   | 3.9  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 4mA <b>default</b>      | 3.5                    | 5.3  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 5mA                     | 4.39                   | 6.6  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 6mA                     | 5.27                   | 7.9  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 7mA                     | 6.15                   | 9.2  | -                | mA         |
| $I_{O(gpio)}$  | Output current        | 8mA                     | 7.02                   | 10.5 | -                | mA         |
| $R_{PU(gpio)}$ | Pullup resistor       | $V_{GPIO\_VREF} = 3.3V$ | 33                     | 47   | 73               | k $\Omega$ |
| $R_{PD(gpio)}$ | Pulldown resistor     | $V_{GPIO\_VREF} = 3.3V$ | 33                     | 47   | 73               | k $\Omega$ |
| $R_{PU(gpio)}$ | Pullup resistor       | $V_{GPIO\_VREF} = 1.8V$ | 18                     | 47   | 73               | k $\Omega$ |
| $R_{PD(gpio)}$ | Pulldown resistor     | $V_{GPIO\_VREF} = 1.8V$ | 18                     | 47   | 73               | k $\Omega$ |

Refer to interface specifications (see [Chapter 2](#)) for electrical details of other interfaces.

Table 5. Power consumption

| Symbol         | Parameter         | Conditions        | Minimum | Typical | Maximum | Unit    |
|----------------|-------------------|-------------------|---------|---------|---------|---------|
| $I_{shutdown}$ | Shutdown current  | $GLOBAL\_EN = 0V$ | -       | 15      | -       | $\mu A$ |
| $I_{shutdown}$ | Shutdown current  | $GLOBAL\_EN > 2V$ | -       | 8       | -       | mA      |
| $I_{idle}$     | Idle current      | $GLOBAL\_EN > 2V$ | -       | 400     | -       | mA      |
| $I_{load}$     | Operation current | $GLOBAL\_EN > 2V$ | -       | 1400    | -       | mA      |

### **i** NOTE

The figures in [Table 5](#) greatly depend on the end application.

# Chapter 4. Pinout

Table 6. Pinout for the Raspberry Pi Compute Module 4

| Pin | Signal            | Description   |
|-----|-------------------|---|
| 1   | GND               | Ground (0V)   |
| 2   | GND               | Ground (0V)   |
| 3   | Ethernet_Pair3_P  | Ethernet pair 3 positive (connect to transformer or MagJack)  |
| 4   | Ethernet_Pair1_P  | Ethernet pair 1 positive (connect to transformer or MagJack)  |
| 5   | Ethernet_Pair3_N  | Ethernet pair 3 negative (connect to transformer or MagJack)  |
| 6   | Ethernet_Pair1_N  | Ethernet pair 1 negative (connect to transformer or MagJack)  |
| 7   | GND               | Ground (0V)   |
| 8   | GND               | Ground (0V)   |
| 9   | Ethernet_Pair2_N  | Ethernet pair 2 negative (connect to transformer or MagJack)  |
| 10  | Ethernet_Pair0_N  | Ethernet pair 0 negative (connect to transformer or MagJack)  |
| 11  | Ethernet_Pair2_P  | Ethernet pair 2 positive (connect to transformer or MagJack)  |
| 12  | Ethernet_Pair0_P  | Ethernet pair 0 positive (connect to transformer or MagJack)  |
| 13  | GND               | Ground (0V)   |
| 14  | GND               | Ground (0V)   |
| 15  | Ethernet_nLED3    | Active-low Ethernet activity indicator (CM4_3.3V signal): typically a green LED is connected to this pin. $I_{OL} = 8\text{mA} @ V_{OL} < 0.4\text{V}$  |
| 16  | Ethernet_SYNC_IN  | IEEE1588 SYNC Input pin (CM4_3.3V signal: $I_{OL} = 8\text{mA} @ V_{OL} < 0.4\text{V}$ )  |
| 17  | Ethernet_nLED2    | Active-low Ethernet speed indicator (CM4_3.3V signal): typically a yellow LED is connected to this pin. A low state indicates the 1Gbit or 100Mbit link: $I_{OL} = 8\text{mA} @ V_{OL} < 0.4\text{V}$ |
| 18  | Ethernet_SYNC_OUT | IEEE1588 SYNC Output pin (CM4_3.3V signal: $I_{OL} = 8\text{mA} @ V_{OL} < 0.4\text{V}$ )   |
| 19  | Ethernet_nLED1    | Active-low Ethernet speed indicator (CM4_3.3V signal): typically a yellow LED is connected to this pin. A low state indicates the 1Gbit or 10Mbit link: $I_{OL} = 8\text{mA} @ V_{OL} < 0.4\text{V}$  |
| 20  | EEPROM_nWP        | Leave floating NB internally pulled up to CM4_3.3V via 100k $\Omega$ ( $V_{IL} < 0.8\text{V}$ ), but can be grounded to prevent writing to the on-board EEPROM which stores the bootcode              |
| 21  | Pi_nLED_Activity  | Active-low Pi activity LED. 20mA Max, 5V tolerant ( $V_{OL} < 0.4\text{V}$ ). (this is the signal that drives the green LED on the Raspberry Pi 4 Model B)  |
| 22  | GND               | Ground (0V)   |
| 23  | GND               | Ground (0V)   |
| 24  | GPIO26            | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to CM4_1.8V   |
| 25  | GPIO21            | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to CM4_1.8V   |
| 26  | GPIO19            | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to CM4_1.8V   |
| 27  | GPIO20            | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to CM4_1.8V   |

