

# **Raspberry Pi**

## **Compute Module 4**

A Raspberry Pi for  
embedded applications

# Colophon

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# Chapter 1. Introduction

## 1.1. Introduction

The Raspberry Pi Compute Module 4 (CM4) and Compute Module 4 Lite (CM4Lite) are loosely based on the Raspberry Pi 4B.

The CM4 has an option for cost sensitive applications to be supplied without the eMMC fitted; this version is called the CM4Lite. For the rest of this document CM4 also refers to CM4Lite unless stated otherwise.

The form factor of the new CM4 and CM4L is different from [previous Compute modules](#), which have all shared a form factor. The change is due to the additional of new interfaces; a second HDMI, PCIe, and Ethernet. The addition of these new interfaces, especially PCIe, would not have been possible while preserving the older form factor.

Instead the electrical interface of the CM4 is via two 100-pin high density connectors. While the switch to a newer form factor has allowed a reduction in the footprint. The total footprint of the CM4, including the socket, is smaller with the new form factor design.

## 1.2. Features

Key features are as follows:

- Small Footprint 55mm x 40mm x 4.7mm with 4xM2.5 mounting holes
- Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 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 (depending on model)
- Options for 0GB, 8GB, 16GB, or 32GB eMMC Flash memory (depending on model)
  - Peak eMMC bandwidth 100MBytes/s (four times faster than previous Compute modules)
- Option for Fully 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 external or PCB trace antenna
- Gigabit Ethernet PHY supporting IEEE 1588
- 1 x PCIe 1-lane Host, Gen 2 ( 5Gbps )
- 1 x USB 2.0 port ( highspeed )
- 28x user GPIO supporting either 3.3v or 1.8v signalling and various interface options:
  - Up to 6x UART
  - Up to 6x I2C
  - Up to 5x SPI
  - 1x SDIO interface
  - 1x DPI (Parallel RGB Display)
  - 1x PCM

- Up to 2x PWM channels
- Up to 3x GPCLK outputs
- 2 x HDMI 2.0 ports (up to 4k60 supported)
- MIPI DSI:
  - 1 x 2-lane MIPI DSI display port
  - 1 x 4-lane MIPI DSI display port
- MIPI CSI-2:
  - 1 x 2-lane MIPI CSI camera port
  - 1 x 4-lane MIPI DSI camera port
- 1 x SDIO 2.0 (CM4Lite only)
- Single +5v PSU input.

# Chapter 2. Interfaces

## 2.1. Wireless

The CM4 can be supplied with an onboard wireless module based on the BCM43456 supporting

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

These interfaces can be individually disabled if required. e.g. in a kiosk application a service engineer may via a key enable wireless operation and then disable it once finished.

There is an onboard antenna that should be arranged such that it isn't surrounded by metal including copper in a ground plane below it ( see mechanical section for details).

There is a standard UFL connector so that an external antenna can be used. Raspberry Pi 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, which unfortunately Raspberry Pi will not be able to help with.

The selection of internal or external antenna is done at boot time in the config.txt file and can not be changed during operation.

The config.txt options are dtparam=ant1 for internal antenna or dtparam=ant2 for 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.

On CM4s 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.

On CM4s without wireless, this pin is reserved.

