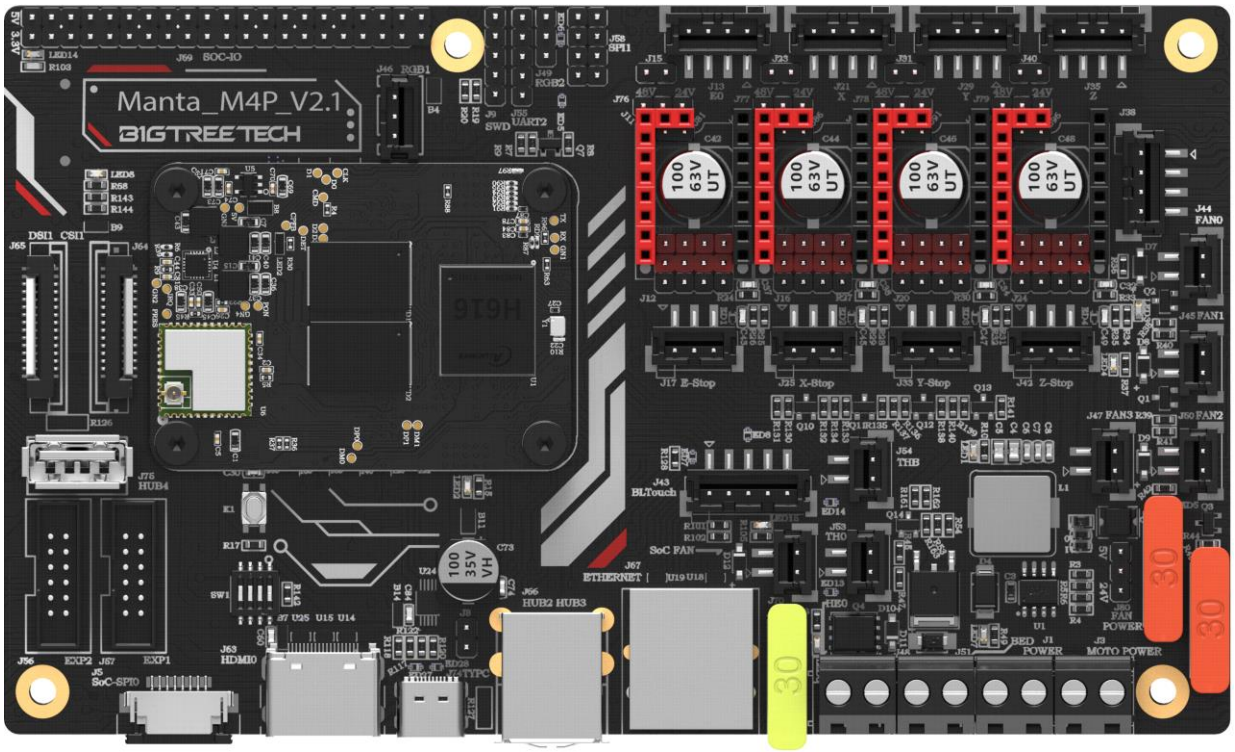
Shenzhen Big Tree Technology Co., Ltd.

BIGTREETECH

BIGTREETECH M4P & CB1

User Manual



Contents

Contents 2
Revision History 4
1. Brief Introduction 5
1.1 Main Features 5
1.2 Basic Parameters 6
1.3 Product Dimension 7
2. Peripheral Interface 8
2.1 Interface Diagram 8
2.1 Pin Out 8
3. Interface Instruction 9
3.1 Installing the Core Board 9
3.2 40 pin GPIO 9
3.3 Type-C 10
3.4 Stepper Driver 10
3.4.1 Normal STEP/DIR(STANDALONE) Mode 10
3.4.2 UART Mode of TMC Driver 12
3.4.3 SPI Mode of TMC Driver 12
3.4.4 DIAG(Sensorless Homing) of TMC Driver 12
3.4.5 Stepper Driver Voltage Selection 13
3.5 BLTouch Wiring 14
3.6 EXP1+EXP2 and LCD Screen Wiring 14
3.7 RGB Wiring 15
3.8 DSI/CSI Wiring 15
3.9 SPI Display Wiring 16
3.10 ADXL345 Accelerometer 16
4. Raspberry PI CM4 Setup steps 17
4.1 Download OS Image 17

4.2 Download and Install Raspberry Pi Imager 17
4.3 Write OS Image 18
4.3.1 CM4 LITE Version (Micro SD Card) 18
4.3.2 CM4 eMMC Version(Note: eMMC version will not tun the system from the Micro SD card.) 21
4.4. System Settings (CM4) 22
4.4.1 USB 2.0 Hub Ports 22
4.4.2 DSI1 Display Interface 22
4.4.3 CSI1 Camera 22
5. BIGTREETECH CB1 Setup steps 23
5.1 Download OS Image 23
5.2 Download and Install Raspberry Pi Imager 23
5.3 Write OS Image 23
5.4 WIFI Setting 25
6. Configure the motherboard 27
6.1 ssh connect to device 27
6.2 Compile firmware 29
6.3 Firmware update 30
6.3.1 Update using SD Card 30
6.3.2 Update using DFU 30
6.4 Configure Klipper 31
7. Precautions 32

Revision History

Revision	Description	Date
01.00	1st Draft	2022/06/01
01.01	Fix 40 pin GPIO	2022/06/20
01.02	1. More detailed CB1 dimension 2. Add wiring of M4P + expansion module 3. Add MCU configuration, system settings, etc…	2022/06/27
01.03	1. Fix M4P CSI/DSI wiring diagram 2. Add ADXL345 wiring diagram 3. Separate CB1 related into separate manual	2022/12/22

1. Brief Introduction

BIGTREETECH CB1 is an alternative to Raspberry Pi CM4, which is currently out of stock. BIGTREETECH M4P is a 4-axis motherboard using a CM4 BTB header, which can work with CB1 or CM4 perfectly.

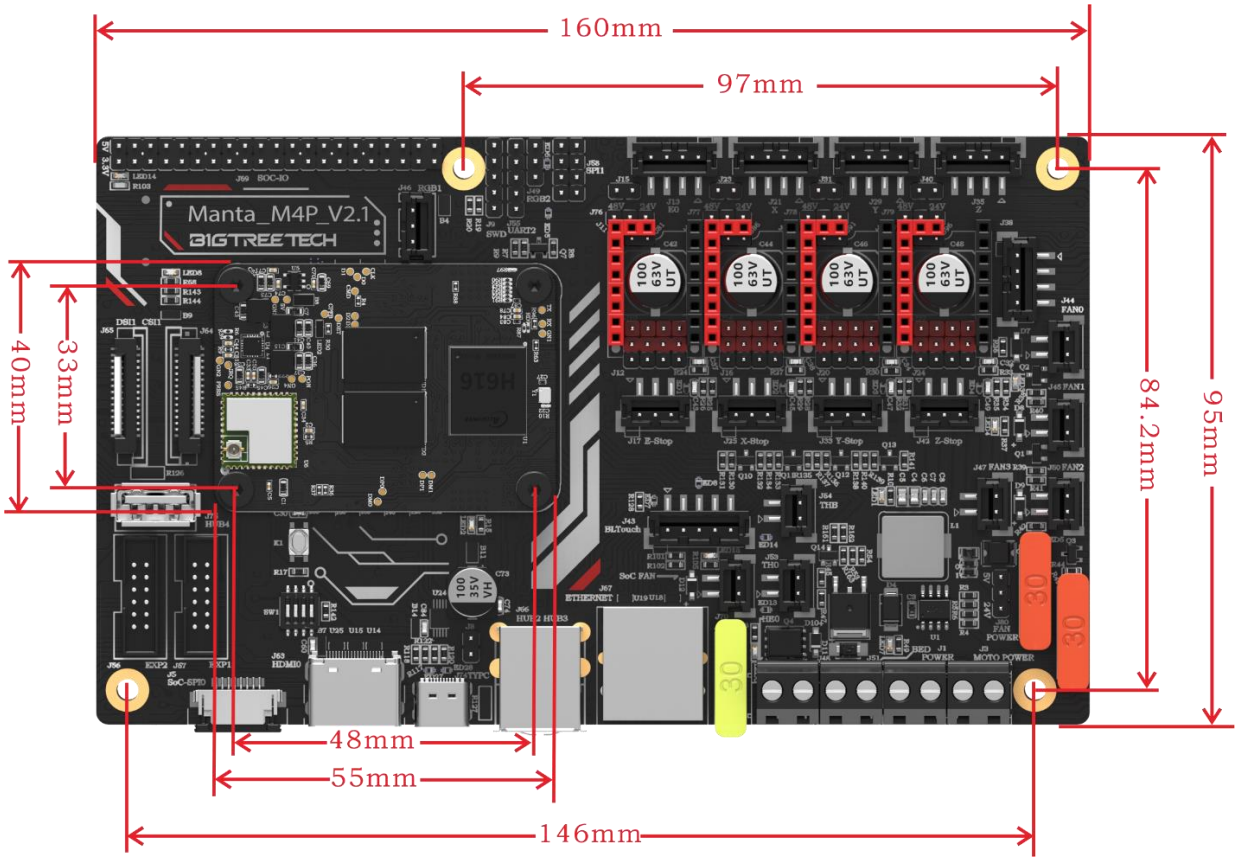
1.1 Main Features

1. DSI1, CSI1 interface (for CM4)
2. Gigabit Ethernet interface (1000M for CM4, 100M for CB1)
3. 3 USB 2.0 ports
4. Equipping the ESD protection chip on the USB and Ethernet ports to prevent being broken down by the static electricity
5. When working with Raspberry Pi CM4, its 40pin pin header has the same function as that of Raspberry Pi(Custom IO for CB1)
6. Using a BTB board-to-board connection, which can be further reinforced with screws, perfectly compatible with CB1 or Raspberry Pi CM4
7. The MCU adopts STM32G0B0RE 32-bit ARM Cortex-M0+ @64MHz chip
8. The power chip adopts TPS5450-5A, which supports DC12/24V power input, the output current of the chip is up to 5A, and the peak value can reach 6A, which perfectly supports the power supply of the core board
9. The protection circuit of the thermistor part prevents the main control chip from burning due to leakage of the heated bed or heater cartridge
10. In CNC fan ports: FAN0, FAN1, and FAN2, a 24V (DCIN) or 5V power supply can be selected with a jumper cap (Note: the voltage of the three CNC fans should be the same, and cannot be set to different voltages individually)
11. MCU firmware can be upgraded through SD card, or through DFU with Klipper's make flash command
12. On-board TMC-driven SPI and UART working modes, on-board DIAG function pins, can be used by simply plugging and unplugging the jumper cap
13. Support filament runout detection, BLTouch, RGB lights...
14. Adopt replaceable fuse for easy replacement

