CM5-DUAL-ETH-4G/5G-BASE

From Waveshare Wiki
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Overview

Introduction

As the IO board for the Raspberry Pi Compute Module 5, CM5-DUAL-ETH-4G/5G-BASE is a baseboard that can be used with the Raspberry Pi Compute Module 5. It features powerful functionality with onboard dual USB 3.2 Gen1 ports, M.2 M KEY, M.2 B KEY (4G/5G module interface), and dual network ports for user convenience.

CM5-DUAL-ETH-4G/5G-BASE

(https://www.waveshare.com/cm5-dual-eth-4g-5g-base.htm)

DSI / CSI / HDMI / USB3.0 / I2C / I2S / SPI / UART / RPi / Ethernet

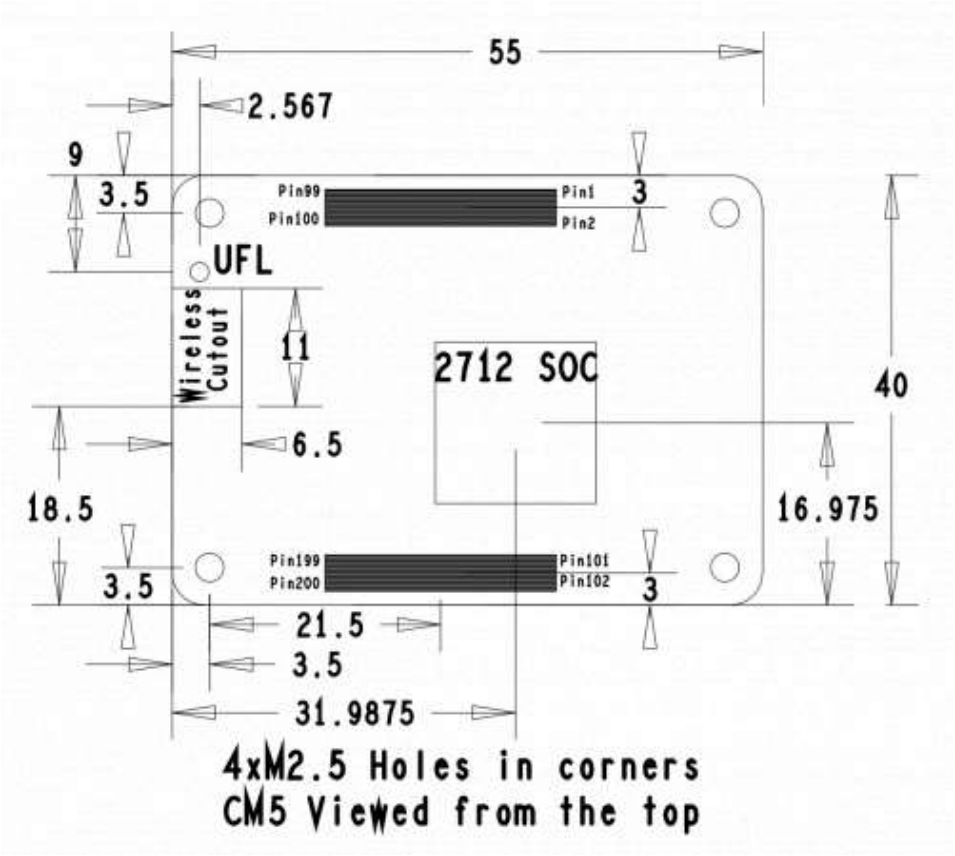
Features and Precautions

1. Do not plug or unplug any device other than USB and HDMI when the device is powered on
2. Type-C can be used as a USB SLAVE interface to flash images or power the device.
3. Onboard 2 USB 3.2 Gen1 ports
4. Supports 4 screens to display different contents, adds MIPI DSI driver, regardless of whether a screen is connected, the system will default to be connected, the screen will display in split-screen mode (related to the system version)
5. Onboard M.2 M KEY interface, supports NVMe hard drive protocol (or AI modules of the PCIe protocol) 6. Onboard M.2 B KEY interface, supports connecting 4G/5G communication modules 7. Onboard BOOT switch, you can turn the BOOT switch to ON before powering on, connect the device to a computer via Type-C to allow the device into flashing mode