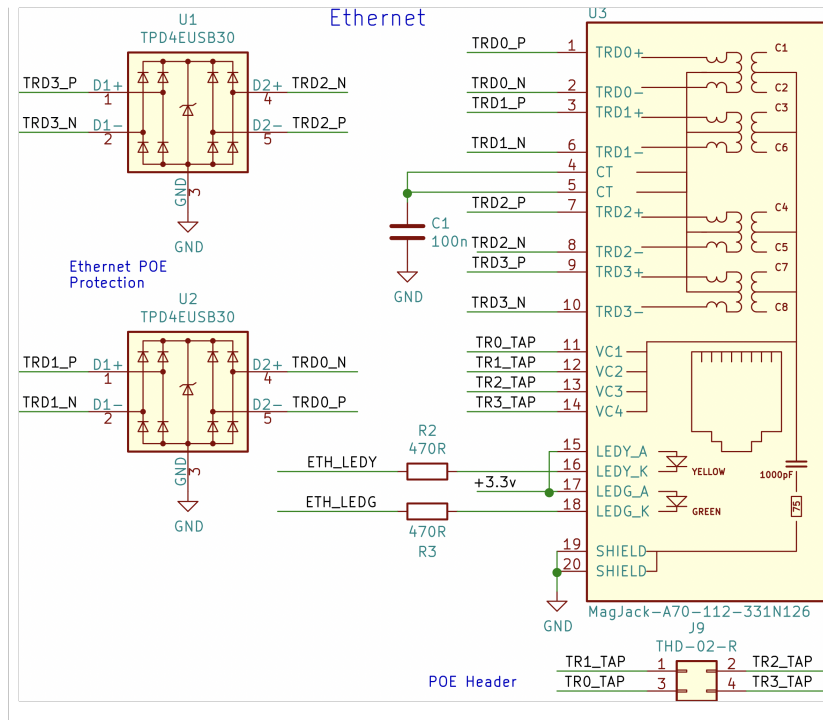
## 2.2. Ethernet

The CM4 has an onboard Gigabit Ethernet PHY—the BCM54210PE —some of the major features of this PHY include;

- [IEEE 1588-2008](#) compliant
- Detection and correction of swapped pairs
- 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 1](#).

Figure 1. 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 a 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 1.8v 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 4B this has been connected to a USB 3 host controller (using the Via Labs [VL1805](#)), on the CM4 the product designer is free to choose how the interface is used. However you should ensure that there is a suitable OS driver for any device that is chosen before proceeding to a prototype.

Connecting up a PCIe device follows the standard PCIe convention. The CM4 has onboard 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**). 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.

Note The PCIe Interface doesn't support MSI-X usually PCIe devices will fall back to MSI. Also there is a limit of upto 32 IRQs available. If the device has problems with interrupts then adding "pci=noms" to cmdline.txt (and reboot) often fixes the issue.

## 2.4. USB 2.0 ( Highspeed )

The USB 2.0 interface support upto 480Mbps signalling. The differential pair should be routed as a 90Ω differential pair. The P N signals should ideally be matched to 0.15mm

### **i** NOTE

The port is capable of being used as a true OTG port. While there is no official documentation, some users have had success making this work. The **USB\_OTG** 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 that is used. If using either as a fixed slave or fixed master, please tie the **USB\_OTGID** pin to ground

## 2.5. GPIO

There are 28 pins available for general purpose I/O (GPIO). These match the GPIO pins on the Raspberry Pi 4B 40-pin header. These pins have access to many internal peripherals e.g I2C, PWM, SPI, UART. The BCM2711 SOC datasheet describes these features in detail and the multiplexing options available. The drive strength and slew rate should ideally be set as low as possible to reduce and EMC issues.

The SOC GPIO bank is powered by **GPIO\_VREF**, this can either be connected to the +1.8v from the CM4 for 1.8v signalling GPIO or +3.3v from the CM4 for +3.3v signalling. You should try and keep the load on the 28 GPIO pins to below 50mA in total.

## 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 27K pullup resistor is included in the CM4.

Basic onboard ESD protection is provided for the I2C EDID signals and the CEC signals, internal pullup and down resistors are provided.

## 2.7. CSI-2 ( MIPI Serial Camera )

The CM4 supports two camera ports; CAM0 ( 2 lanes ) and CAM1 ( 4 lanes)

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

Camera sensors supported by the official Raspberry Pi firmware are; the OmniVision OV5647, Sony IMX219 and Sony IMX477.

CSI signals should be routed as 100Ω differential pairs, each signal within a pair should ideally be matched to better than 0.15mm.