|    |        |  |
|----|--------|--|
| 28 | GPIO13 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 29 | GPIO16 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 30 | GPIO6  | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 31 | GPIO12 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 32 | GND    | Ground (0V)  |
| 33 | GND    | Ground (0V)  |
| 34 | GPIO5  | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 35 | ID_SC  | (BCM2711 GPIO 1) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a> |
| 36 | ID_SD  | (BCM2711 GPIO 0) GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a> |
| 37 | GPIO7  | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 38 | GPIO11 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 39 | GPIO8  | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 40 | GPIO9  | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 41 | GPIO25 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 42 | GND    | Ground (0V)  |
| 43 | GND    | Ground (0V)  |
| 44 | GPIO10 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 45 | GPIO24 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 46 | GPIO22 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 47 | GPIO23 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 48 | GPIO27 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 49 | GPIO18 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 50 | GPIO17 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 51 | GPIO15 | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>                  |
| 52 | GND    | Ground (0V)  |

|    |                 |  |
|----|-----------------|--|
| 53 | GND             | Ground (0V)  |
| 54 | GPIO4           | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>  |
| 55 | GPIO14          | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a>  |
| 56 | GPIO3           | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a> . Internal 1.8kΩ pull up to GPIO_VREF  |
| 57 | SD_CLK          | SD card clock signal (only available on CM4Lite)   |
| 58 | GPIO2           | GPIO: typically a 3.3V signal, but can be a 1.8V signal by connecting GPIO_VREF to <a href="#">CM4_1.8V</a> . Internal 1.8kΩ pull up to GPIO_VREF  |
| 59 | GND             | Ground (0V)  |
| 60 | GND             | Ground (0V)  |
| 61 | SD_DAT3         | SD card/eMMC Data3 signal (only available on CM4Lite)  |
| 62 | SD_CMD          | SD card/eMMC Command signal (only available on CM4Lite)  |
| 63 | SD_DAT0         | SD card/eMMC Data0 signal (only available on CM4Lite)  |
| 64 | SD_DAT5         | SD card/eMMC Data5 signal (only available on CM4Lite)  |
| 65 | GND             | Ground (0V)  |
| 66 | GND             | Ground (0V)  |
| 67 | SD_DAT1         | SD card/eMMC Data1 signal (only available on CM4Lite)  |
| 68 | SD_DAT4         | SD card/eMMC Data4 signal (only available on CM4Lite)  |
| 69 | SD_DAT2         | SD card/eMMC Data2 signal (only available on CM4Lite)  |
| 70 | SD_DAT7         | SD card/eMMC Data7 signal (only available on CM4Lite)  |
| 71 | GND             | Ground (0V)  |
| 72 | SD_DAT6         | SD card/eMMC Data6 signal (only available on CM4Lite)  |
| 73 | SD_VDD_OVERRIDE | Connect to <a href="#">CM4_3.3V</a> to force SD card/eMMC interface to 1.8V signalling instead of 3.3V, otherwise leave unconnected. Typically only used if external eMMC is connected.  |
| 74 | GND             | Ground (0V)  |
| 75 | SD_PWR_ON       | Output to power-switch for the SD card. The CM4 sets this pin high (3.3V) to signal that power to the SD card should be turned on. If booting from the SD card is required then a pullup should also be fitted so the power-switch defaults to on. (only available on CM4Lite) |
| 76 | Reserved        | Do not connect anything to this pin.   |
| 77 | +5V (Input)     | 4.75V-5.25V. Main power input  |
| 78 | GPIO_VREF       | Must be connected to <a href="#">CM4_3.3V</a> (pins 84 and 86) for 3.3V GPIO or <a href="#">CM4_1.8V</a> (pins 88 and 90) for 1.8V GPIO. This pin cannot be floating or connected to ground.   |
| 79 | +5V (Input)     | 4.75V-5.25V. Main power input  |
| 80 | SCL0            | I2C clock pin (BCM2711 GPIO45): typically used for Camera and Display. Internal 1.8kΩ pull up to <a href="#">CM4_3.3V</a>  |
| 81 | +5V (Input)     | 4.75V-5.25V. Main power input  |
| 82 | SDA0            | I2C Data pin (BCM2711 GPIO44): typically used for Camera and Display. Internal 1.8kΩ pull up to <a href="#">CM4_3.3V</a>   |