1.2 Basic Parameters

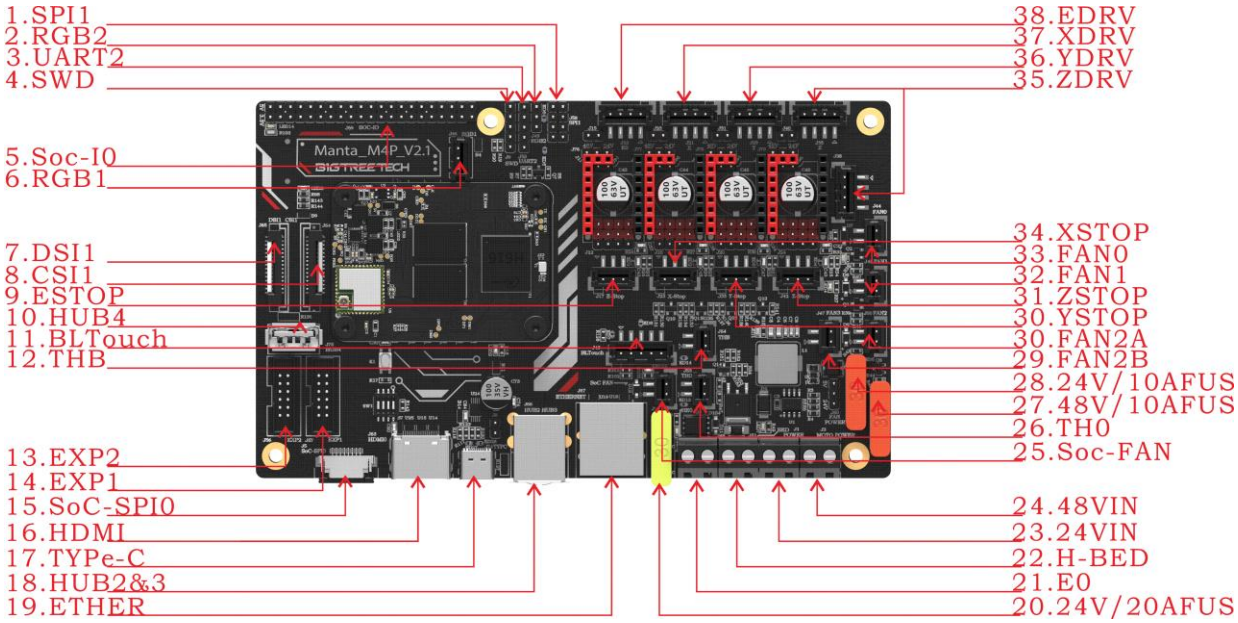
1. Product Size: 160 x 95mm
2. Installation Size: 146 x 84.2mm; 97 x 84.2mm
3. Core Board Installation Size: 33 x 48mm
4. The maximum output current of the heated bed port: 10A
5. The maximum output current of the heater cartridge port: 6A
6. Fan Port: Three for CNC Fan(24V/5V Voltage Selectable), One SoC Fan(Voltage not Selectable)
7. The maximum output current of the fan port:1A
8. Total current for heater cartridge + driver + fan: ＜20A
9. Extended Interface: BLTouch(Servos, Probe), Fil-DET, 2 * RGB
10. Motor Driver: Support TMC5160, TMC2209, TMC2225, TMC2226, TMC2208, TMC2130, ST820, LV8729, DRV8825, A4988...
11. Driver Working Mode Support: SPI, UART, STEP/DIR
12. Motor Drive Interface: X, Y, Z(Dual Z-axis), E0, a total of four.
13. Temperature Sensor Interface: 2-way 100K NTC
14. Display Screen: RepRapDiscount EXP-1 + EXP-2

1.3 Product Dimension

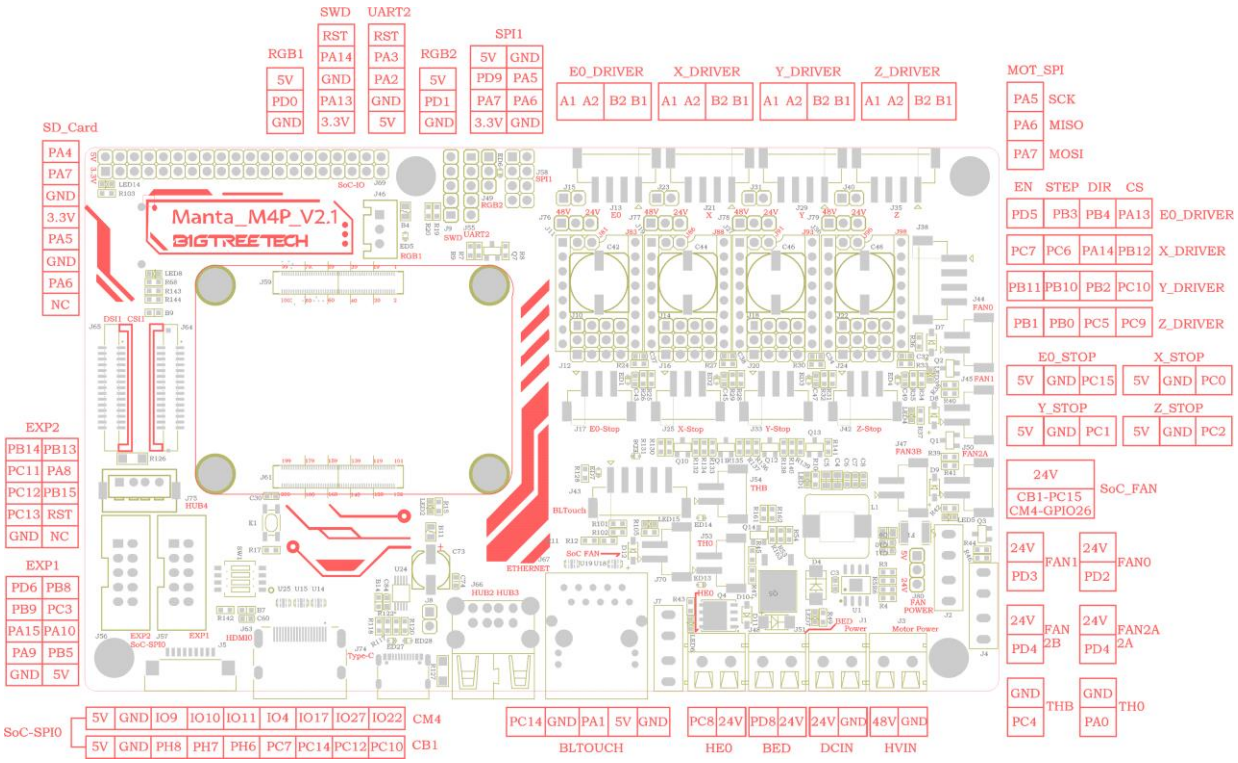


2. Peripheral Interface

2.1 Interface Diagram



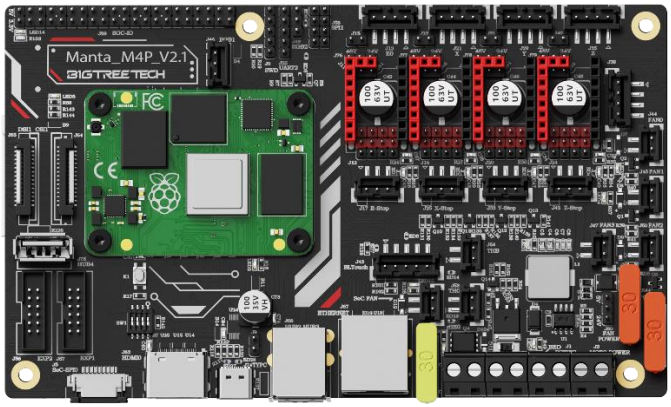
2.1 Pin Out



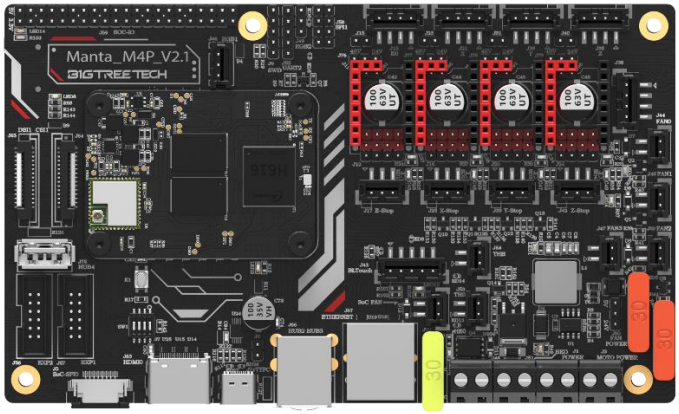
3. Interface Instruction

3.1 Installing the Core Board

M4P+CM4：Pay attention to the direction, as shown below.

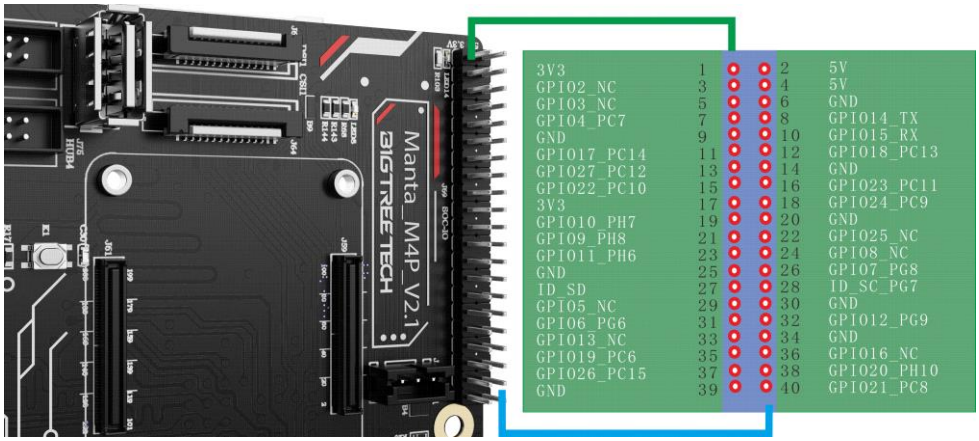


M4P+CM4：Pay attention to the direction, as shown below.



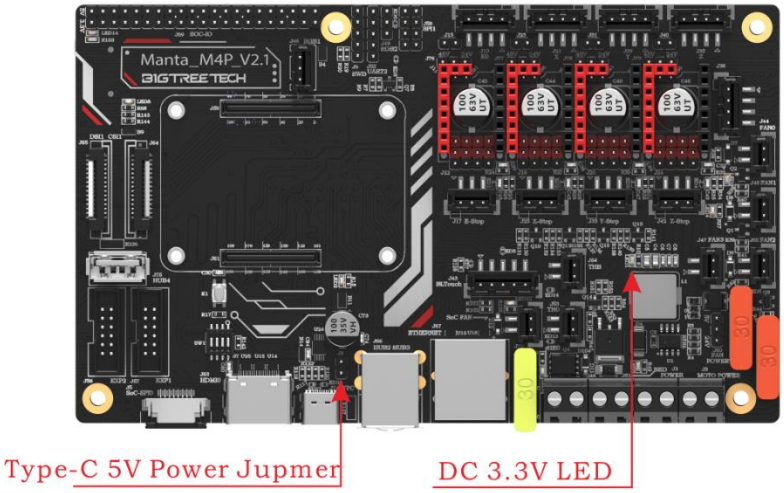
3.2 40 pin GPIO

When working with CM4, the pin arrangement of 40 Pin GPIO is exactly the same as that of Raspberry Pi. When working with CB1, it is a custom IO arrangement, as shown in the figure below, the 'GPIO4' in front of '_' is the IO of CM4, and the latter 'PC7' is the IO of CB1.



3.3 Type-C

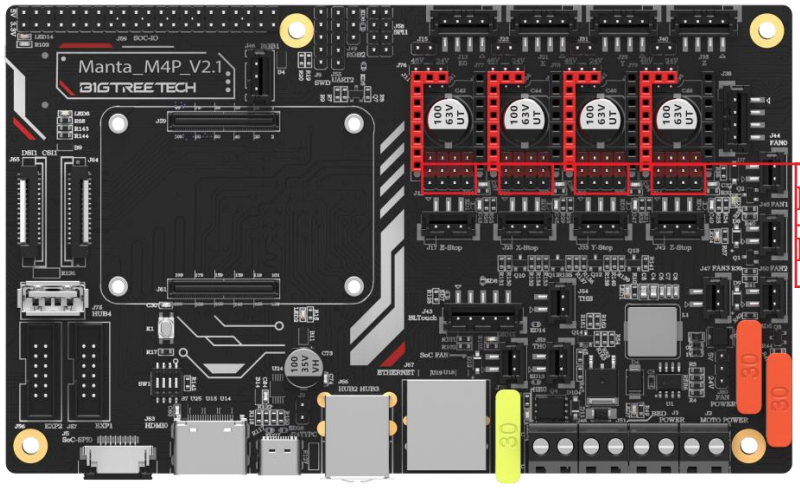
After the M4P is powered on, the red LED1 on the lower right side of the motherboard will light up, indicating that the power supply is normal. The J8 on the middle of the board is the power selection terminal, it needs to be short circuited only when the type-C USB is used to supply power to the motherboard or the USB is used to supply power externally. The signal of type-C is connected to the SoC, Only used when writing OS image for CM4 eMMC version.



3.4 Stepper Driver

3.4.1 Normal STEP/DIR(STANDALONE) Mode

For example, A4988, DRV8825, LV8729, ST820...use the jumper cap to short MS0-MS2 according to the driver subdivision table.



DRV8825	RST/SLP	MS0	MS1	MS2
ELSE		MS1	MS2	MS3

Note: If using A4988or DRV8825, RST and SLP must be shorted with jumper caps for normal operation.