## 2.8. DSI ( MIPI Serial Display )

The CM4 supports two display ports; DISP0 ( 2 lanes ) and DISP1 ( 4 lanes)

Each lane supports a maximum of data rate per lane of 1Gbit/s.

Currently the DSI interface is not thoroughly documented, although [Linux kernel drivers](#) are available. Only DSI displays



supported by the official Raspberry Pi firmware are supported, however displays can also be added via the parallel DPI interface which is available as a GPIO alternate function.

DSI signals should be routed as 100Ω differential pairs, each signal within a pair should ideally be matched to better than 0.15mm.

**NOTE**

The CM4 only supports up to 3 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.

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

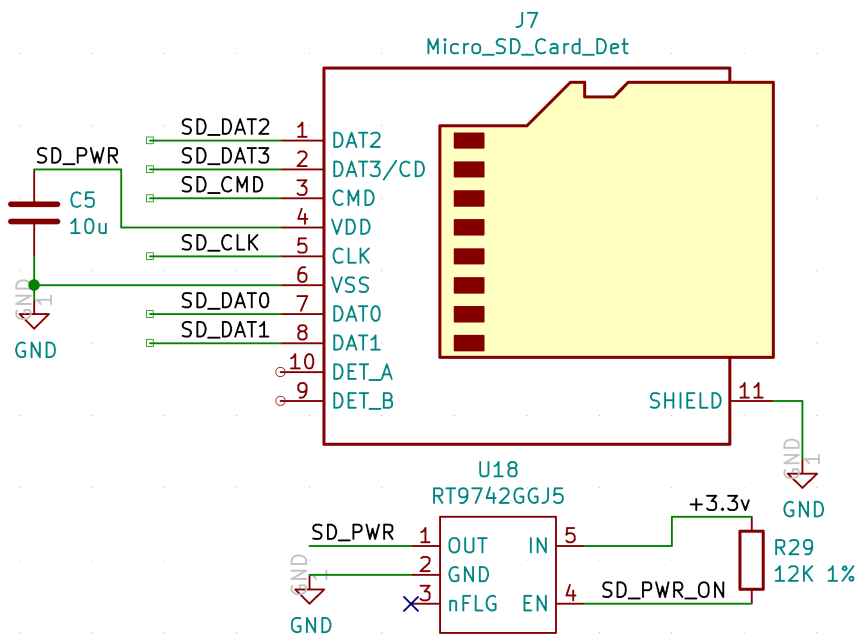
This I2C bus is normally used for identifying HATs and controlling CSI0 and DSI1 devices. If the firmware isn't using the I2C bus e.g. CSI0 and DSI0 aren't being used then these pins may be used if required.

### 2.11. SDIO/eMMC ( CM4Lite only )

If the CM4Lite is used ie. no on board eMMC, then the eMMC signals are available on the connector so that an external eMMC or SDCARD can be used.

The **SD\_PWR\_ON** signal is used to enable an external power switch to turn on power to the SDCARD, for eMMC it typically isn't used. When **SD\_VDD\_override** is high, this signal is used to force 1.8v signalling on the SDIO interface. Typically this is used with eMMC memory

Figure 2. CM4Lite SDCARD 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. Onboard filtering is provided by a 100nF capacitor to ground for each signal. On the Raspberry Pi 4B 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. It is recommended to only pull this pin low once the OS has shutdown. After software shutdown **Global\_EN** needs to be pulled low for > 1ms to restart the power system on the CM4

## 2.14. RUN\_PG

This pin when high signals that the CM4 has started. Driving this pin low resets the CM4, this should be done with caution as 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 4B. Under Linux this pin will flash to signify eMMC access, while if there is an error during booting this LED will flash error patterns which can be decoded using the [look up table](#) on the Raspberry Pi website.