|     |                   |   |
|-----|-------------------|---|
| 83  | +5V (Input)       | 4.75V-5.25V. Main power input   |
| 84  | CM4_3.3V (Output) | 3.3V $\pm$ 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low   |
| 85  | +5V (Input)       | 4.75V-5.25V. Main power input   |
| 86  | CM4_3.3V (Output) | 3.3V $\pm$ 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low   |
| 87  | +5V (Input)       | 4.75V-5.25V. Main power input   |
| 88  | CM4_1.8V (Output) | 1.8V $\pm$ 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low   |
| 89  | WL_nDisable       | Can be left floating; if driven low the wireless interface will be disabled. Internally pulled up via 1.8k $\Omega$ to <a href="#">CM4_3.3V</a>   |
| 90  | CM4_1.8V (Output) | 1.8V $\pm$ 2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power-off or GLOBAL_EN being set low   |
| 91  | BT_nDisable       | Can be left floating; if driven low the Bluetooth interface will be disabled. Internally pulled up via 1.8k $\Omega$ to <a href="#">CM4_3.3V</a>  |
| 92  | RUN_PG            | Bidirectional pin. Can be driven low (via a 220 $\Omega$ resistor) to reset the CM4 CPU. As an output, a high signals that power is good and CPU is running. Internally pulled up to +3.3V via 10k $\Omega$ |
| 93  | nRPIBOOT          | A low on this pin forces booting from an RPI server (e.g. PC or a Raspberry Pi); if not used leave floating. Internally pulled up via 10k $\Omega$ to +3.3V   |
| 94  | AnalogIP1         | Analogue input of the MXL7704: typically connected to CC pin of Type C power connector  |
| 95  | PI_LED_nPWR       | Active-low output to drive Power On LED. This signal needs to be buffered.  |
| 96  | AnalogIP0         | Analogue input of the MXL7704: typically connected to CC pin of Type C power connector  |
| 97  | Camera_GPIO       | Typically used to shut down the camera to reduce power. Reassigning this pin to another function isn't recommended. <a href="#">CM4_3.3V</a> signalling   |
| 98  | GND               | Ground (0V)   |
| 99  | GLOBAL_EN         | Input. Drive low to power off CM4. Internally pulled up with a 100k $\Omega$ to +5V   |
| 100 | nEXTRST           | Output. Driven low during reset; Driven high ( <a href="#">CM4_3.3V</a> ) once CM4 CPU has started to boot  |
| 101 | USB_OTG_ID        | Input (3.3V signal) USB OTG Pin. Internally pulled up. When grounded the CM4 becomes a USB host but the correct OS driver also needs to be used   |
| 102 | PCIe_CLK_nREQ     | Input (3.3V signal) PCIe clock request pin (low to request PCI clock). Internally pulled up   |
| 103 | USB_N             | USB D-  |
| 104 | Reserved          | Do not connect anything to this pin.  |
| 105 | USB_P             | USB D+  |
| 106 | Reserved          | Do not connect anything to this pin.  |
| 107 | GND               | Ground (0V)   |
| 108 | GND               | Ground (0V)   |
| 109 | PCIe_nRST         | Output (+3.3V signal) PCIe reset active-low   |
| 110 | PCIe_CLK_P        | PCIe clock Out positive (100MHz) NB AC coupling capacitor included on CM4   |
| 111 | VDAC_COMP         | Video DAC output (TV OUT)   |