8. Do not connect other devices when using Type-C for flashing, otherwise insufficient power supply will cause the device to be unrecognized
9. The USB3.0 port has a maximum current output of 2A

Dimensions

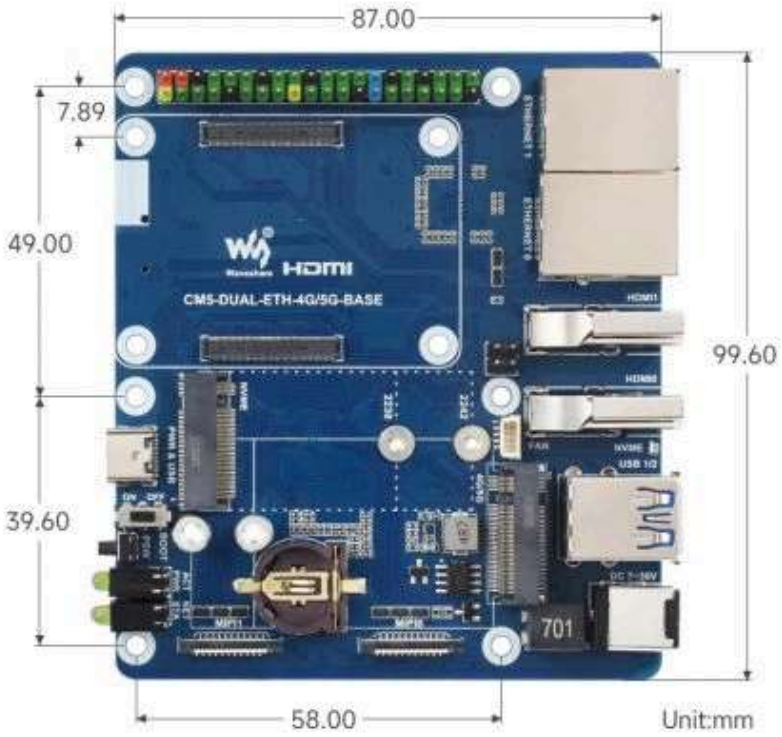
Core Board Size



(/wiki/File:500px-

Compute-Module-5-1-1.png)

Baseboard Size



(/wiki/File:500px-CM5-

DUAL-ETH-4G-5G-BASE-details-size.jpg)

Case Size

Stay tuned...

Image Flashing

How to Flash

Enter flashing mode

1. Onboard BOOT switch, you can turn the BOOT switch to ON before powering on, connect the device to a computer via Type-C to allow the device into flashing mode

Click here (https://www.waveshare.com/wiki/Compute_Module_Burn_EMMC) for EMMC version

Click here (https://www.waveshare.com/wiki/CM4_Burn_SD) for LITE version

M.2 M KEY (NVMe Hard Drive)

1. Enable PCIE interface

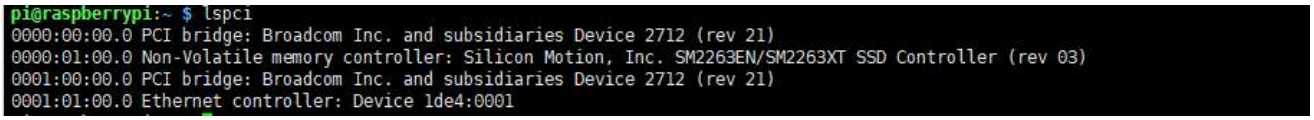
```
PI5B defaults to not having the PCIE interface enabled. Add to /boot/firmware/config.txt:
dtparam=pciex1
```

2. PCIE is gen2 by default, if you need to enable PCIE gen3, then add following to /boot/firmware/config.txt:

```
dtparam=pciex1_gen=3
```