## 2.17. LED\_PWR

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

## 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. The EEPROM can only be written via **rpiboot** ( via the USB ) this is a security feature again to prevent final customers accidentally changing the EEPROM.

The EEPROM contains a bootloader config file, and full details of the configuration options can be found [on the Raspberry Pi website](#). To change the configuration file you need to do the following.

In the **rpiboot** CM4 recovery directory go ahead and,

```
$ rpi-eeeprom-config pieeprom.bin > bootconf.txt
```

then edit the configuration using a text editor. For example if you have a UART cable then setting **BOOT\_UART=1** will help debug boot issues,

```
BOOT_UART=1
```

then save the new configuration and exit editor. You can apply the configuration change to the EEPROM image file,

```
$ rpi-eeeprom-config --out pieeprom-new.bin --config bootconf.txt pieeprom.bin  
$ sudo ./rpiboot -l -v -d cm4/recovery
```

on Raspberry Pi 4B, or any other Linux machine, with the USB cable connected.

# Chapter 3. Electrical and Mechanical

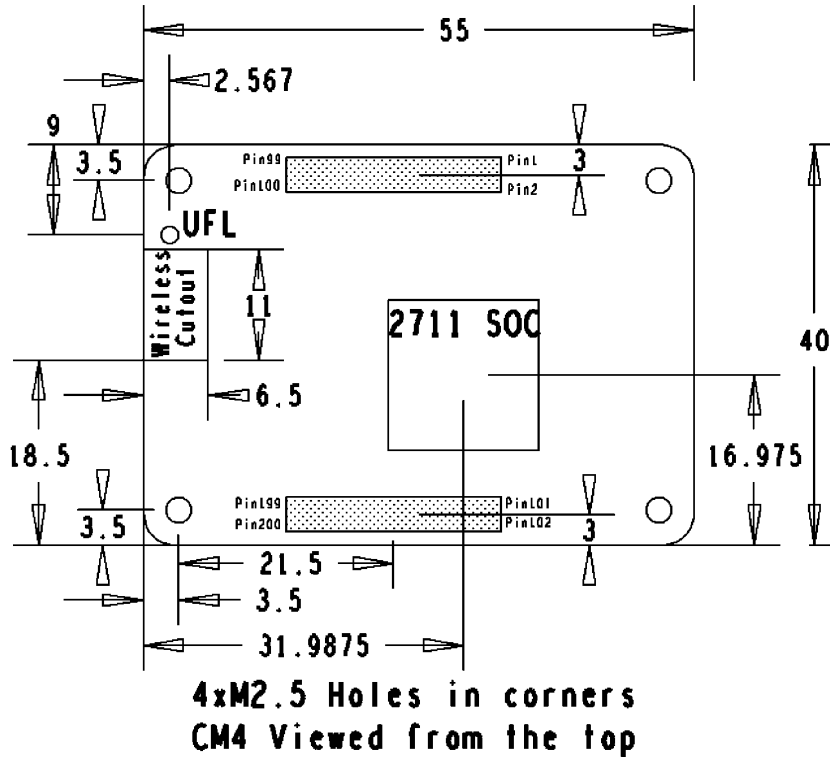
## 3.1. Mechanical

The CM4 is a compact 40x55mm module. Module thickness 4.7mm. When connected the height is either 5.078 or 6.578 mm depending on the stacking height chosen.

1. 4xM2.5 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

For wireless version the on board antenna if used should be pointed towards the edge of the plastic enclosure.

Figure 3. Mechanical specification of the Raspberry Pi Compute Module 4



There shouldn't be any metal including ground planes under the antenna. The ground plane cutout should be a minimum of 6.5mm x 11mm, ideally 8mm x 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.

Note that 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 4B, but as it is in a smaller form factor it might run warmer depending on the conditions. The CM4 will automatically reduce its clock frequency if it detects it is running warm. The BCM2711 will reduce the clock rate to keep its temperature below 85°C. So in high ambient temperatures it is possible that the clock will also be automatically throttled back.