|     |               |  |
|-----|---------------|--|
| 112 | PCIe_CLK_N    | PCIe clock Out negative (100MHz) NB AC coupling capacitor included on CM4  |
| 113 | GND           | Ground (0V)  |
| 114 | GND           | Ground (0V)  |
| 115 | CAM1_D0_N     | Input Camera1 D0 negative  |
| 116 | PCIe_RX_P     | Input PCIe GEN 2 RX positive NB external AC coupling capacitor required  |
| 117 | CAM1_D0_P     | Input Camera1 D0 positive  |
| 118 | PCIe_RX_N     | Input PCIe GEN 2 RX negative NB external AC coupling capacitor required  |
| 119 | GND           | Ground (0V)  |
| 120 | GND           | Ground (0V)  |
| 121 | CAM1_D1_N     | Input Camera1 D1 negative  |
| 122 | PCIe_TX_P     | Output PCIe GEN 2 TX positive NB AC coupling capacitor included on CM4   |
| 123 | CAM1_D1_P     | Input Camera1 D1 positive  |
| 124 | PCIe_TX_N     | Output PCIe GEN 2 TX positive NB AC coupling capacitor included on CM4   |
| 125 | GND           | Ground (0V)  |
| 126 | GND           | Ground (0V)  |
| 127 | CAM1_C_N      | Input Camera1 clock negative   |
| 128 | CAM0_D0_N     | Input Camera0 D0 negative  |
| 129 | CAM1_C_P      | Input Camera1 clock positive   |
| 130 | CAM0_D0_P     | Input Camera0 D0 positive  |
| 131 | GND           | Ground (0V)  |
| 132 | GND           | Ground (0V)  |
| 133 | CAM1_D2_N     | Input Camera1 D2 negative  |
| 134 | CAM0_D1_N     | Input Camera0 D1 negative  |
| 135 | CAM1_D2_P     | Input Camera1 D2 positive  |
| 136 | CAM0_D1_P     | Input Camera0 D1 positive  |
| 137 | GND           | Ground (0V)  |
| 138 | GND           | Ground (0V)  |
| 139 | CAM1_D3_N     | Input Camera1 D3 negative  |
| 140 | CAM0_C_N      | Input Camera0 clock negative   |
| 141 | CAM1_D3_P     | Input Camera1 D3 positive  |
| 142 | CAM0_C_P      | Input Camera0 clock positive   |
| 143 | HDMI1_HOTPLUG | Input HDMI1 hotplug. Internally pulled down with a 100k $\Omega$ . 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3)   |
| 144 | GND           | Ground (0V)  |
| 145 | HDMI1_SDA     | Bidirectional HDMI1 SDA. Internally pulled up with a 1.8k $\Omega$ . 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3) |

|     |               |   |
|-----|---------------|---|
| 146 | HDMI1_TX2_P   | Output HDMI1 TX2 positive   |
| 147 | HDMI1_SCL     | Bidirectional HDMI1 SCL. Internally pulled up with a 1.8kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3) |
| 148 | HDMI1_TX2_N   | Output HDMI1 TX2 negative   |
| 149 | HDMI1_CEC     | Input HDMI1 CEC. Internally pulled up with a 27kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3)          |
| 150 | GND           | Ground (0V)   |
| 151 | HDMI0_CEC     | Input HDMI0 CEC. Internally pulled up with a 27kΩ. 5V tolerant (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3)           |
| 152 | HDMI1_TX1_P   | Output HDMI1 TX1 positive   |
| 153 | HDMI0_HOTPLUG | Input HDMI0 hotplug. Internally pulled down 100kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3)          |
| 154 | HDMI1_TX1_N   | Output HDMI1 TX1 negative   |
| 155 | GND           | Ground (0V)   |
| 156 | GND           | Ground (0V)   |
| 157 | DSI0_D0_N     | Output Display0 D0 negative   |
| 158 | HDMI1_TX0_P   | Output HDMI1 TX0 positive   |
| 159 | DSI0_D0_P     | Output Display0 D0 positive   |
| 160 | HDMI1_TX0_N   | Output HDMI1 TX0 negative   |
| 161 | GND           | Ground (0V)   |
| 162 | GND           | Ground (0V)   |
| 163 | DSI0_D1_N     | Output Display0 D1 negative   |
| 164 | HDMI1_CLK_P   | Output HDMI1 clock positive   |
| 165 | DSI0_D1_P     | Output Display0 D1 positive   |
| 166 | HDMI1_CLK_N   | Output HDMI1 clock negative   |
| 167 | GND           | Ground (0V)   |
| 168 | GND           | Ground (0V)   |
| 169 | DSI0_C_N      | Output Display0 clock negative  |
| 170 | HDMI0_TX2_P   | Output HDMI0 TX2 positive   |
| 171 | DSI0_C_P      | Output Display0 clock positive  |
| 172 | HDMI0_TX2_N   | Output HDMI0 TX2 negative   |
| 173 | GND           | Ground (0V)   |
| 174 | GND           | Ground (0V)   |
| 175 | DSI1_D0_N     | Output Display1 D0 negative   |
| 176 | HDMI0_TX1_P   | Output HDMI0 TX1 positive   |