Driver chips	MS1	MS2	MS3	Microsteps	Excitation Mode
A4988 16 microstep max 35V 2A	L	L	L	Full Step	2 Phase
	H	L	L	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	H	H	L	1/8	2W1-2 Phase
	H	H	H	1/16	4W1-2 Phase
Current R_S=0.1Ω	$I_{TripMAX} = \frac{V_{REF}}{8 * R_S}$				

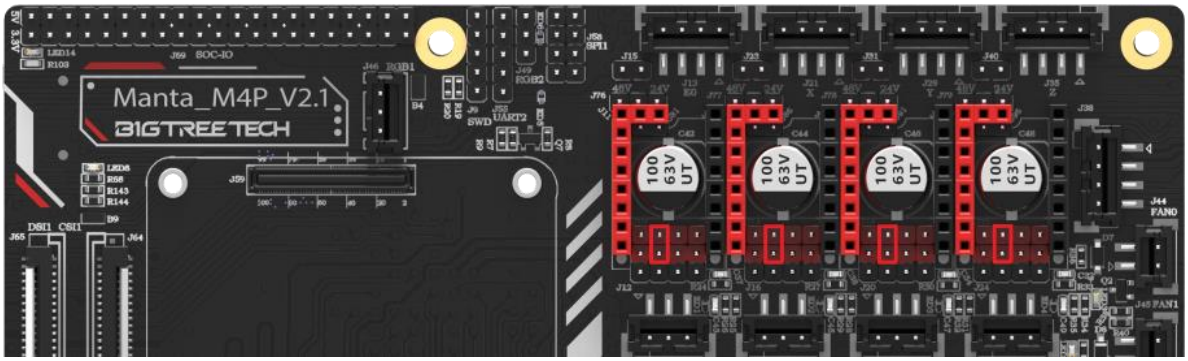
Driver chips	MODE2	MODE1	MODE0	Microsteps	Excitation Mode
DRV8825 Maximum 32microsteps 8.2V-45V 2.5A at 24V T=25℃	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	
	H	L	L	1/16	
	H	L	H	1/32	
	H	H	L	1/32	
	H	H	H	1/32	
Current R_{ISENSE}=0.1Ω	$I_{CHOP} = \frac{V_{(xREF)}}{5 * R_{ISENSE}}$				

Driver chips	MD3	MD2	MD1	Microsteps	Excitation Mode
LV8729 Maximum 128microsteps 36V 1.8A	L	L	L	Full Step	2 Phase
	L	L	H	1/2	1-2 Phase
	L	H	L	1/4	W1-2 Phase
	L	H	H	1/8	2W1-2 Phase
	H	L	L	1/16	4W1-2 Phase
	H	L	H	1/32	8W1-2 Phase
	H	H	L	1/64	16W1-2 Phase
	H	H	H	1/128	32W1-2 Phase
Current RF1=0.22Ω	$I_{OUT} = (V_{REF} / 5) / RF1$				

Driver chips	MS3	MS2	MS1	Microsteps
ST820 Maximum 256microsteps 45V 1.5A	L	L	L	Full Step
	L	L	H	1/2
	L	H	L	1/4
	L	H	H	1/8
	H	L	L	1/16
	H	L	H	1/32
	H	H	L	1/128
	H	H	H	1/256
Current Rs=0.15Ω	$I_{peak} = \frac{V_{REF} * V_{DD}}{5 * R_S}$			

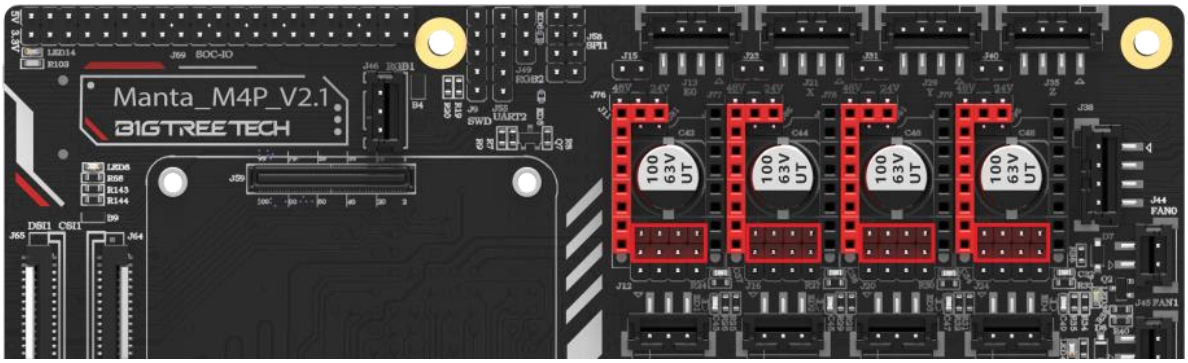
3.4.2 UART Mode of TMC Driver

For example, TMC2208, TMC2209, TMC2225... Use a jumper cap for each to connect the position of the red box in the figure, and the subdivision and driver current is set by firmware.



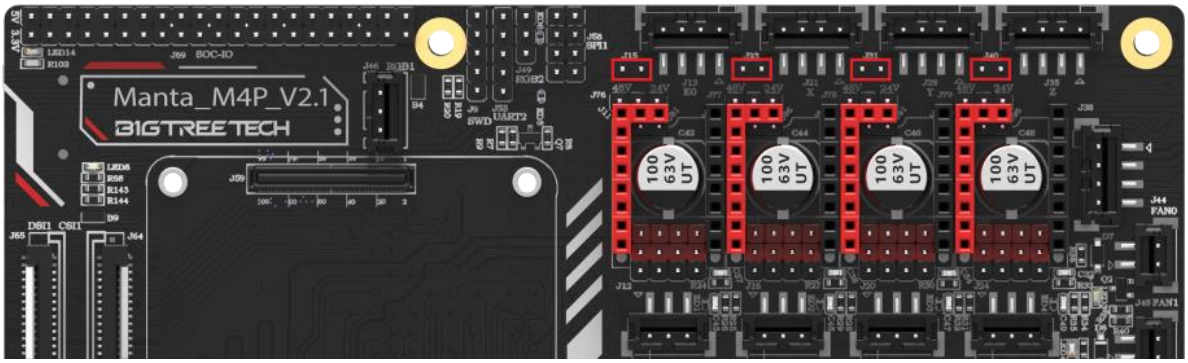
3.4.3 SPI Mode of TMC Driver

For example, TMC2130, TMC5160, TMC5161... Use 4 jumper caps for each to connect the position of the red box in the figure, and the subdivision and driver current is set by firmware.



3.4.4 DIAG(Sensorless Homing) of TMC Driver

As shown in the figure, plug the jumper cap when using the Sensorless Homing function, and leave it unplugged when it is not used. There is no need to cut the DIAG pin of the driver.

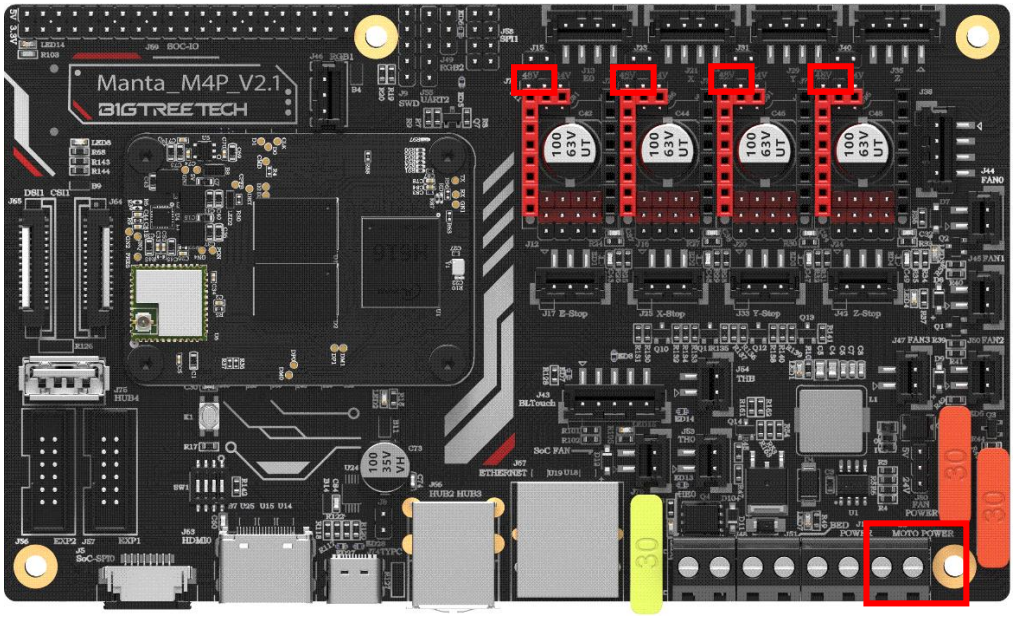


3.4.5 Stepper Driver Voltage Selection

The power supply of each driver can be set by the jumper. When the jumper is inserted into the left side, the independent MOTOR POWER port is used for driver power, and the supported voltage up to 56V. When the jumper is inserted into the right side, the main POWER port is used for driver power, and the 12/24v voltage is supported.

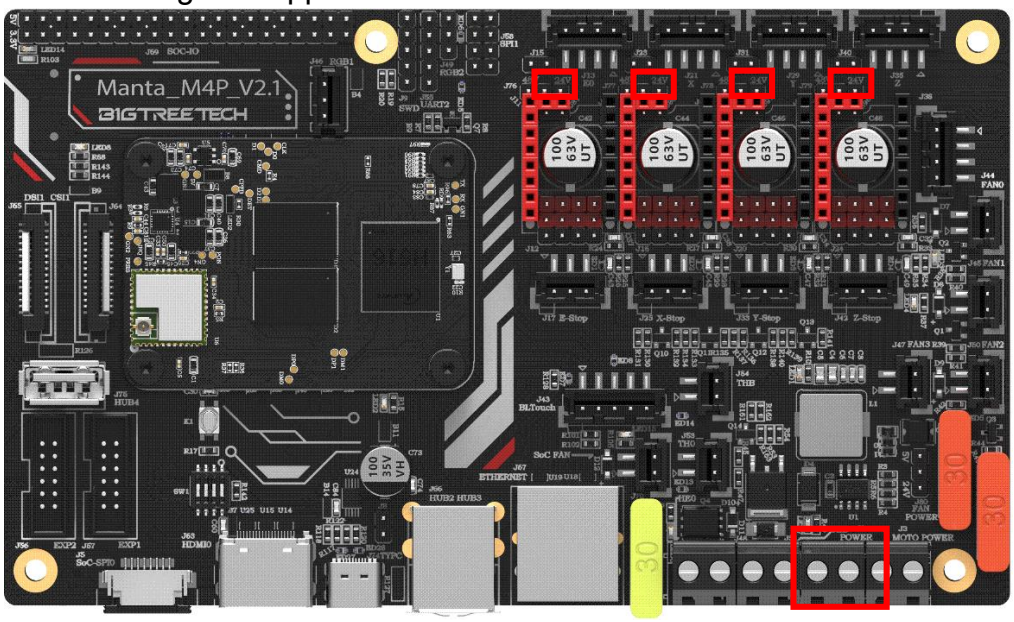
3.4.5.1 Driver independent power supply

The jumper is inserted into the left side and powered by the MOTOR POWER port. the supported voltage up to 56V.