Operating temperature range: 0°C - 85°C

## 3.3. Electrical Specification

### ⚠ WARNING

Stresses above those listed in [Table 2](#) 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 1. Absolute maximum ratings

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

Please note that  $V_{ref}$  is the GPIO bank voltage which must be tied to either 3.3V or 1.8v rail.

Table 2. DC characteristics

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Unit
$V_{IL(gpio)}$	Input low voltage	$V_{ref} = 3.3V$	0	-	0.8	V
$V_{IH(gpio)}$	Input high voltage	$V_{ref} = 3.3V$	2.0	-	$V_{GPIO\_ref}$	V
$V_{IL(gpio)}$	Input low voltage	$V_{ref} = 1.8V$	0	-	0.35	V
$V_{IH(gpio)}$	Input high voltage	$V_{ref} = 1.8V$	0.65	-	$V_{GPIO\_ref}$	V
$I_{IL(gpio)}$	Input leakage current		-	-	10	$\mu A$
$V_{OL(gpio)}$	Output low voltage		-	-	0.4	V
$V_{OH(gpio)}$	Output high voltage		$V_{GPIO\_ref} - 0.4$	-	-	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

$I_{O(\text{gpio})}$	Output current	7mA	6.15	9.2	-	mA
$I_{O(\text{gpio})}$	Output current	8mA	7.02	10.5	-	mA
$R_{\text{PU}(\text{gpio})}$	Pullup resistor	$V_{\text{ref}} = 3.3\text{V}$	33	47	73	k $\Omega$
$R_{\text{PD}(\text{gpio})}$	Pulldown resistor	$V_{\text{ref}} = 3.3\text{V}$	33	47	73	k $\Omega$
$R_{\text{PU}(\text{gpio})}$	Pullup resistor	$V_{\text{ref}} = 1.8\text{V}$	18	47	73	k $\Omega$
$R_{\text{PD}(\text{gpio})}$	Pulldown resistor	$V_{\text{ref}} = 1.8\text{V}$	18	47	73	k $\Omega$

Refer to interface specifications for electrical details of other interfaces.

# Chapter 4. Pin Out

Table 3. Pin out 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	Low Active Ethernet Activity indicator ( 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 ( 1.8v signal : $I\{OL\} = 8\text{mA} @ V\{OL\} < 0.4\text{v}$ )
17	Ethernet_nLED2	Low Active Ethernet speed indicator ( 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 ( 1.8v signal : $I\{OL\} = 8\text{mA} @ V\{OL\} < 0.4\text{v}$ )
19	Ethernet_nLED1	Low Active Ethernet speed indicator ( 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	Leaving floating ( NB internally pulled up to <b>CM4_3.3v</b> via 100K ( $V_{IL} < 0.8\text{v}$ ) but can be grounded to prevent writing to the on board EEPROM which stores the bootcode
21	Pi_nLED_Activity	Low Active 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 4B )
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 1.8v
25	GPIO21	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
26	GPIO19	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
27	GPIO20	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
28	GPIO13	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
29	GPIO16	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
30	GPIO6	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v

31	GPIO12	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
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 1.8v
35	ID_SC	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
36	ID_SD	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
37	GPIO7	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
38	GPIO11	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
39	GPIO8	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
40	GPIO9	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
41	GPIO25	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
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 1.8v
45	GPIO24	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
46	GPIO22	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
47	GPIO23	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
48	GPIO27	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
49	GPIO18	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
50	GPIO17	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
51	GPIO15	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
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 1.8v
55	GPIO14	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v
56	GPIO3	GPIO Typically a 3.3v signal but can be a 1.8v signal by connecting GPIO_Vref to 1.8v. Internal 1.8K pull up to GPIO_Vref
57	SD_CLK	SDCARD 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 1.8v. Internal 1.8K pull up to GPIO_Vref
59	GND	Ground (0V)
60	GND	Ground (0V)
61	SD_DAT3	SDCARD/eMMC Data3 signal (only available on CM4Lite)
62	SD_CMD	SDCARD/eMMC Command signal (only available on CM4Lite)
63	SD_DAT0	SDCARD/eMMC Data0 signal (only available on CM4Lite)
64	SD_DAT5	SDCARD/eMMC Data5 signal (only available on CM4Lite)
65	GND	Ground (0V)