3. After the modification, reboot the PI5, and the device can be recognized.

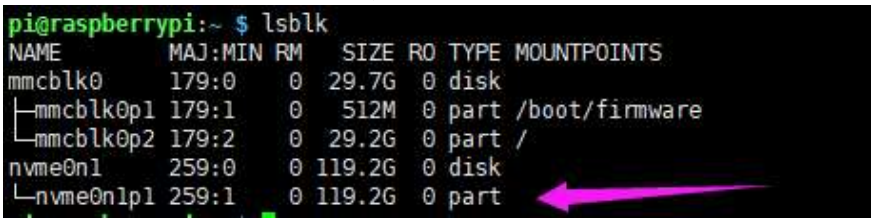
As shown in the figure below, SM2263 is identified as my SSD solid state drives, and the other PI5 is the RPI chip



(/wiki/File:PCIe_TO_M.2_HAT%2B_W_1.png)

4. Partition, skip this step if you have partitioned and formatted on other platforms (Note: Partitioning will delete all data on the SSD, please proceed with caution)

Lsblk This command is executed to view the disk (if you want to see the details, run the sudo fdisk -l command)



(/wiki/File:PCIe_TO_M.2_HAT%2B_W_2.png)

Partition:

sudo fdisk /dev/nvme0n1 The device number is the total device number, do not add p1, that is just a partition

How to use the partitioning tool fdisk:

n New partition
q Quit without saving
p Print the partition table
m Print the selection menu
D Delete the partition
w Save and exit
t Modify the ID number

Add the partition and execute n, then save and exit with w

5. Format

```
sudo mkfs.     Execute the command and press Tab key, you will see a lot of different suf
fixes, and the different suffixes are the formats you need to format
```

```
pi@raspberrypi:~ $ sudo mkfs.
mkfs.bfs    mkfs.cramfs  mkfs.exfat   mkfs.ext2    mkfs.ext3    mkfs.ext4    mkfs.fat     mkfs.minix   mkfs.msdos   mkfs.ntfs    mkfs.vfat
```

(/wiki/File:PCIe_TO_M.2_HAT%2B_W_3.png)

If I want to format it in ext4 file format, then execute the command:

```
sudo mkfs.ext4 /dev/nvme0n1p1
```

Wait a moment, once all "done" appear as below, it indicates that the formatting is compl
eted

```
pi@raspberrypi:~ $ sudo mkfs.ext4 /dev/nvme0n1p1
mke2fs 1.47.0 (5-Feb-2023)
Discarding device blocks: done
Creating filesystem with 31258368 4k blocks and 7815168 inodes
Filesystem UUID: 1a84fb29-5460-475f-afb7-0a90271ef975
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624, 11239424, 20480000, 23887872

Allocating group tables: done
Writing inode tables: done
Creating journal (131072 blocks): done
Writing superblocks and filesystem accounting information: done
```

(/wiki/File:PCIe_TO_M.2_HAT%2B_W_4.png)

6. Mount

```
Create a mount directory
sudo mkdir toshiba
Mount the device
sudo mount /dev/nvme0n1p1 ./toshiba
Check the disk status
df -h
```

Read/Write Test

Enter the directory where the disk is mounted

```
cd toshiba
```

- Free up the memory

```
sudo sh -c "sync && echo 3 > /proc/sys/vm/drop_caches"
```

- Copy Raspberry Pi memory content to the hard disk (write)

```
sudo dd if=/dev/zero of=./test_write count=2000 bs=1024k
```

```
pi@raspberrypi:~/toshiba $ sudo dd if=/dev/zero of=./test_write count=2000 bs=1024k
2000+0 records in
2000+0 records out
2097152000 bytes (2.1 GB, 2.0 GiB) copied, 3.78947 s, 553 MB/s
```

(/wiki/File:PCIe_TO_M.2_HAT%2B_W_5.png)

- Copy the hard drive content to the Raspberry Pi memory (/etc/fstab read)

```
sudo dd if=./test_write of=/dev/null count=2000 bs=1024k
```

```
pi@raspberrypi:~/toshiba $ dd if=./test_write of=/dev/null count=2000 bs=1024k
2000+0 records in
2000+0 records out
2097152000 bytes (2.1 GB, 2.0 GiB) copied, 3.53634 s, 593 MB/s
```

(/wiki/File:Pcie-m2-6new.png)

- Note: The test results vary for different cards and environments. The Raspberry Pi is significantly affected. If you want to test accurate performance, use a PC for the test