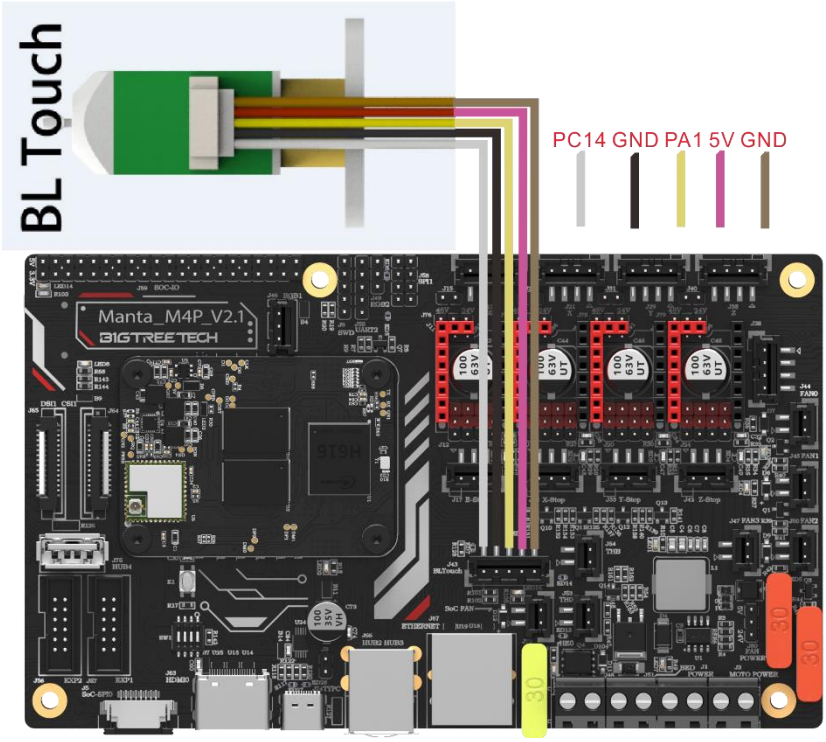


3.4.5.2 Main power supply

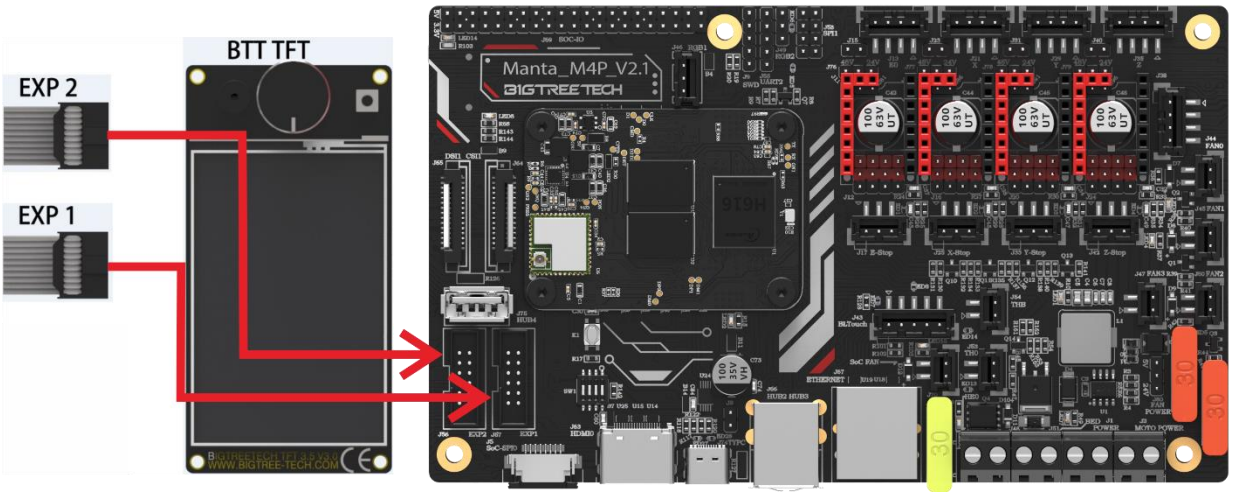
The jumper is inserted into the right side and powered by the main POWER port. the 12/24v voltage is supported.



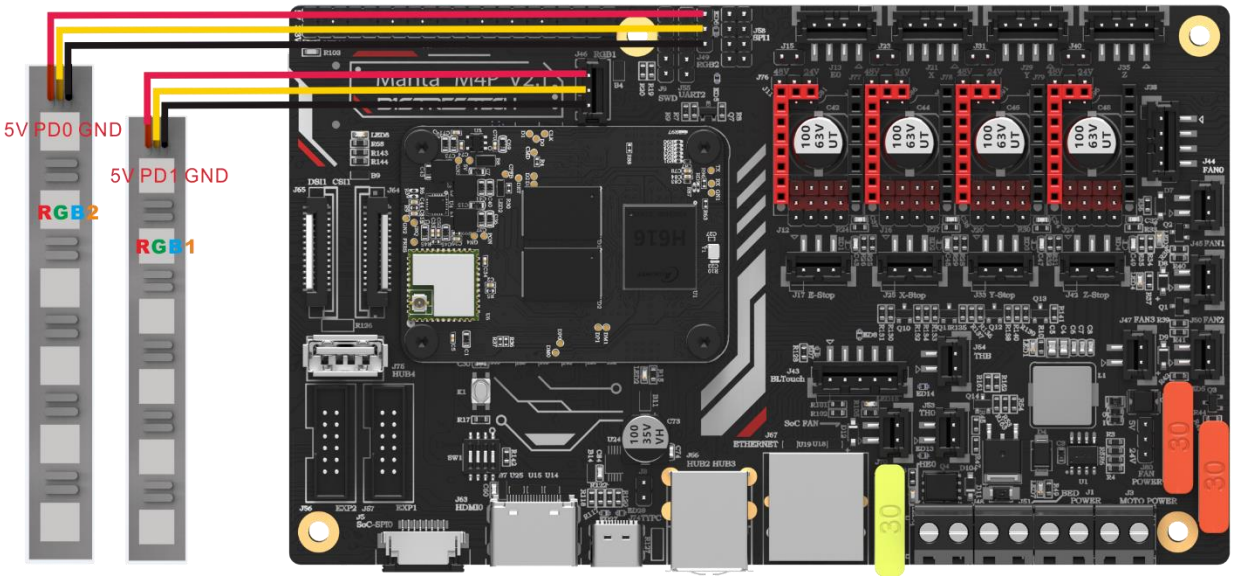
3.5 BLTouch Wiring



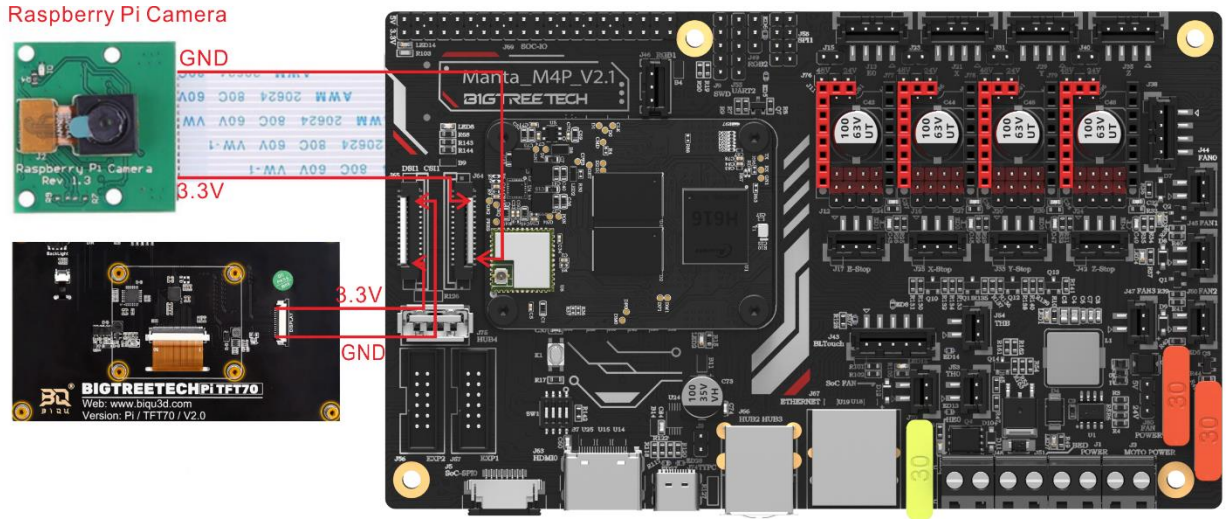
3.6 EXP1+EXP2 and LCD Screen Wiring



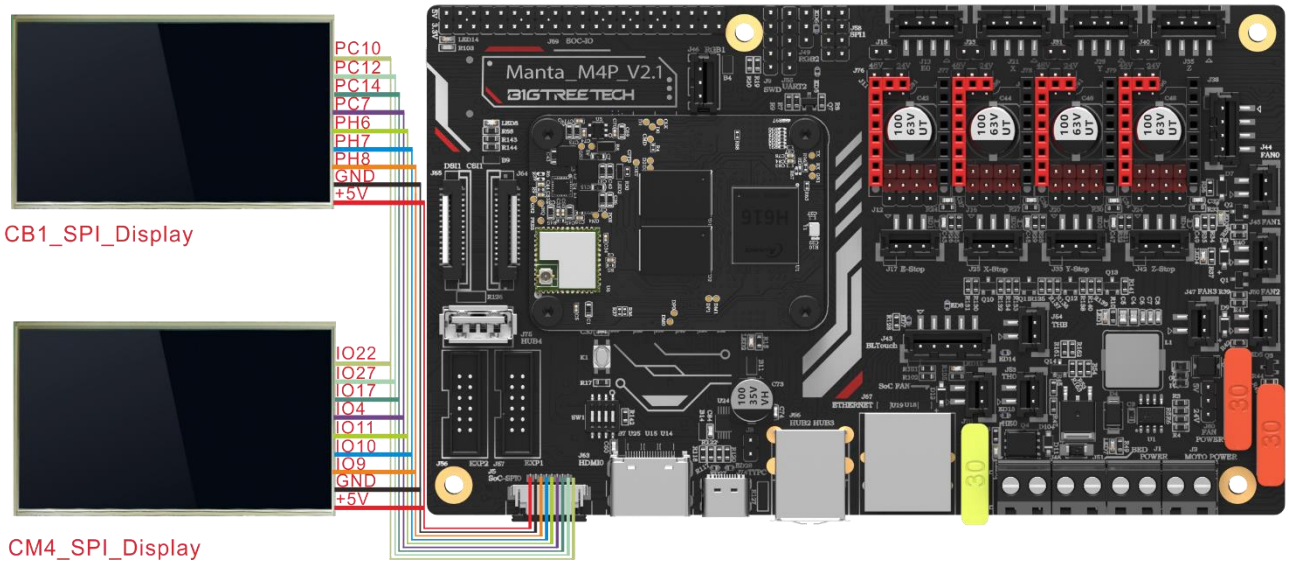
3.7 RGB Wiring



3.8 DSI/CSI Wiring

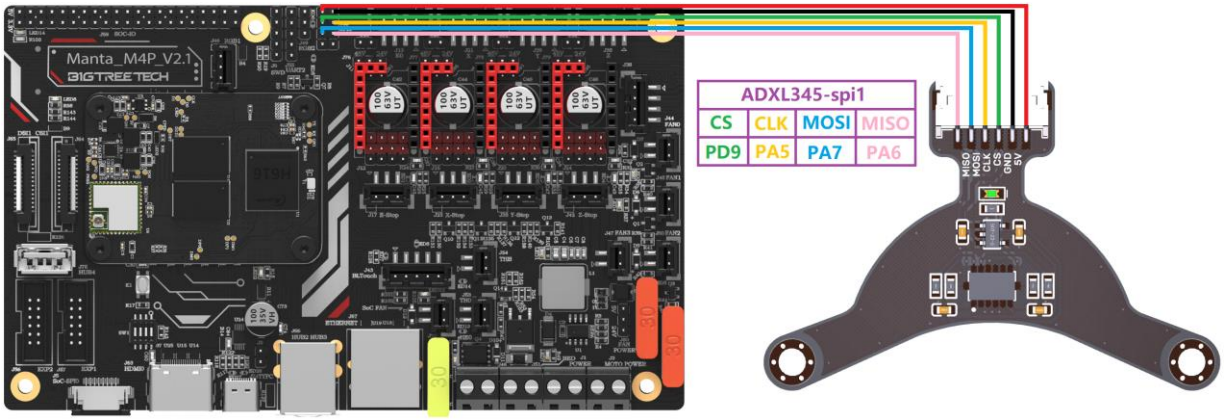


3.9 SPI Display Wiring



3.10 ADXL345 Accelerometer

Refer to here: https://www.klipper3d.org/Measuring_Resonances.html, We can refer to the following wiring and configuration when connecting to the M4P motherboard