66	GND	Ground (0V)
67	SD_DAT1	SDCARD/eMMC Data1 signal (only available on CM4Lite)
68	SD_DAT4	SDCARD/eMMC Data4 signal (only available on CM4Lite)
69	SD_DAT2	SDCARD/eMMC Data2 signal (only available on CM4Lite)
70	SD_DAT7	SDCARD/eMMC Data7 signal (only available on CM4Lite)
71	GND	Ground (0V)
72	SD_DAT6	SDCARD/eMMC Data6 signal (only available on CM4Lite)
73	SD_VDD_Override	Force SDCARD/eMMC interface to 1.8v signalling if set to 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 SDCARD. CM4 sets this pin High (3.3v) to signal that Power to the SDCARD should be turned on. If booting from the SDCARD is required then a pullup should be fitted (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 <b>CM4_3.3v</b> ( pins 84 and 86 ) for 3.3v GPIO or <b>CM4_1.8v</b> ( 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	IIC Clock pin ( Raspberry Pi GPIO45) Typically used for Camera and Displays Internal 1.8K pull up to <b>CM4_3.3v</b>
81	+5v (Input)	4.75v-5.25v Main power input
82	SDA0	IIC Data pin ( Raspberry Pi GPIO44 ) Typically used for Camera and Displays Internal 1.8K pull up to <b>CM4_3.3v</b>
83	+5v (Input)	4.75v-5.25v Main power input
84	CM4_3.3v (Output)	3.3v +/-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 +/-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 +/-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. Internal pulled up via 1.8K to <b>CM4_3.3v</b>
90	CM4_1.8v (Output)	1.8v +/-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. Internal pulled up via 1.8K to <b>CM4_3.3v</b>
92	RUN_PG	Bidirectional pin. Can be driven low ( via a 220R resistor) to Reset the CM4 CPU. As an Output a high signals Power Good and CPU running. Internally pulled up to +3.3v via 10K

93	nRPIBOOT	A low on this pin force booting from an RPI server ( e.g PC or a Raspberry Pi) if not used leave floating. Internally pulled via 10K to +3.3v
94	AnalogIP1	Analogue input of the MAX7704. Typically connected to CC pin of Type C power connector
95	PI_LED_nPWR	Low active Output to drive Power On LED. This signal needs to be buffered.
96	AnalogIP0	Analogue input of the MAX7704. Typically connected to CC pin of Type C power connector
97	Camera_GPIO	Typically used to Shutdown the camera to reduce power. Reassigning this pin to another function isn't recommended. <b>CM4_3.3v</b> signalling
98	GND	Ground (0V)
99	GLOBAL_EN	Input. Drive low to power off CM4. Internally pulled up with a 100K to +5v
100	nEXTRST	Output Driven low during reset Driven high ( <b>CM4_3.3v</b> ) once CM4 CPU has started to boot
101	USB_OTG_ID	Input ( 3.3v signal ) USB OTG Pin. Internal 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). Internal 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 (+3.3 signal) PCIe Reset Low active
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. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by the CM4 by an on board HDMI05-CL02F3)
144	GND	Ground (0V)
145	HDMI1_SDA	Bidir HDMI1 SDA Internally pulled up with a 1.8K. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by the CM4 by an on board HDMI05-CL02F3)
146	HDMI1_TX2_P	Output HDMI1 TX2 Positive
147	HDMI1_SCL	Input HDMI1 SCL Internally pulled up with a 1.8K. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by 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 27K. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by the CM4 by an on board HDMI05-CL02F3)
150	GND	Ground (0V)
151	HDMI0_CEC	Input HDMI0 CEC Internally pulled up with a 27K. 5v tolerant ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by 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 100K. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by 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	Bidir HDMI0 SDA Internally pulled up with a 1.8K. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by the CM4 by an on board HDMI05-CL02F3)
200	HDMI0_SCL	Bidir HDMI0 SCL Internally pulled up with a 1.8K. 5v tolerant. ( It can just be connected directly to a HDMI connector a small amount of ESD protection is provided by 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 not fit 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 4B.