Auto Mount

Test shows there's no issue. If it's not required to be used as a system disk, but only for expanding the disk, set it to auto-mount

```
sudo nano /etc/fstab

#Add at the end
/dev/nvme0n1p1  /home/pi/toshiba  ext4  defaults  0  0
#/dev/nvme0n1p1 is the device name, /home/pi/toshiba refers to mounting to a directory, e
xt4 is the file system type, defaults uses the default mount option
#Make the changes take effect (reboot only after testing, otherwise it will fail to mount
and boot)
sudo mount -a

#Then reboot
Check the device with lsblk
```

NVMe SSD Boot

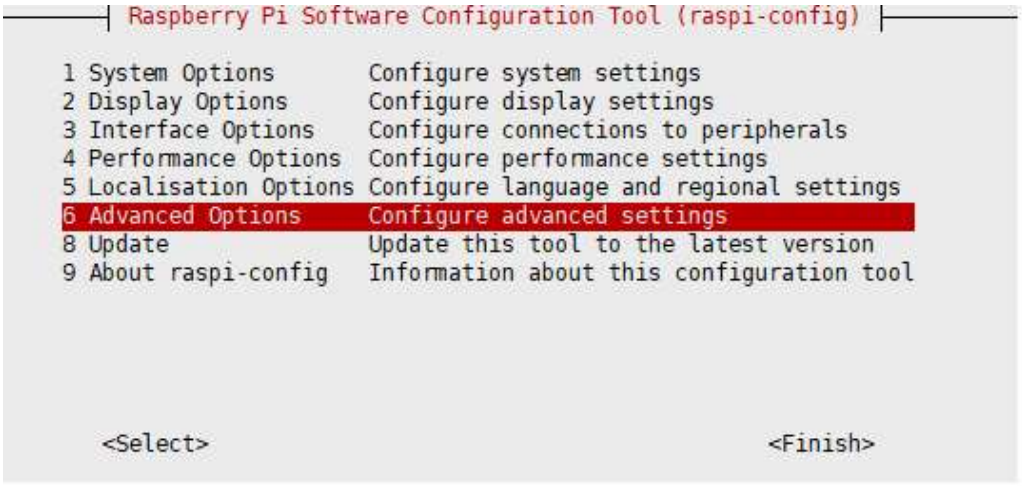
Boot the Raspberry Pi with a TF card first, mount and test it, and make sure the hardware can work properly