|     |             |   |
|-----|-------------|---|
| 177 | DSI1_D0_P   | Output Display1 D0 positive   |
| 178 | HDMI0_TX1_N | Output HDMI0 TX1 negative   |
| 179 | GND         | Ground (0V)   |
| 180 | GND         | Ground (0V)   |
| 181 | DSI1_D1_N   | Output Display1 D1 negative   |
| 182 | HDMI0_TX0_P | Output HDMI0 TX0 positive   |
| 183 | DSI1_D1_P   | Output Display1 D1 positive   |
| 184 | HDMI0_TX0_N | Output HDMI0 TX0 negative   |
| 185 | GND         | Ground (0V)   |
| 186 | GND         | Ground (0V)   |
| 187 | DSI1_C_N    | Output Display1 clock negative  |
| 188 | HDMI0_CLK_P | Output HDMI0 clock positive   |
| 189 | DSI1_C_P    | Output Display1 clock positive  |
| 190 | HDMI0_CLK_N | Output HDMI0 clock negative   |
| 191 | GND         | Ground (0V)   |
| 192 | GND         | Ground (0V)   |
| 193 | DSI1_D2_N   | Output Display1 D2 negative   |
| 194 | DSI1_D3_N   | Output Display1 D3 negative   |
| 195 | DSI1_D2_P   | Output Display1 D2 positive   |
| 196 | DSI1_D3_P   | Output Display1 D3 positive   |
| 197 | GND         | Ground (0V)   |
| 198 | GND         | Ground (0V)   |
| 199 | HDMI0_SDA   | Bidirectional HDMI0 SDA. Internally pulled up with a 1.8kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3) |
| 200 | HDMI0_SCL   | Bidirectional HDMI0 SCL. Internally pulled up with a 1.8kΩ. 5V tolerant. (It can be connected directly to a HDMI connector; a small amount of ESD protection is provided on the CM4 by an on-board HDMI05-CL02F3) |

All ground pins should be connected. If none of the signals on the second connector (pins 101 to 200) are used, then you may omit the connector to reduce costs, but mechanical stability needs to be considered.

The voltage on GPIO pins 0-27 must not exceed **CM4\_3.3V** if +3.3V signalling is used or **CM4\_1.8V** if +1.8V signalling is used. These pins are the same as on the 40-pin connector on the Raspberry Pi 4 Model B.

If the **CM4\_1.8V** rail is used to power other devices other than the **GPIO\_VREF** then you should ensure that in case of surprise power removal (e.g. the +5V pin goes below +4.5V) from the CM4, the load on the **CM4\_1.8V** must go to zero.

Similarly if the **CM4\_3.3V** rail is used to power other devices other than the **GPIO\_VREF**, then you should ensure that in the case of surprise power removal the **CM4\_3.3V** rail never falls below the **CM4\_1.8V** rail. This is the typical case, but you should check this in your design. In the case where it does fall below the **CM4\_1.8V** rail, then extra circuitry is required to disconnect the **CM4\_3.3V** load.

No reverse voltage must be applied to any pin, or power-up may be prevented; i.e. during power-down/off no pin may have external voltage applied, otherwise this may prevent a subsequent power-up.



## 4.1. Differential pairs

It is recommended that P/N signals within a pair are matched to better than 0.15mm. Often, matching between pairs is not so critical: e.g. HDMI pair-to-pair matching should be better than 25mm, so on a typical board no extra matching is required.

### 4.1.1. 100Ω differential pair signal lengths

On the CM4 all differential pairs are matched to better than 0.05mm (P/N signals).

#### **i** NOTE

It is recommended that pairs are also matched on the interface board.

On the CM4, pair-to-pairs are not always matched, as many interfaces do not require very accurate matching between pairs. [Table 7](#) documents the CM4 track-length difference within each group. (A non-zero value represents how much longer in mm that track is, when compared to the signal with zero length difference.)