If the **CM4\_1.8v** rail is use 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 surprise power removal the **CM4\_3.3v** rail never fails 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 power up.

## 4.1. Differential Pairs

It is recommended that P/N signals within a pair are matched to better 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 pairs signal lengths

On the CM4 all differential pairs are matched to better than 0.05mm ( P /N signals ). It is recommended that pairs are also matched on the interface board.

On the CM4 pair to pairs aren't always matched. Many interfaces don't require very accurate matching between pairs. The table below documents the CM4 Track length difference within each group ( a non zero value is how much longer in mm that track is compared to the signal with zero length difference)

Table 4. 100 Ω  
Differential paris  
signal length

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 Pairs signal lengths**

On the CM4 all differential pairs are matched to better than 0.05mm ( P /N signals ). It is recommended that pairs are also matched on the interface board.

On the CM4 pair to pairs aren't always matched. Many interfaces don't require very accurate matching between pairs. The table below documents the CM4 Track length difference within each group ( a non zero value is how much longer in mm that track is compared to the signal with zero length difference)

*Table 5. 90 Ω  
Differential paris  
signal length*

Signal	Length
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
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 only requires a single +5v supply. The CM4 can also supply upto 600mA at +3.3v and +1.8v to peripherals.

All pins must 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 powerup.

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. +3.3v rises
2. +1.8v rises
3. `RUN_PG` rises
4. `EXT_nRESET` rises

## 5.2. Power down sequencing

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

Once the OS has shutdown the +5v rail can be removed or the `GLOBAL_EN` pin can be taken low to put the CM4 into the low power mode.

# Appendix A: Troubleshooting

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

## Hardware Checklist

1. Is the +5v supply good ? Pull `GLOBAL_EN` low apply an external 2A load to the +5v supply does it stay >4.75v including noise ideally it should be >4.9v including any noise.
2. Remove external 2A load, but keep `GLOBAL_EN` low
3. Check the CM4 +3.3v rail is < 200mV if it isn't there is an external power path back feeding the CM4 either directly or indirectly, it could also be via the CM4 digital pins e.g the ethernet pins.
4. Still with Global enable low check the CM4 +1.8v rail is <200mV if you haven't anything connected to these pins you can ignore this check. Again if the 1.8v rail is above 200mV then there is an external path back feeding the 1.8v rail.
5. Remove the pull down on Global enable.
6. Check global now goes high ( internally pulled up on the CM4)
7. Check 3.3v supply rises to >3.15v if it doesn't this suggests there is too much load on the 3.3v rail.
8. Check the 1.8v rail gets to >1.71v if it doesn't, this suggests there is 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 14,15.
  - a. See <https://www.raspberrypi.org/documentation/configuration/uart.md>
3. Short the EMMC GPIO pin and use usbboot. This can be used to enable different boot modes (e.g. network) and enable UART logging. Instructions and the updated recovery.bin / pieeprom.bin are [here](#)

## 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.
2. A future update to the recovery.bin will configure the write protect regions in the bootloader EEPROM when it is updated. The reference IO module has a jumper to configure the write protect PIN.