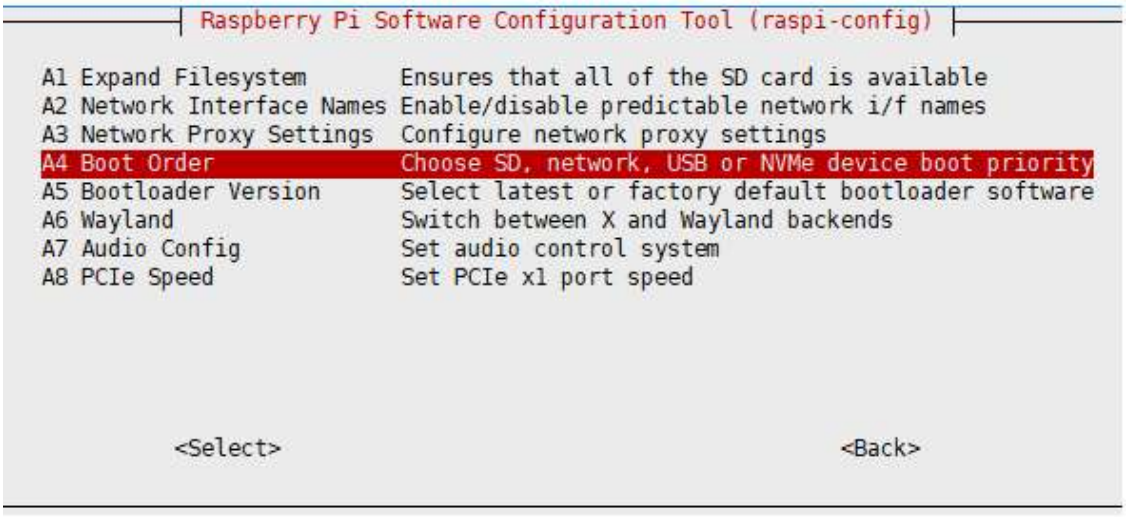
Choose one of the following methods

Method 1

1. Run the following command:

```
sudo raspi-config
```





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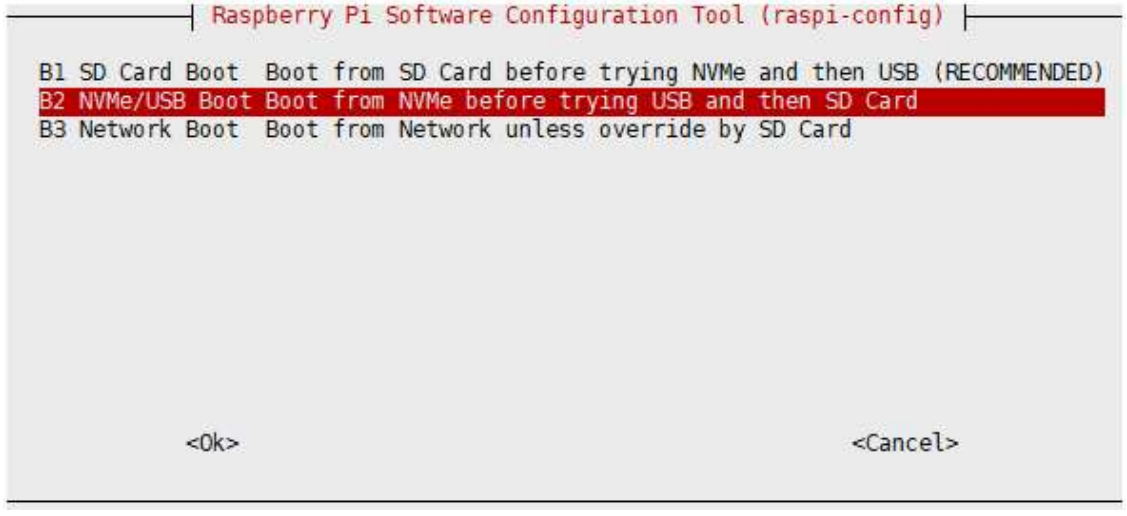

e:PCIE_NVME_BOOT-1.png)

2. Reboot Raspberry Pi

If you find you can't modify it multiple times, please reconnect to the network and then try to modify it (wait for the network to synchronize the time automatically), or modify the file after setting the correct time

3. Flash the system to NVME, then connect the NVME to the expansion board, remove the TF card and power it on again

Method 2

1. Modify the BOOT_ORDER in the Raspberry Pi boot loader configuration:

```
sudo rpi-eeprom-config --edit
Modify BOOT_ORDER=0xf41 to BOOT_ORDER=0xf416
```

Value	Mode	Description
0x0	SD CARD DETECT	Try SD then wait for card-detect to indicate that the card has changed - deprecated now that 0xf (RESTART) is available.
0x1	SD CARD	SD card (or eMMC on Compute Module 4).
0x2	NETWORK	Network boot - See Network boot server tutorial
0x3	RPIBOOT	RPIBOOT - See usbboot
0x4	USB-MSD	USB mass storage boot - See USB mass storage boot
0x5	BCM-USB-MSD	USB 2.0 boot from USB Type C socket (CM4: USB type A socket on CM4IO board). Not available on Raspberry Pi 5.
0x6	NVME	CM4 and Pi 5 only: boot from an NVMe SSD connected to the PCIe interface. See NVMe boot for more details.
0x7	HTTP	HTTP boot over ethernet. See HTTP boot for more details.
0xe	STOP	Stop and display error pattern. A power cycle is required to exit this state.
0xf	RESTART	Restart from the first boot-mode in the BOOT_ORDER field i.e. loop

```
(/wiki/File:PCIe_TO_M.2_HAT%2B_W_6.png)
For more information, please refer to BOOT_ORDER  (https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#raspberry-pi-bootloader-configuration)
```