Table 7. 100Ω differential pair signal lengths

| Signal    | Length |
|-----------|--------|
| CAM0_C_N  | 0.02   |
| CAM0_C_P  | 0.02   |
| CAM0_D0_N | 0.06   |
| CAM0_D0_P | 0.07   |
| CAM0_D1_N | 0      |
| CAM0_D1_P | 0.01   |
|           |        |
| CAM1_C_N  | 0.78   |
| CAM1_C_P  | 0.78   |
| CAM1_D0_N | 0.02   |
| CAM1_D0_P | 0.01   |
| CAM1_D1_N | 0.4    |
| CAM1_D1_P | 0.4    |
| CAM1_D2_N | 0.05   |
| CAM1_D2_P | 0.04   |
| CAM1_D3_N | 0.01   |
| CAM1_D3_P | 0      |
|           |        |
| DSI0_C_N  | 0      |
| DSI0_C_P  | 0      |
| DSI0_D0_N | 0      |
| DSI0_D0_P | 0      |
| DSI0_D1_N | 0.01   |
| DSI0_D1_P | 0.01   |
|           |        |

|                  |      |
|------------------|------|
| DSI1_C_N         | 1.28 |
| DSI1_C_P         | 1.28 |
| DSI1_D0_N        | 0    |
| DSI1_D0_P        | 0.01 |
| DSI1_D1_N        | 1.06 |
| DSI1_D1_P        | 1.06 |
| DSI1_D2_N        | 0.83 |
| DSI1_D2_P        | 0.84 |
| DSI1_D3_N        | 3.78 |
| DSI1_D3_P        | 3.79 |
|                  |      |
| HDMI0_CLK_N      | 3.25 |
| HDMI0_CLK_P      | 3.24 |
| HDMI0_TX0_N      | 1.76 |
| HDMI0_TX0_P      | 1.76 |
| HDMI0_TX1_N      | 0.62 |
| HDMI0_TX1_P      | 0.62 |
| HDMI0_TX2_N      | 0    |
| HDMI0_TX2_P      | 0    |
|                  |      |
| HDMI1_CLK_N      | 2.47 |
| HDMI1_CLK_P      | 2.46 |
| HDMI1_TX0_N      | 1.51 |
| HDMI1_TX0_P      | 1.51 |
| HDMI1_TX1_N      | 1    |
| HDMI1_TX1_P      | 1    |
| HDMI1_TX2_N      | 0    |
| HDMI1_TX2_P      | 0.01 |
|                  |      |
| Ethernet_Pair0_P | 5.23 |
| Ethernet_Pair0_N | 5.23 |
| Ethernet_Pair1_P | 0    |
| Ethernet_Pair1_N | 0    |
| Ethernet_Pair2_P | 3.82 |
| Ethernet_Pair2_N | 3.82 |
| Ethernet_Pair3_P | 4.29 |
| Ethernet_Pair3_N | 4.29 |

### 4.1.2. 90Ω differential pair signal lengths

On the CM4 all differential pairs are matched to better than 0.05mm (P/N signals).

**i NOTE**

It is recommended that pairs are also matched on the interface board.

Pair-to-pairs aren't always matched as many interfaces don't require very accurate matching between pairs. [Table 8](#) documents the CM4 track-length difference within each group. (A non-zero value represents how much longer in mm that track is, when compared to the signal with zero length difference.)

Table 8. 90Ω differential pair signal lengths

| Signal     | Length |
|------------|--------|
| PCIe_CLK_P | 0.65   |
| PCIe_CLK_N | 0.65   |
| PCIe_TX_P  | 0      |
| PCIe_TX_N  | 0      |
| PCIe_RX_P  | 0.23   |
| PCIe_RX_N  | 0.23   |
|            |        |
| USB2_P     | 0      |
| USB2_N     | 0      |

# Chapter 5. Power

## 5.1. Power-up sequencing

The CM4 requires a single +5V supply, and can supply up to 600mA at +3.3V and +1.8V to peripherals.

All pins should not have any power applied to them before the +5V rail is applied.

If the EEPROM is to be write-protected, then the `EEPROM_nWP` should be low before power-up.

If the CM4 is to be booted using USB then `RPI_nBOOT` needs to be low within 2ms of +5V rising.

+5V should rise monotonically to 4.75V and stay above 4.75V for the entire operation of the CM4.

The power-up sequence will start when both +5V rail is above 4.75V and `GLOBAL_EN` rises. `GLOBAL_EN` has internal RC delay so that it rises after +5V has risen. The order of events is as follows

1. +5V rises
2. `GLOBAL_EN` rises
3. +3.3V rises
4. +1.8V rises at least 1ms after +3.3V
5. `RUN_PG` rises at least 10ms after +1.8V
6. `EXT_nRESET` rises at least 1s after `RUN_PG`

## 5.2. Power-down sequencing

The operating system should be shut down before the power is removed, to ensure that the file system remains consistent. If this can't be achieved, then a filesystem like `btrfs`, `f2fs` or `overlayfs` (use `raspi-config` to enable this) should be considered.

Once the operating system has shut down, the +5V rail can be removed or the `GLOBAL_EN` pin can be taken low to put the CM4 into the lowest power mode.

During the shutdown sequence the +1.8V will be discharged before the +3.3V rail.