## Firmware

1. A 5.4 kernel and the latest firmware release is required. These can be updated by using usbboot to mount the EMMC as a USB MSD device but you must use the updated usbboot binaries in the alpha test folder
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 4B device tree file will be used. <https://github.com/raspberrypi/linux/blob/rpi-5.4.y/arch/arm/boot/dts/bcm2711-rpi-cm4.dts>

# Appendix B: Availability

Raspberry Pi guarantees availability of the CM4 until at least January 2026.

## Support

For support please see the hardware documentation section of the Raspberry Pi website and post questions to the Raspberry Pi forum.

## Ordering codes

Table 6. Part Number Options

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

Table 7. Ordering Options

Wireless	RAM LPDDR4	Storage eMMC	RPTL #	Part Number	Order Multiple	RRP
-	1GB	Lite	SC0318	CM4001000	1+ / Bulk	\$ 25.00
-	1GB	8GB	SC0319	CM4001008	1+ / Bulk	\$ 30.00
-	1GB	16GB	SC0320	CM4001016	1+ / Bulk	\$ 35.00
-	1GB	32GB	SC0321	CM4001032	1+ / Bulk	\$ 40.00
Yes	1GB	Lite	SC0314	CM4101000	Bulk	\$ 30.00
Yes	1GB	8GB	SC0315	CM4101008	Bulk	\$ 35.00
Yes	1GB	16GB	SC0316	CM4101016	Bulk	\$ 40.00
Yes	1GB	32GB	SC0317	CM4101032	Bulk	\$ 45.00
-	2GB	Lite	SC0287	CM4002000	1+ / Bulk	\$ 30.00
-	2GB	8GB	SC0288	CM4002008	1+ / Bulk	\$ 35.00
-	2GB	16GB	SC0289	CM4002016	1+ / Bulk	\$ 40.00
-	2GB	32GB	SC0290	CM4002032	1+ / Bulk	\$ 45.00
Yes	2GB	Lite	SC0275	CM4102000	1+ / Bulk	\$ 35.00
Yes	2GB	8GB	SC0276	CM4102008	1+ / Bulk	\$ 40.00
Yes	2GB	16GB	SC0277	CM4102016	1+ / Bulk	\$ 45.00
Yes	2GB	32GB	SC0278	CM4102032	1+ / Bulk	\$ 50.00
-	4GB	Lite	SC0291	CM4004000	Bulk	\$ 45.00
-	4GB	8GB	SC0292	CM4004008	Bulk	\$ 50.00

-	4GB	16GB	SC0293	CM4004016	Bulk	\$ 55.00
-	4GB	32GB	SC0294	CM4004032	Bulk	\$ 60.00
Yes	4GB	Lite	SC0279	CM4104000	1+ / Bulk	\$ 50.00
Yes	4GB	8GB	SC0280	CM4104008	1+ / Bulk	\$ 55.00
Yes	4GB	16GB	SC0281	CM4104016	1+ / Bulk	\$ 60.00
Yes	4GB	32GB	SC0282	CM4104032	1+ / Bulk	\$ 65.00
-	8GB	Lite	SC0295	CM4008000	Bulk	\$ 70.00
-	8GB	8GB	SC0296	CM4008008	Bulk	\$ 75.00
-	8GB	16GB	SC0297	CM4008016	Bulk	\$ 80.00
-	8GB	32GB	SC0298	CM4008032	Bulk	\$ 85.00
Yes	8GB	Lite	SC0283	CM4108000	Bulk	\$ 75.00
Yes	8GB	8GB	SC0284	CM4108008	Bulk	\$ 80.00
Yes	8GB	16GB	SC0285	CM4108016	Bulk	\$ 85.00
Yes	8GB	32GB	SC0286	CM4108032	Bulk	\$ 90.00

Note RRP was correct at time of publication.

Some options have Minimum ordering qualities (MOQ), please check with your supplier.

For prototyping often a higher LPDDR RAM capacity option will exist, without an MOQ. You can use the higher LPDDR RAM option, but limit it to the lower capacity by changing config.txt.

## 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.



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