2. Reboot Raspberry Pi

```
If you find you can't modify it multiple times, please reconnect to the network and then try to modify it (wait for the network to synchronize the time automatically), or modify the file after setting the correct time
```

3. Flash the system to NVME, then connect the NVME to the expansion board, remove the TF card and power it on again

Fan Control

The PI5 fan defaults to starting when the temperature reaches 50 degrees. If you want to control it at other temperatures, you can do so by adding specific content to /boot/firmware/config.txt, for example:

```
dtparam=fan_temp0=36000,fan_temp0_hyst=2000,fan_temp0_speed=90
dtparam=fan_temp1=40000,fan_temp1_hyst=3000,fan_temp1_speed=150
dtparam=fan_temp2=52000,fan_temp2_hyst=4000,fan_temp2_speed=200
dtparam=fan_temp3=58000,fan_temp3_hyst=5000,fan_temp3_speed=255
```

Among which:

```
fan_temp0/1/2/3               Indicates the temperature (36000 means 36℃)

fan_temp0/1/2/3_speed  Indicates the corresponding rotational speed (value up to 255)

fan_temp0/1/2/3_hyst      Indicates the hysteresis temperature
```

For more details, please click here (https://github.com/raspberrypi/linux/blob/7af85d54e39733bb9a236b95ea5ed1ab8277d560/arch/arm/boot/dts/overlays/README#L265)

Notice: There are only 4 temperatures: 0, 1, 2 and 3, and it's not possible to set other temperatures. The hysteresis temperature must not exceed the step range between two temperatures

MIPI

Support dual MIPI, customers can freely choose CSI or DSI connections

The DSI screen is 800x480 resolution screen by default, please refer to the corresponding WIKI for other resolution screens

DSI

```
#Add the following to the config.txt file:
sudo nano /boot/firmware/config.txt
# DSI0
dtoverlay=vc4-kms-dsi-7inch,dsi0
# DSI1
dtoverlay=vc4-kms-dsi-7inch,dsi1
```

CSI

Update the system:

```
sudo rpi-update
```

Add the following to the config.txt file:
sudo nano /boot/firmware/config.txt
Note: A single camera can only connect to MIPI0

Mode	CAM0 setup statement	CAM1 setup statement
OV9281	dtoverlay=ov9281,cam0	dtoverlay=ov9281,cam1
IMX290/IMX327	dtoverlay=imx290,clock-frequency=37125000,cam0	dtoverlay=imx290,clock-frequency=37125000,cam1
IMX378	dtoverlay=imx378,cam0	dtoverlay=imx378,cam1
IMX219	dtoverlay=imx219,cam0	dtoverlay=imx219,cam1
IMX477	dtoverlay=imx477,cam0	dtoverlay=imx477,cam1
IMX296	dtoverlay=imx296,cam0	dtoverlay=imx296,cam1
IMX708	dtoverlay=imx708,cam0	dtoverlay=imx708,cam1

Allow one connection to DSI and one connection to CSI, for example, use IMX219 to connect to MIPI1

For example, if you want to connect a DSI display to MIPI1, add the following to the config.txt file

```
dtoverlay=imx219,cam0
dtoverlay=vc4-kms-dsi-7inch,dsi1
```

Use the shortcut Ctrl+o to save the file, then press Enter

(/wiki/File:CM4-NANO-B-CSI-03.png)

Use the shortcut Ctrl+x to exit the editor
Reboot the device

```
sudo reboot
```

Test Camera

1. Enter the camera detection command, and you can see that the camera has been detected

```
rpicam-hello --list-cameras
```

```
pi@CM4-NANO-B:~ $ libcamera-hello --list-cameras
[0:00:59.527001537] [1165]  INFO Camera camera_manager.cpp:293 libcamera v0.0.0+3424-e68e0f1e
[0:00:59.581096979] [1172]  WARN RPI raspberrypi.cpp:1202 Mismatch between Unicam and CamHelper for e
mbedded data usage!
[0:00:59.581715900] [1172]  INFO RPI raspberrypi.cpp:1317 Registered camera /base/soc/i2c0mux/i2c@0/i
mx219@10 to Unicam device /dev/media3 and ISP device /dev/media0
Available cameras
-----------------
0 : imx219 [3280x2464] (/base/soc/i2c0mux/i2c@0/imx219@10)
    Modes: 'SRGGB10_CSI2P' : 640x480 1640x1232 1920x1080 3280x2464
           'SRGGB8' : 640x480 1640x1232 1920x1080 3280x2464
```