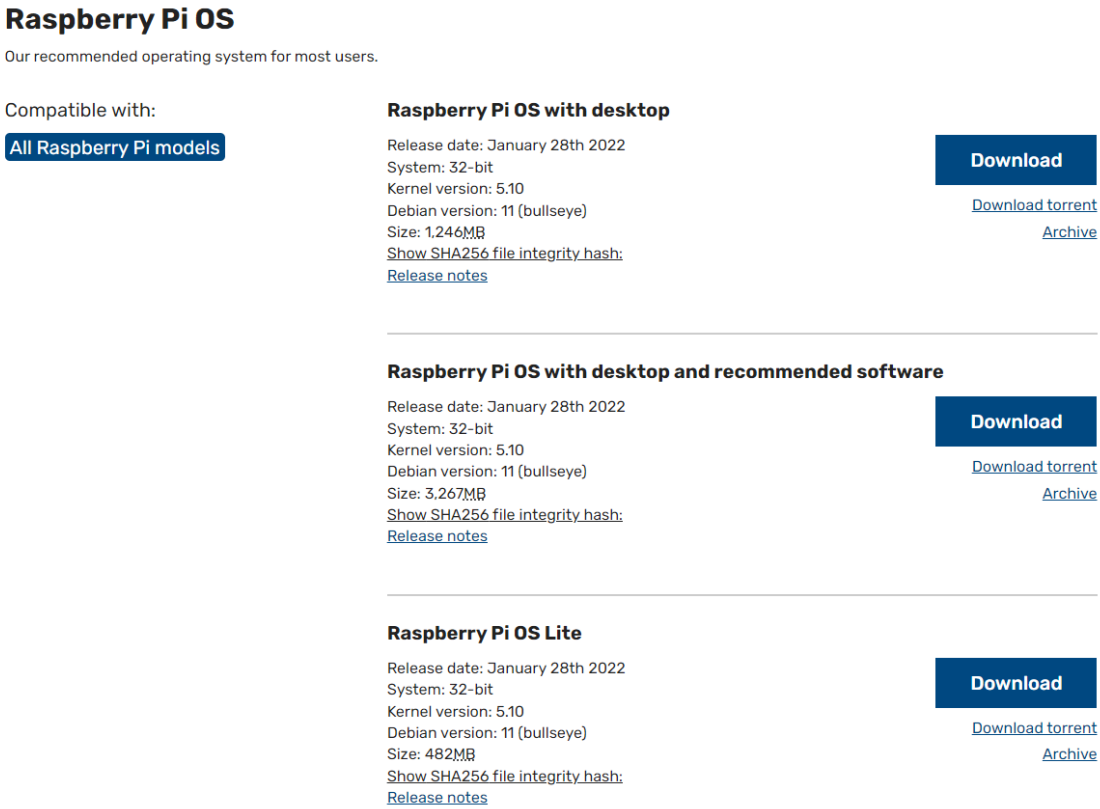



```
[adxl345]
cs_pin: PD9
spi_bus: spi1
#spi_software_sclk_pin: PA5
#spi_software_mosi_pin: PA7
#spi_software_miso_pin: PA6
```

4. Raspberry PI CM4 Setup steps

4.1 Download OS Image

If CM4 core board is used, You can directly download the images of Fluidd or Mainsail, also can download the OS image from the official website of Raspberry Pi
Fluidd: https://github.com/fluidd-core/FluiddPI/releases
Mainsail: https://github.com/mainsail-crew/MainsailOS/releases
Raspberry Pi official OS: https://www.raspberrypi.com/software/operating-systems
(CM4 needs to refer to the following system settings to enable the system's USB, DSI and other interfaces, whose operation is slightly different from the standard Raspberry Pi 3B, 4B, etc.)



4.2 Download and Install Raspberry Pi Imager

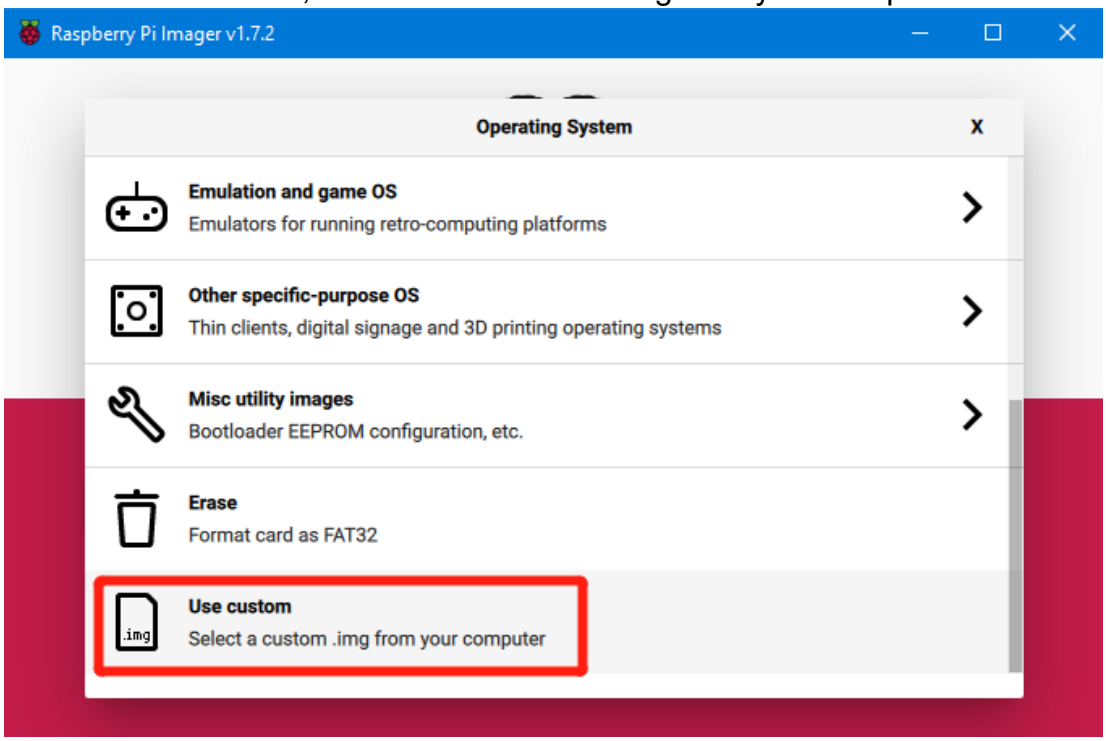
Install the official Raspberry Pi Imager: https://www.raspberrypi.com/software/

4.3 Write OS Image

4.3.1 CM4 LITE Version (Micro SD Card)

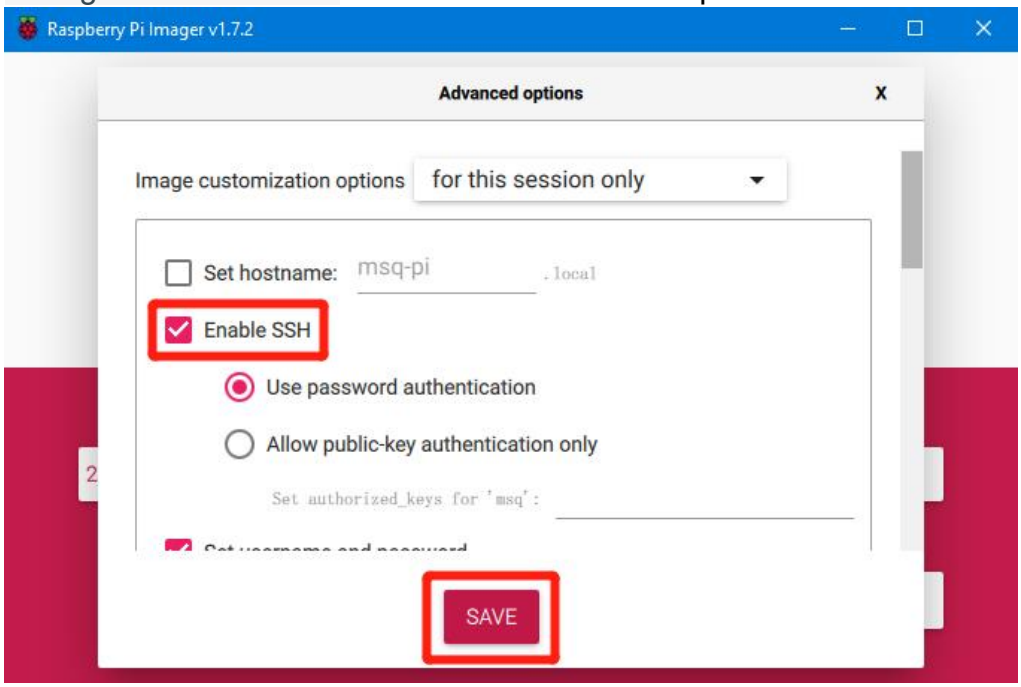
1. Plug the Micro SD card into the computer via a card reader.
2. Select Operating System.

3. Select "Use Custom", then select a custom.img from your computer.



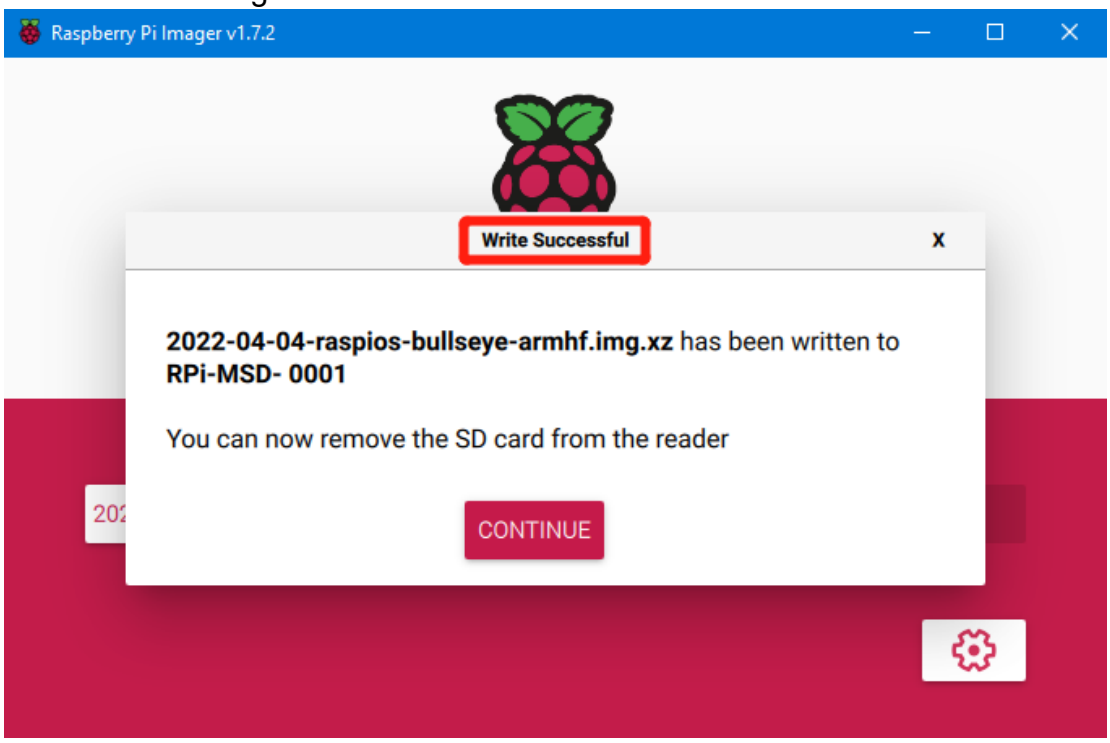
4. Click the setting icon in the lower right corner

5. “Enable SSH”and click“SAVE”， There are other features that can be set in this menu. Please modify them according to your own needs. Details are as follows：
Set hostname: raspberrypi.local //Custom hostname Default:raspberrypi.local
Enable SSH
Set username and password // Custom username and password，Default username: pi password：raspberry
Configure wireless LAN // Custom the SSID and password of WLAN



6. Select the Micro SD card and click "WRITE" (Writing the image will format the Micro SD card. Be careful not to select the wrong storage device, otherwise, the data will be formatted).

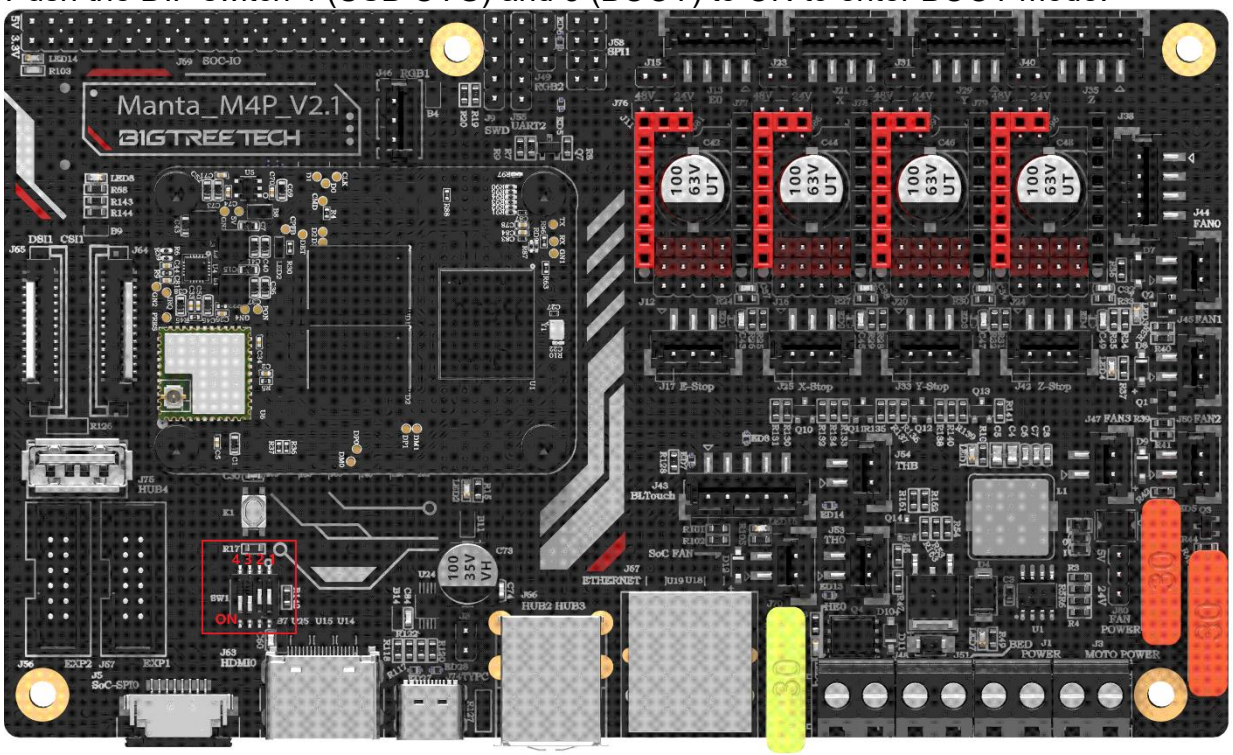
7. Wait for the writing to finish.