## 5.3. Power consumption

The exact power consumption of the CM4 will greatly depend on the tasks being run on the CM4. The lowest shutdown power consumption mode is with the `GLOBAL_EN` driven low, typically is 15µA. With `GLOBAL_EN` high but software shut down, the typical consumption is 8mA. Idle power consumption is typically 400mA, but this varies considerably depending on the operating system. Operating power consumption is typically around 1.4A; again, this greatly depends on the operating system and the tasks being executed.

## 5.4. Regulator outputs

To make it easier to interface to the CM4 the on-board regulators (+3.3V and +1.8V) can each supply 600mA to devices connected to the CM4. The loads on these outputs isn't taken into account in the power consumption figures.

# Appendix A: Troubleshooting

The CM4 has a number of stages of power-up before the CPU starts. If there is an error at any of the stages, power-up will be halted.

## Hardware checklist

1. Is the +5V supply good? Check this by pulling `GLOBAL_EN` low and apply an external 2A load to the +5V supply. Does it stay > +4.75V including noise? Ideally it should remain > +4.9V including any noise.
2. Remove external 2A load, but keep `GLOBAL_EN` pulled low.
3. Check the CM4 +3.3V rail is < 200mV. If this is not the case there is an external power path back-feeding the CM4, either directly or indirectly. This could also occur via the digital pins, e.g Ethernet.
4. Still with `GLOBAL_EN` pulled low check the CM4 +1.8V rail is < 200mV. Again if the +1.8V rail is above 200mV then there is an external path back-feeding the 1.8V rail. (If nothing is connected to these pins you can ignore this check.)
5. Remove the pull down on `GLOBAL_EN`.
6. Check `GLOBAL_EN` now goes high (it is internally pulled up on the CM4)
7. Check the +3.3V supply rises to > +3.15V. If it does not, this suggests there is too much load on the +3.3V rail.
8. Check the +1.8V rail gets to > +1.71V. If it does not, this suggests there is too much load on the +1.8V rail.
9. Check `RUN_PG` goes high
10. Check `ACT_LED` starts to oscillate to indicate booting; check it isn't flashing an error code.

## Bootloader

1. Connect a HDMI cable to see if the HDMI diagnostics screen appears.
2. Connect a USB serial cable to GPIO pins 14 and 15.
  - a. See <https://www.raspberrypi.com/documentation/computers/configuration.html#configuring-uarts> for details.
3. Short the `nRPIBOOT` pin to ground to force USB boot mode. The CM4IO board has a jumper for `nRPIBOOT` This can be used to enable different boot modes (e.g. network) and enable UART logging.
  - a. See <https://www.raspberrypi.com/documentation/computers/compute-module.html#flashing-the-compute-module-emmc>

## rpi-eeeprom-update

1. CM4 will not run `recovery.bin` from from the EMMC (or SD Card on CM4Lite). Therefore, the only way to update the bootloader EEPROM is via `usbboot` or self-update.

## EEPROM write-protect

The on-board EEPROM can be write-protected by shorting `EEPROM_nWP` to ground. The CM4IO board has a jumper for

EEPROM\_nWP.

1. See <https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#raspberry-pi-4-bootloader-configuration>

## Firmware

1. A 5.4 or newer kernel and the latest firmware release is required. These can be updated by using usbboot to mount the EMMC as a USB MSD device.
2. Nightly OS images are now available which contain `rpi-update` master firmware + kernel. Bug fixes for CM4 will normally be provided via these images except where a test/patch binary is required.
  - a. See <http://downloads.raspberrypi.org/nightlies/>

## Kernel

1. The updated OS images use the new Raspberry Pi Compute Module 4 device tree file. If that is not found then the Raspberry Pi 4 Model B device tree file will be used.
  - a. See <https://github.com/raspberrypi/linux/blob/rpi-5.4.y/arch/arm/boot/dts/bcm2711-rpi-cm4.dts>

# Appendix B: Availability

## Support

For documentation please see the [Compute Module Hardware documentation](#) section of the [Raspberry Pi website](#). Support questions can be posted to the [Raspberry Pi forum](#).