(/wiki/File:CM4-NANO-B-CSI-01.png)

2. Display the camera screen to the desktop

```
rpicam-hello -t 0
```

3. Take a photo

```
rpicam-jpeg -o test.jpg
```

4. Record a 10s video

```
rpicam-vid -t 10s -o test.h264
```

Other commands

Check if the camera is detected

```
rpicam-hello --list-cameras
```

Open the corresponding camera

```
rpicam-hello --camera 1 -t 0
rpicam-hello --camera 0 -t 0
```

Take a photo

```
rpicam-jpeg -o test.jpg
#You can add --camera to specify the camera
```

Real-Time Clock (RTC)

There is no battery by default, and an additional RTC battery is required

The CR/ML1220 can be used to power the RTC

Software Debugging

The default device is /dev/rtc0

Regarding time, by inputting "date" in the command line, you can see the current time. Connecting the Raspberry Pi system to the network will automatically synchronize the time. If the default RTC device is connected and functioning properly, the RTC time will be updated after the automatic network synchronization

sudo hwclock -r Read the RTC time, if there are multiple RTC devices, you can use -f to select the corresponding devices (for example: sudo hwclock -f /dev/rtc1 -r)

Hwclock

System clock -> Hardware clock (RTC)

```
sudo hwclock -w
```

Synchronize hardware clock (RTC) -> System clock

```
sudo hwclock  -s
 #Need to turn off the network, or disable network time synchronization, otherwise it will be changed back
```

Set the hardware clock time (RTC):

```
sudo hwclock --set --date="9/8/2023 16:45:05"
```

View the hardware clock (RTC)

```
sudo hwclock -r
```

Show version information.

```
sudo hwclock --verbose
```

Automated Wakeup

To support a low-power mode for wake-up alarms, add the configuration:

```
sudo -E rpi-eeprom-config --edit
#Add the following 2 lines
POWER_OFF_ON_HALT=1
WAKE_ON_GPIO=0
#Restart the device after adding (if you connect to the serial port log, you can see that t
here are update related logs)
sudo reboot
#You can use the following methods to test the function:
echo +600 | sudo tee /sys/class/rtc/rtc0/wakealarm
sudo halt  or  sudo poweroff
#10 minutes later, it will be awakened and restarted
```

RTC Battery Charging

Note: Before adding this, make sure your RTC battery allows charging and check the maximum allowable voltage

```
sudo nano /boot/firmware/config.txt
#Add
dtparam=rtc_bbat_vchg=3000000
#Among these, 3,000,000 represents the maximum voltage. Charging will stop when it reaches
3V, and trickle charging is initiated when the voltage is below 3V
```

USB

There are two USB3.2 Gen2 port onboard, with a current limit of 2A

2500M Ethernet Port (ETH1)

RJ45 2500M network port, supports 10M / 100M / 1000M / 2500M network access

Using RTL8156 scheme

The Raspberry Pi OS supports drive-free, which may not be available for third-party systems or cannot achieve 2500M speed

4G/5G

The board itself does not support 4G/5G and needs to be connected to the module through the M.2 B KEY interface. The M.2 B KEY only has USB 3.0 channels and does not support PCIe devices

Connect 4G/5G module and SIM card

If you need to turn off the 4G/5G module, you can control it using GPIO6 (BCM encoding 6).
A high level output on GPIO6 turns off the module, while a low level output turns it on
It takes a certain amount of time (about 30 seconds) to turn off or on the module

M.2 4G/5G Network Card

M.2 Status LED status description:

STA	NET	Status
Steady on	**Off**	**Shutdown or booting up**
Steady on	**Steady on**	**Searching for the network**
Steady on	**Flickering**	**Connected, working normally**
Off	**Flickering/Steady on**	**Shutting down**