4.3.2 CM4 eMMC Version(Note: eMMC version will not tun the system from the Micro SD card.)

1. Install rpiboot
   For Windows:
   http://github.com/raspberrypi/usbboot/raw/master/win32/rpiboot_setup.exe
   For Mac and Linux:
   https://github.com/raspberrypi/usbboot#building

2. Push the DIP switch 4 (USB OTG) and 3 (BOOT) to ON to enter BOOT mode.



3. Plug the Type-C into the USB port of the computer(in order to avoid problems caused by the insufficient USB power supply of the computer, it is best to use an external 24V power supply to power the motherboard). Run `sudo ./rpiboot`(Mac/Linux) or rpiboot.exe on Windows, then the eMMC of CM4 will be recognized as a mass storage device by the computer (if rpiboot reports an error at this time, you can try to re-plug the USB).

4. The step of using the Raspberry Pi Imager to write the OS image is exactly the same as the LITE version. Note: the SSH function should also be enabled.

5. When the writing is completed, push the DIP switch 4 (USB OTG) and 3 (BOOT) back to OFF after power off, and power on again to enter the normal working mode.

4.4. System Settings (CM4)

4.4.1 USB 2.0 Hub Ports

M4P is designed with a USB 2.0 Hub, in order to save power consumption, the USB port of CM4 is disabled by default. If you want to enable it, you need to add the following content to the config.txt file:
`dtoverlay=dwc2,dr_mode=host`

4.4.2 DSI1 Display Interface

The default display interface is HDMI. The onboard DSI port of M4P uses the DSI1 interface. You need to download the DSI1 driver and enter the following sentence in the command line:
`sudo wget https://datasheets.raspberrypi.com/cmio/dt-blob-disp1-cam1.bin -O /boot/dt-blob.bin`
After downloading this driver and restarting, the screen of DSI1 will work normally. If you want to use the HDMI interface, you need to delete the downloaded `/boot/dt-blob.bin` driver and restart, then the HDMI can output normally.

4.4.3 CSI1 Camera

The DSI1 driver downloaded in **4.4.2 DSI1 Display Interface** also includes the CSI1 driver. If you just want to install the CSI1 driver, not DSI1, please find the driver you want to use at https://datasheets.raspberrypi.com/licence.html and download it in the boot folder of CM4 and rename it to `dt-blob.bin`, and then refer to the settings here.
https://projects.raspberrypi.org/en/projects/getting-started-with-picamera/

5. BIGTREETECH CB1 Setup steps

5.1 Download OS Image

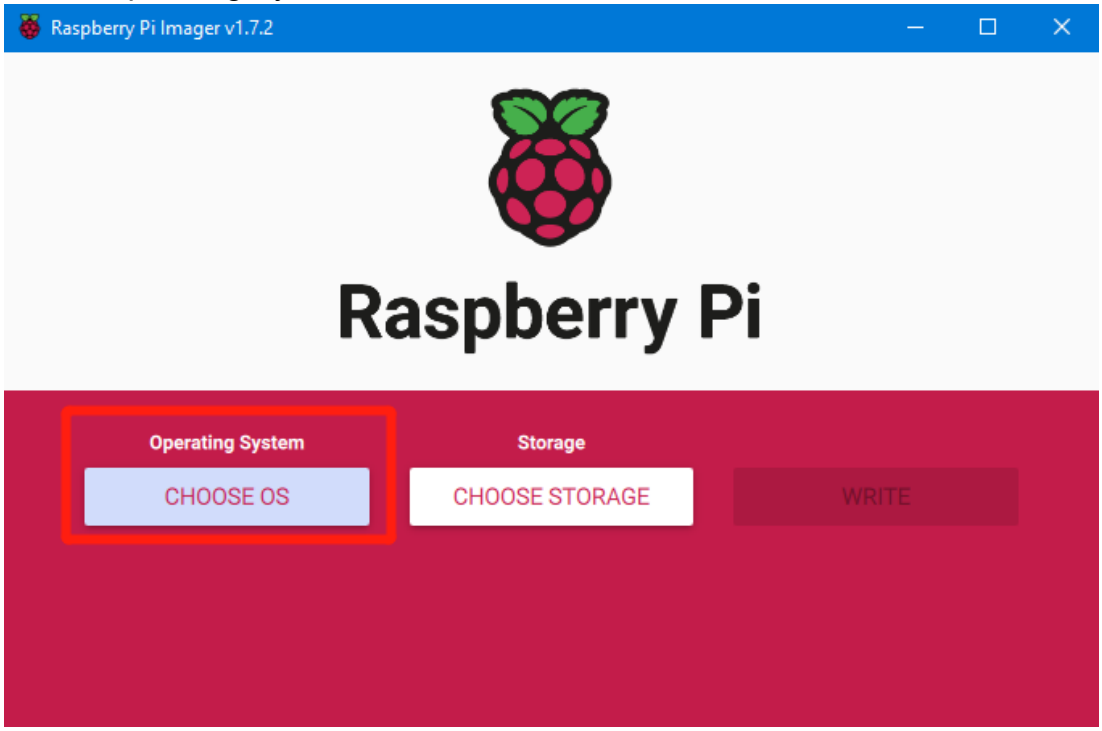
If BIGTREETECH CB1 core board is used, You can only download and install the system image provided by BIGTREETECH:
https://github.com/bigtreetech/CB1/releases

5.2 Download and Install Raspberry Pi Imager

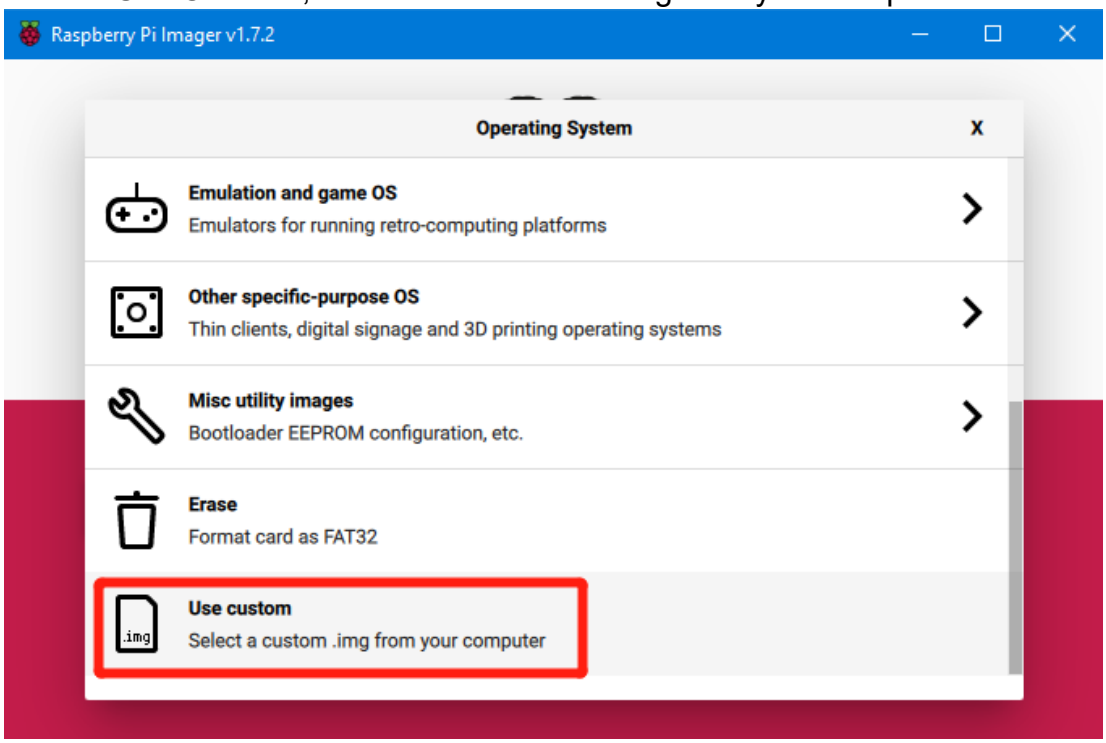
Install the official Raspberry Pi Imager: https://www.raspberrypi.com/software/
The system image of CB1 can also be written with this software.

5.3 Write OS Image

1. Plug the Micro SD card into the computer via a card reader.
2. Select Operating System.

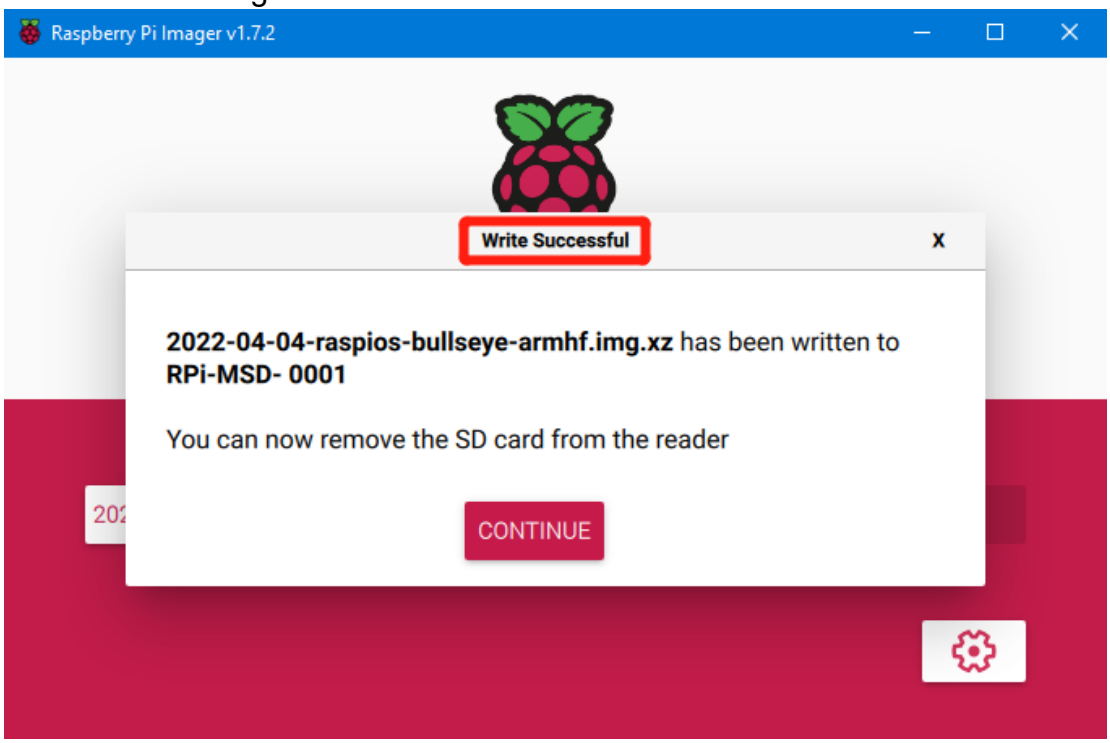


3. Select "Use Custom", then select a custom.img from your computer.



4. Select the Micro SD card and click "WRITE" (Writing the image will format the Micro SD card. Be careful not to select the wrong storage device, otherwise, the data will be formatted).