## Ordering codes

Table 9. Part number options

| Model                      | Wireless | RAM LPDDR4 | eMMC Storage     |
|----------------------------|----------|------------|------------------|
| CM4                        | 0 = No   | 01 = 1GB   | 000 = 0GB (Lite) |
|                            | 1 = Yes  | 02 = 2GB   | 008 = 8GB        |
|                            |          | 04 = 4GB   | 016 = 16GB       |
|                            |          | 08 = 8GB   | 032 = 32GB       |
| <b>Example Part Number</b> |          |            |                  |
| CM4                        | 1        | 02         | 032              |

Table 10. Ordering options

| Wireless | RAM LPDDR4 | Storage eMMC | RPL #   | Part Number | Order Multiple | RRP      |
|----------|------------|--------------|---------|-------------|----------------|----------|
| -        | 1GB        | Lite         | SC0695B | CM4001000   | 1+ / Bulk      | \$ 30.00 |
| -        | 1GB        | 8GB          | SC0696B | CM4001008   | 1+ / Bulk      | \$ 35.00 |
| -        | 1GB        | 16GB         | SC0697B | CM4001016   | 1+ / Bulk      | \$ 40.00 |
| -        | 1GB        | 32GB         | SC0698B | CM4001032   | 1+ / Bulk      | \$ 45.00 |
| Yes      | 1GB        | Lite         | SC0691B | CM4101000   | 1+ / Bulk      | \$ 35.00 |
| Yes      | 1GB        | 8GB          | SC0692B | CM4101008   | 1+ / Bulk      | \$ 40.00 |
| Yes      | 1GB        | 16GB         | SC0693B | CM4101016   | 1+ / Bulk      | \$ 45.00 |
| Yes      | 1GB        | 32GB         | SC0694B | CM4101032   | 1+ / Bulk      | \$ 50.00 |
| -        | 2GB        | Lite         | SC0679B | CM4002000   | 1+ / Bulk      | \$ 35.00 |
| -        | 2GB        | 8GB          | SC0680B | CM4002008   | 1+ / Bulk      | \$ 40.00 |
| -        | 2GB        | 16GB         | SC0681B | CM4002016   | 1+ / Bulk      | \$ 45.00 |
| -        | 2GB        | 32GB         | SC0682B | CM4002032   | 1+ / Bulk      | \$ 50.00 |
| Yes      | 2GB        | Lite         | SC0667B | CM4102000   | 1+ / Bulk      | \$ 40.00 |
| Yes      | 2GB        | 8GB          | SC0668B | CM4102008   | 1+ / Bulk      | \$ 45.00 |
| Yes      | 2GB        | 16GB         | SC0669B | CM4102016   | 1+ / Bulk      | \$ 50.00 |
| Yes      | 2GB        | 32GB         | SC0670B | CM4102032   | 1+ / Bulk      | \$ 55.00 |
| -        | 4GB        | Lite         | SC0683B | CM4004000   | 1+ / Bulk      | \$ 50.00 |
| -        | 4GB        | 8GB          | SC0684B | CM4004008   | 1+ / Bulk      | \$ 55.00 |

|     |     |      |         |           |           |          |
|-----|-----|------|---------|-----------|-----------|----------|
| -   | 4GB | 16GB | SC0685B | CM4004016 | 1+ / Bulk | \$ 60.00 |
| -   | 4GB | 32GB | SC0686B | CM4004032 | 1+ / Bulk | \$ 65.00 |
| Yes | 4GB | Lite | SC0671B | CM4104000 | 1+ / Bulk | \$ 55.00 |
| Yes | 4GB | 8GB  | SC0672B | CM4104008 | 1+ / Bulk | \$ 60.00 |
| Yes | 4GB | 16GB | SC0673B | CM4104016 | 1+ / Bulk | \$ 65.00 |
| Yes | 4GB | 32GB | SC0674B | CM4104032 | 1+ / Bulk | \$ 70.00 |
| -   | 8GB | Lite | SC0687B | CM4008000 | 1+ / Bulk | \$ 75.00 |
| -   | 8GB | 8GB  | SC0688B | CM4008008 | 1+ / Bulk | \$ 80.00 |
| -   | 8GB | 16GB | SC0689B | CM4008016 | 1+ / Bulk | \$ 85.00 |
| -   | 8GB | 32GB | SC0690B | CM4008032 | 1+ / Bulk | \$ 90.00 |
| Yes | 8GB | Lite | SC0675B | CM4108000 | 1+ / Bulk | \$ 80.00 |
| Yes | 8GB | 8GB  | SC0676B | CM4108008 | 1+ / Bulk | \$ 85.00 |
| Yes | 8GB | 16GB | SC0677B | CM4108016 | 1+ / Bulk | \$ 90.00 |
| Yes | 8GB | 32GB | SC0678B | CM4108032 | 1+ / Bulk | \$ 95.00 |

**i NOTE**

RRP was correct at time of publication and excludes taxes.

## Packaging

Small quantities are supplied in individual cardboard boxes. These have an internal ESD coating so that a separate ESD bag isn't required. This packaging is recyclable and reduces waste.