Before configuration, please confirm that the module has been powered on
For 5G, please refer to 5G configuration (https://www.waveshare.com/wiki/SIM8200EA-M2_5G_HAT)

4G Configuration

```
sudo apt-get install minicom
sudo minicom -D /dev/ttyUSB2
#Enter the following command:
AT+CUSBPIDSWITCH=9011,1,1
#Return OK to proceed
#Then wait for the network card to restart
#This command only needs to be set once; the next time it powers on, it will default to t
his mode
#If unable to obtain the USB0 network card, execute:
sudo dhclient -v usb0
```

For RNDIS dial-up, please refer to: RNDIS Dial-up Internet (https://www.waveshare.com/wiki/Raspberry_Pi_RNDIS_dial-up_Internet_access)

After performing the steps above normally, it will detect the USB0 network card (if you are not connected to other USB network cards)

If you are using an IoT card, such as a mobile IoT card, and have successfully registered on the network; however, dial-up internet access fails and you cannot ping, you can try one of the following AT commands to select the optimal frequency band:

```
AT+CNBP=0x0002000000400183,0x000001E000000000,0x0000000000000021
AT+CNBP=0x0002000000400180,0x480000000000000000000000000000000000000000000042000001E20000
0095,0x0000000000000021
```

AT Command

If unable to connect to the network, you can check the status with the command AT

```
sudo apt-get install minicom
sudo minicom -D /dev/ttyUSB2
```

Common AT Commands

The following AT commands are general for 4G/5G modules

Command	Description	Return value
AT	AT Test Command	OK
ATE	ATE1 sets echo ATE0 closes echo	OK
AT+CGMI	Query module manufacturer	OK
AT+CGMM	Query module model	OK
AT+CGSN	Query product serial number	OK
AT+CSUB	Query module version and chip	OK
AT+CGMR	Query the firmware version serial number	OK
AT+IPREX	Set the module hardware serial port baud rate	+IPREX: OK
AT+CRESET	Reset module	OK
AT+CSQ	Check network signal quality, return signal value	+CSQ: 17,99 OK
AT+CPIN?	Check SIM card status, return READY, indicating that the SIM card can be recognized normally	+CPIN: READY
AT+COPS?	Query the current operator, the operator information will be returned after normal networking	+COPS: OK
AT+CREG?	Query network registration status	+CREG: OK
AT+CPSI?	Query UE system information	
AT+CNMP	Network mode selection command: 2: Automatic 13: GSM only 38: LTE only 48: Any modes but LTE	OK

For more AT commands, please refer to: AT_Command_V2.00 (https://files.waveshare.com/wiki/CM5-DUAL-ETH-BASE/SIM7500_SIM7600_Series_AT_Command_Manual_V2.00.pdf)
For more documents, please refer to: SIMCom (https://en.simcom.com/product/SIM7600X-H.html)

Resources

Datasheets and Schematic Diagram

CM5 Core board datasheet (https://datasheets.raspberrypi.com/cm5/cm5-datasheet.pdf)
CM5 Core board 3D (https://pip.raspberrypi.com/categories/1096-design-files)
CM5 Core introduction (https://datasheets.raspberrypi.com/cm5/cm5-product-brief.pdf)
CM5-DUAL-ETH-4G/5G-BASE Schematic (https://files.waveshare.com/wiki/CM5-DUAL-ETH-BASE/CM5-DUAL-ETH-4G_5G-BASE-Sch.pdf)
CM5-DUAL-ETH-4G/5G-BASE-3D (https://files.waveshare.com/wiki/CM5-DUAL-ETH-BASE/CM5-DUAL-ETH-4G_5G-BASE-3D.zip)

Related Links

FAQ

Question: Can the old versions of the Raspberry Pi operating system be used with CM5?

Answer:

CM5 requires the latest version of Raspberry Pi OS Bookworm (2024-11-19 or later).

Support

Technical Support

If you need technical support or have any feedback/review, please click the **Submit Now** button to submit a ticket, Our support team will check and reply to you within 1 to 2 working days. Please be patient as we make every effort to help you to resolve the issue.
Working Time: 9 AM - 6 PM GMT+8 (Monday to Friday)

Submit Now (https://service.waveshare.com/)