5. Wait for the writing to finish.

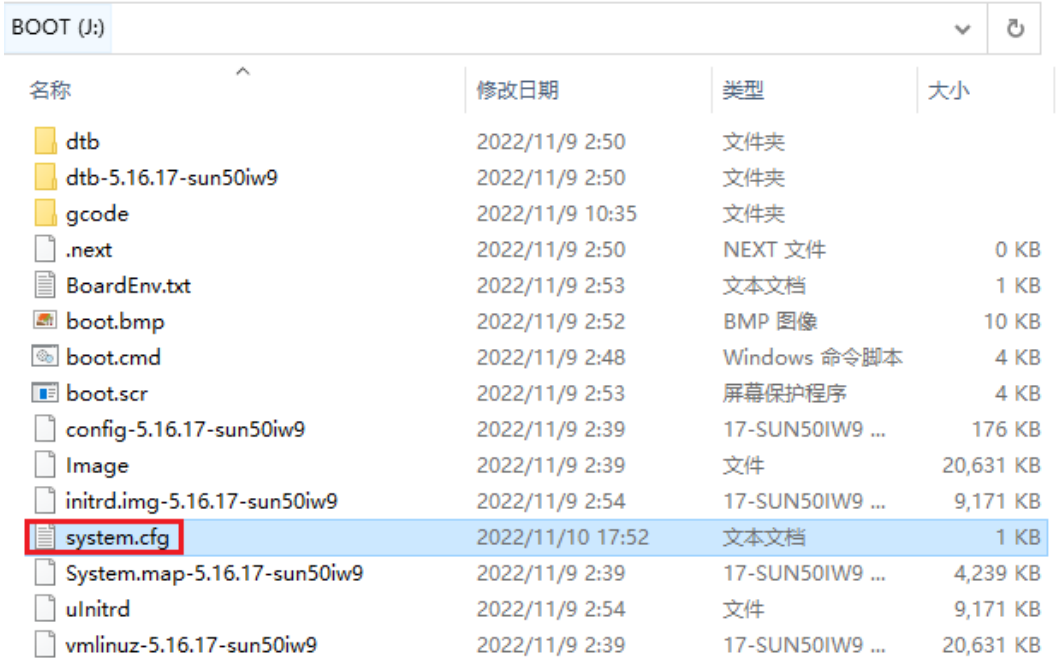


5.4 WIFI Setting

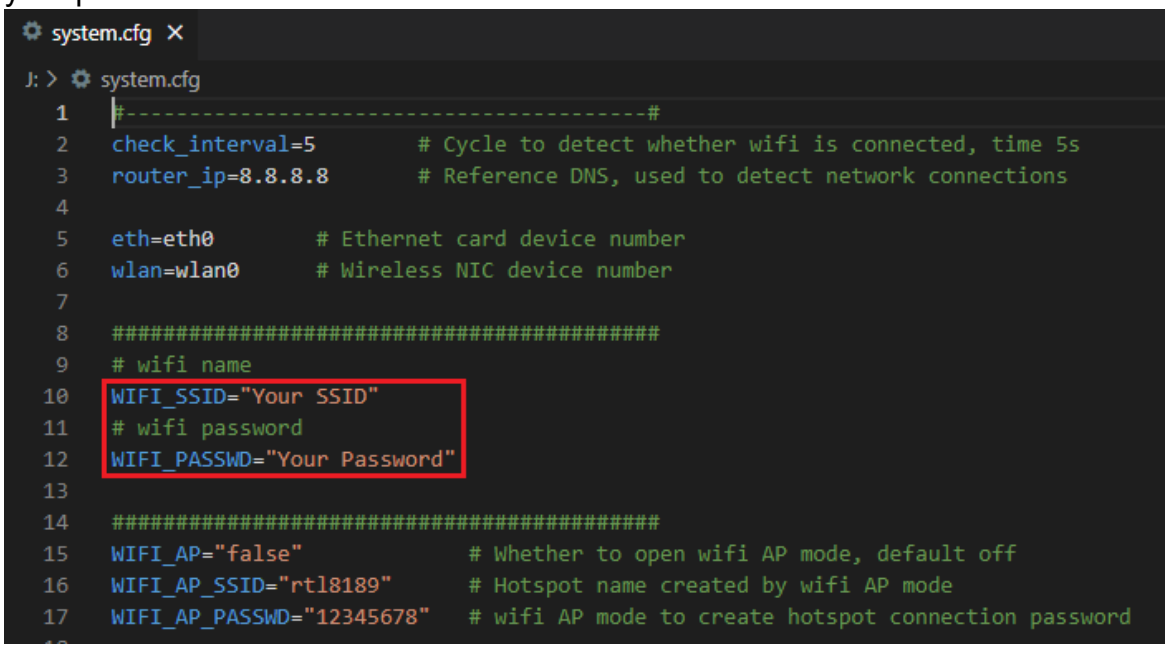
Note: This step can be skipped if you are using a network cable connection.

CB1 cannot directly use the Raspberry Pi Imager to set the WiFi name

and password like CM4. After the OS image writing is completed, the MicroSD card will have a FAT32 partition recognized by the computer, find "system.cfg"



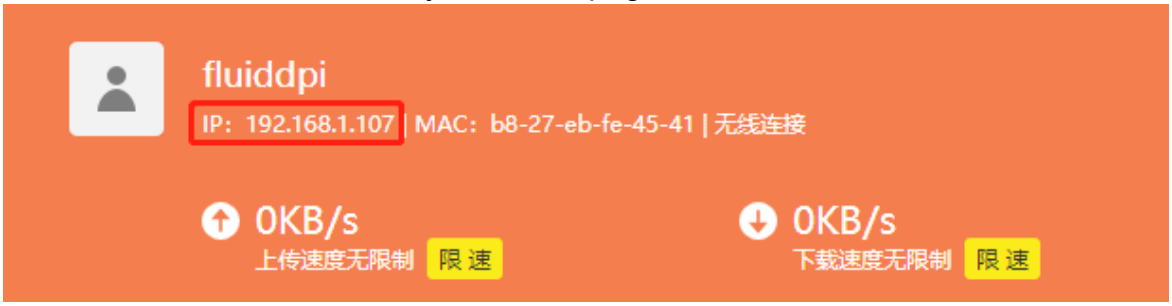
Open it with Notepad, replace WIFI-SSID with your WiFi name, and PASSWORD with your password.



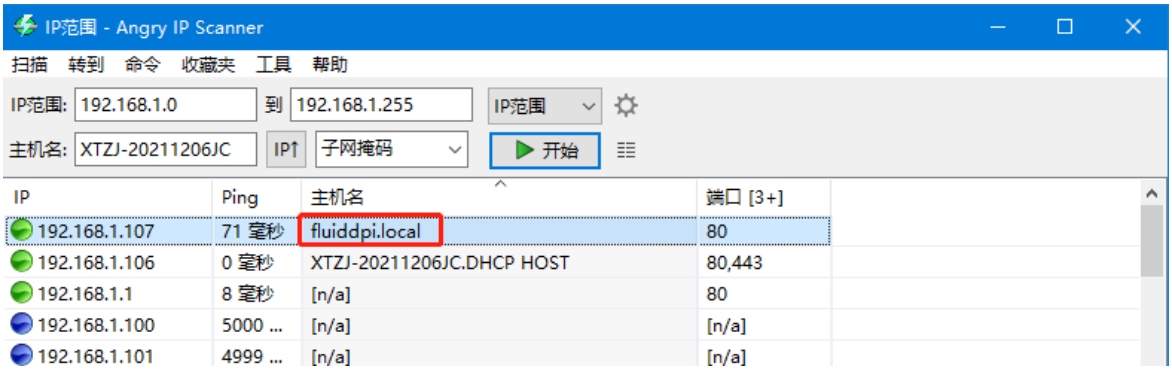
6. Configure the motherboard

6.1 ssh connect to device

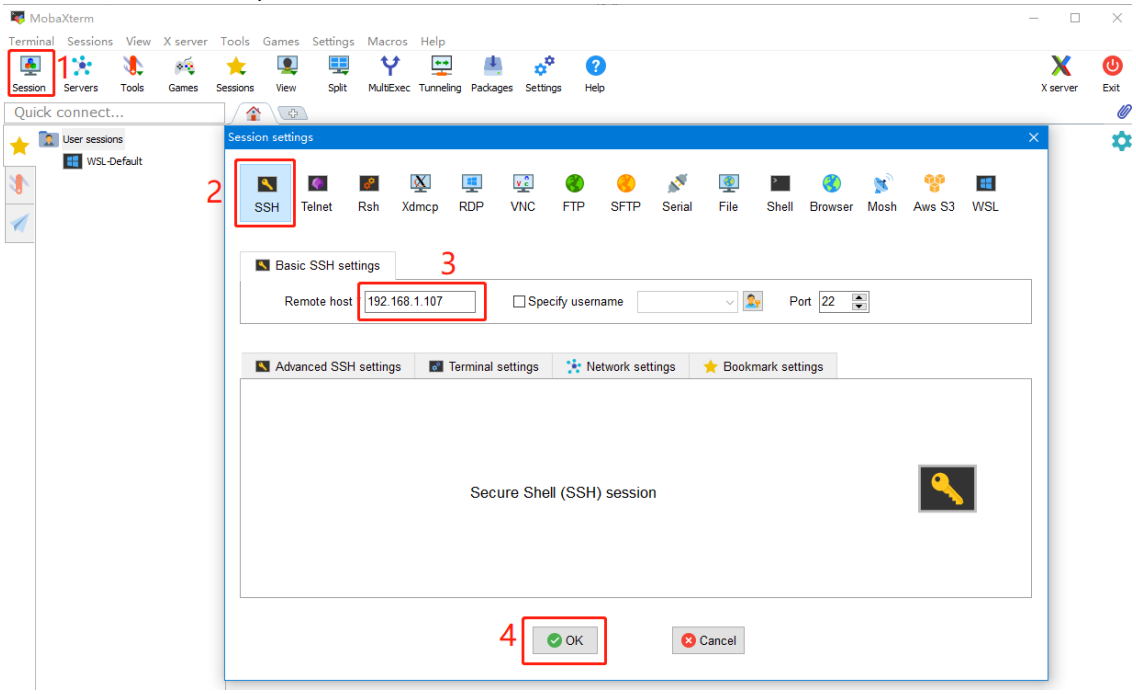
1. Install the ssh application Mobaxterm: https://mobaxterm.mobatek.net/download-home-edition.html
2. Insert Micro SD card to M4P, wait for system to load after power on, aprox. 1-2min
3. The device will automatically be assigned a IP address after successfully connected to the network
4. Find the device IP address in your router page



5. Or use the https://angryip.org/ tool，scan all IP address in the current network organize by names, find the IP named Fluidd, Mailsail (CM4) or Hurakan (CB1) like shown below



6. Open Mobaxtermand click “Session”, and click “SSH”，inset the device IP into Remote host and click “OK” (note: your computer and the device needs to be in the same network)



7. Input the login name and password to enter the SSH terminal interface

CM4:

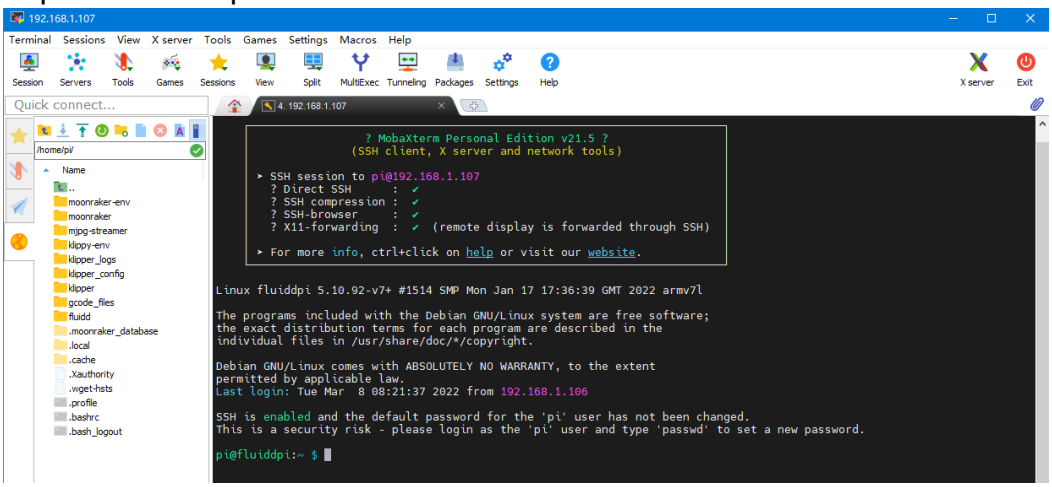
login as: pi

password: raspberry

CB1:

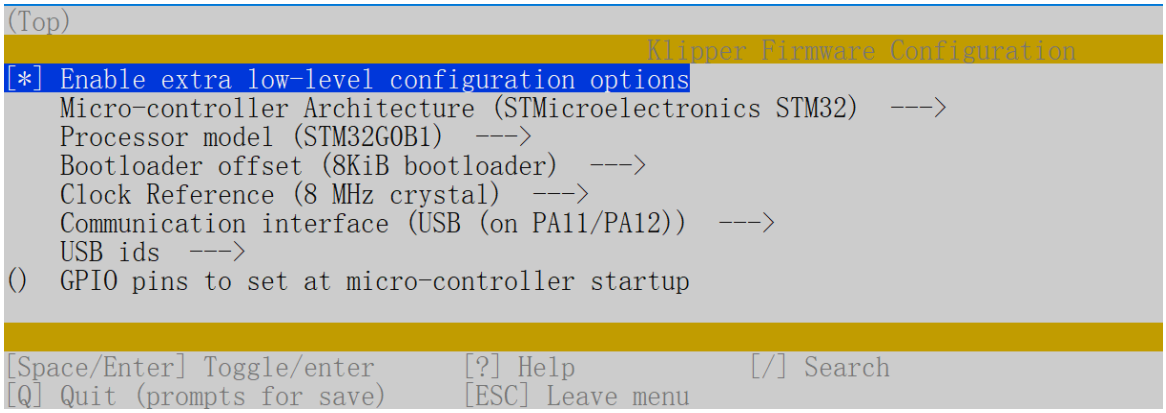
login as: biqu

password: biqu



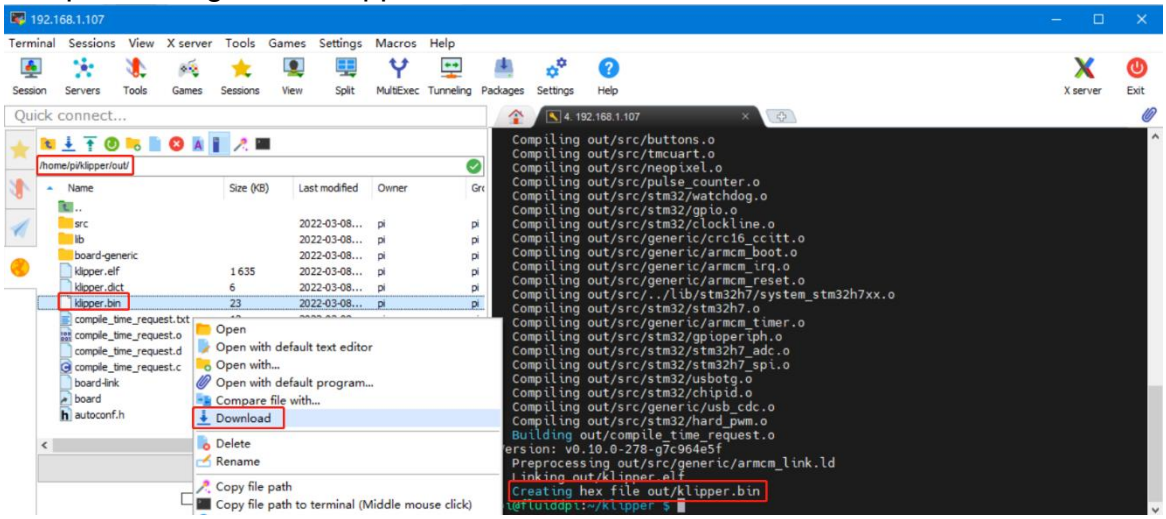
6.2 Compile firmware

1. After ssh successfully connected to the device, enter in terminal:
   `cd ~/klipper/`
   `make menuconfig`
   Compile with the configuration shown below(if the options below is not available, please update you Klipper source code to the newest version)
   * [*] Enable extra low-level configuration options
   * Micro-controller Architecture (STMicroelectronics STM32) --->
   * Processor model (STM32G0B1) --->
   * Bootloader offset (8KiB bootloader) --->
   * Clock Reference (8 MHz crystal) --->
   * Communication interface (USB (on PA11/PA12)) --->



2. Press q to exit, and Yes when asked to save the configuration

3. Run `make` to compile firmware，”klipper.bin” file will be generated in `home/pi/kliiper/out` folder when `make` is finished, download it onto your computer using the ssh application.



6.3 Firmware update

6.3.1 Update using SD Card

1. Rename klipper.bin to ”firmware.bin”, Copy to the SD card root directory, insert the SD card into the SD card slot of the M4P, click the “reset” button or power on again. The firmware will be updated automatically. After the update, the "firmware.bin" in the SD card will be renamed as "FIRMWARE.CUR".

2. Enter: `ls /dev/serial/by-id/` in terminal to check motherboad ID to confirm whether firmware is updated successfully like showm below.

```
pi@fluiddpi:~/klipper $ ls /dev/serial/by-id/
usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00
pi@fluiddpi:~/klipper $
```

   copy and save this ID，it is needed when modifying klipper config

6.3.2 Update using DFU

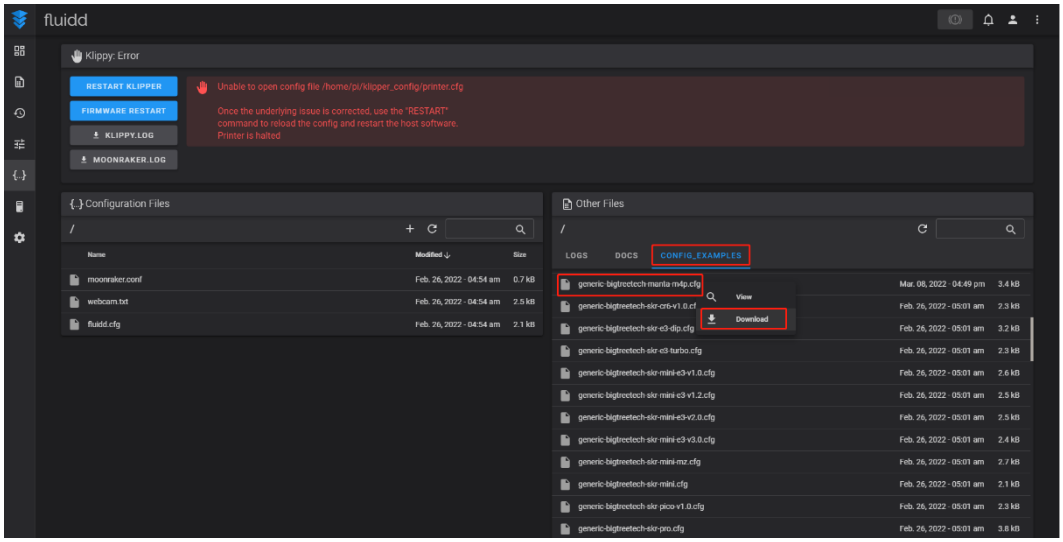
If the MCU klipper device ID can be found by `ls /dev/serial/by-id/`, we can input:
`make flash FLASH_DEVICE= /dev/serial/by-id/usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00`
to update firmware (NOTE: Replace `/dev/serial/by-id/xxx` with the actual ID found in the previous step)

```
biqu@Hurakan:~/klipper$ make flash FLASH_DEVICE=/dev/serial/by-id/usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00
  Building hid-flash
/bin/sh: 1: pkg-config: not found
    hid-flash requires libusb-1.0, please install with:
    sudo apt-get install libusb-1.0
  Flashing out/klipper.bin to /dev/serial/by-id/usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00
Entering bootloader on /dev/serial/by-id/usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00
Device reconnect on /sys/devices/platform/soc/5200000.usb/usb1/1-1/1-1.1/1-1.1:1.0
sudo dfu-util -p 1-1.1 -R -a 0 -s 0x8002000:leave -D out/klipper.bin

dfu-util 0.9

Copyright 2005-2009 Weston Schmidt, Harald Welte and OpenMoko Inc.
Copyright 2010-2016 Tormod Volden and Stefan Schmidt
This program is Free Software and has ABSOLUTELY NO WARRANTY
Please report bugs to http://sourceforge.net/p/dfu-util/tickets/

dfu-util: Invalid DFU suffix signature
dfu-util: A valid DFU suffix will be required in a future dfu-util release!!!
Opening DFU capable USB device...
ID 0483:df11
Run-time device DFU version 011a
Claiming USB DFU Interface...
Setting Alternate Setting #0 ...
Determining device status: state = dfuIDLE, status = 0
dfuIDLE, continuing
DFU mode device DFU version 011a
Device returned transfer size 1024
DfuSe interface name: "Internal Flash  "
Downloading to address = 0x08002000, size = 25264
Download        [=========================] 100%        25264 bytes
Download done.
File downloaded successfully
dfu-util: Error during download get_status

Failed to flash to /dev/serial/by-id/usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00: Error running dfu-util

If the device is already in bootloader mode it can be flashed with the
following command:
  make flash FLASH_DEVICE=0483:df11
  OR
  make flash FLASH_DEVICE=1209:beba

If attempting to flash via 3.3V serial, then use:
  make serialflash FLASH_DEVICE=/dev/serial/by-id/usb-Klipper_stm32g0b1xx_190028000D50415833323520-if00
```

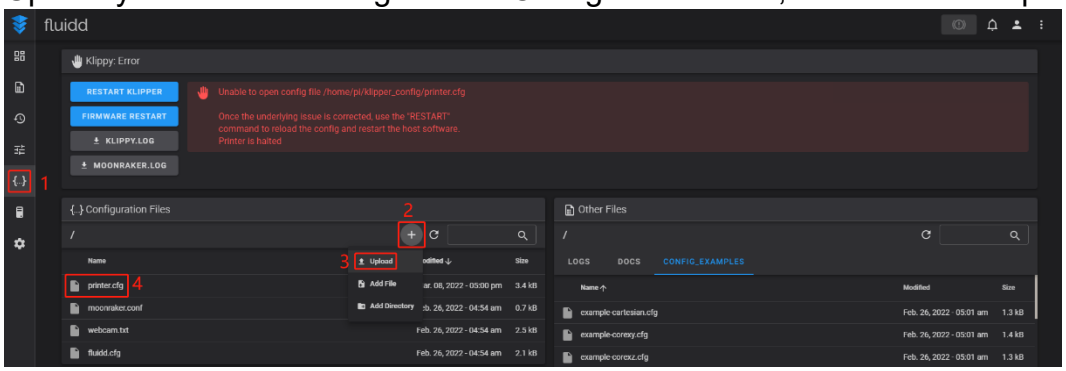
There will be an error message “dfu-util: Error during download get_status” after update. Just ignore it.

6.4 Configure Klipper

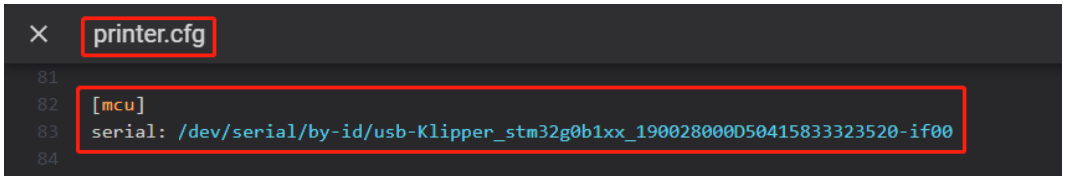
1. Enter your device IP address into your browser to open the webUI，find the reference config for motherboard in the directory shown below，if there is no such config available, update your klipper source code to the newest version or download from github: https://github.com/bigtreetech/Manta-M4P



2. Upload your finished config file into Configuration Files, and rename to “printer.cfg”



3. Insert the correct motherboad ID



Refer to https://www.klipper3d.org/Overview.html for detailed configuration guide according to your machine type.

7. Precautions

1. All unplugging and plugging operations should be performed under the condition of power off, including enabling the eMMC writing.
2. Pay attention to the heat dissipation of CM4 and CB1. If the running application consumes too many system resources, the CM4/CB1 will get hot quite seriously.

If you need other resources for this product, please visit https://github.com/bigtreetech/ and find them yourself. If you cannot find the resources you need, you can contact our after-sales support.

If you encounter other problems during use, feel free to contact us, and we are answering them carefully; Any good opinions or suggestions on our products are also welcome, too, and we will consider them carefully. Thank you for choosing BIGTREETECH. Your support means a lot to us!